

Adolescents' learning and experiences of solving the need for dietary supplementation through socioscientific issue (SSI) method

Adolescents' learning and experiences

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Abstract

Purpose – The purpose of this paper is to assess the socioscientific issue (SSI) method as a way of improving seventh graders' nutrition know-how on dietary supplements (DS), and to describe how students experience learning nutritional issues through the SSI method.

Design/methodology/approach – Participants were seventh graders from three different classes ($n = 43$). Health education intervention lasted 7 h and it embodied the three-staged model: the scenario, the inquiry and the decision-making stages. The study was qualitative in nature. The data were collected through a questionnaire before and after the intervention. The data were analyzed using summative content analysis.

Findings – Intervention tended to deepen students' know-how on vitamins and rational use of DS. Students' experiences of learning nutritional issues through the SSI method were generally positive. The scenario stage was considered current and authentic. The inquiry stage and decision-making stage helped in understanding the societal connections between the study task and the rational use of DS.

Practical implications – SSI method enhances students' knowledge about the rational use of DS. E-learning environment gave students possibilities to work collaboratively. Especially, possibilities to discuss with peers and share own experiences supported learning.

Originality/value – To solve the need of dietary supplements (DS) is a complex nutritional issue for society and for individuals. Since consumption of special diets has increased among adolescents, the rational consumption of DS is relevant and interesting learning topic at secondary school.

Keywords Health education, Adolescents, Diet

Paper type Research paper

Introduction

Dietary supplements (DS) have been classified into five categories; natural plant extracts, natural metabolites, natural fats and oils, antioxidants, vitamins and minerals (Webb, 2011). There is only an extra need for dietary supplements in certain stages of life; in early childhood, among the aged, during pregnancy, and when following a special diet, for example a vegan diet or an elimination diet related to food allergies (National Nutrition Council, Ministry of Agriculture and Forestry, 2014). The use of dietary supplements is also a health and lifestyle choice (Blumberg *et al.*, 2018). However, research shows that people

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tend to consume dietary supplements unnecessarily and they have gaps in nutrition knowledge (e.g. Barnes *et al.*, 2016; Cowan *et al.*, 2018; Jun *et al.*, 2018; Lowry *et al.*, 2015; Parry *et al.*, 2018).

This phenomenon is also observed among adolescents. Research on adolescents (11–18 year olds) and young adults (18–25 year olds) has revealed several misconceptions on the health benefits of DS. Consumption of DS is perceived to promote energy and better health, prevent illnesses, help people to do better at sports, give energy and enhance the immune system (Dorsch and Bell, 2005; Joseph *et al.*, 2017; Jun *et al.*, 2018; Lowry *et al.*, 2015; O’Dea, 2003; Tsarouhas *et al.*, 2018). Research also shows adolescents being uncertain of their DS needs and relying on their mother’s opinion as well as being unaware of any potential health risks regarding the consumption of DS (O’Dea, 2003). There are only a few studies concerning adolescents’ knowledge on nutritional supplements and/or their opinions of perceived health benefits of using DS (Dorsch and Bell, 2005; Günter and Demir, 2018; Little *et al.*, 2002; O’Dea, 2003; Thompsen *et al.*, 1987). These studies show that adolescents’ nutrition knowledge on the need for DS varies greatly, and is often inadequate.

Healthier diets cost more than unhealthy diets and diet cost is an important predictor of the quality of diet and nutrient intake (Blumberg *et al.*, 2018; Darmon and Drewnowski, 2015). In Finland, one-fifth of the adolescents consume a special diet. Typically, adolescents consume lifestyle related diets, such as a vegan diet, a sports related diets and weight reducing diets. Of the therapeutic diets the most commonly used are a lactose free diet and an elimination diet related to allergies (Parviainen *et al.*, 2017). Composing a balanced special diet needs proper knowledge of DS. Nutrition knowledge is, however, theoretical and nutrient metabolism appears abstract, both of which challenge students’ thinking. For example, a small daily dose of vitamin D is needed in order to maintain good bone health and prevent osteoporosis. However, overconsumption of vitamin D poses a danger of toxicity for all age groups (National Nutrition Council, Ministry of Agriculture and Forestry, 2014).

Kostanjevec *et al.* (2011) recommend that, in formal education, one should aim to lead students toward analytical and logical thinking for solving nutrition problems. Adolescents also get DS information from coaches, peers, physical trainers, family members, physicians and dietitians in the media and on the internet (Dorsch and Bell, 2005). Seeking health information from the internet has increased significantly in recent years (e.g. European Commission, 2016; Hutchinson *et al.*, 2016) and adolescents tend to seek online health information that is relevant to their personal health concerns and reassurances that their health experiences are considered normal (Colditz *et al.*, 2018). However, much of the health information they encounter may be too complex, inaccurate, biased or some combination of these (Colditz *et al.*, 2018) and the students (ages 12–13) have limited evaluation abilities, especially for the commercial resource, and only a small, partial association with prior stance and offline reading ability (Kiili *et al.*, 2018). Thus, the accuracy of the nutritional information that adolescents face from different sources of media is often impossible to determine. The expanding dietary supplement industry also creates unnecessary nutrient needs and misleads consumers (Lowry *et al.*, 2015; Ronis *et al.*, 2017).

The socioscientific issue (SSI) method has been successfully used in teaching health matters (e.g. Kärkkäinen *et al.*, 2018; Ekborg *et al.*, 2013; Ottander and Ekborg, 2012; Zeyer and Kyburz-Graber, 2012). SSI method integrates knowledge, students’ context and analytical evaluation skills, emotions and seeks to engage students in socioscientific decision making as a means of empowering them to deal with SSIs. An emphasis is placed on student moral development and the role of emotion. Zeidler *et al.* (2009) SSI method challenges students’ rational, social and emotional skills (Sadler, 2004; Sadler *et al.*, 2007), and it has been shown to strengthen generic skills in students such as teamwork, problem solving, media literacy, decision making and argumentation; it also provides students with relevant competencies (Ottander and Ekborg, 2012; Ratcliffe and Grace, 2003; Sadler *et al.*, 2007). SSI-based teaching can also foster content

learning (Sadler *et al.*, 2016). According to Ottander and Ekborg (2012) the more interesting the secondary school students found a topic, the more they claimed they learnt.

The aim of this study is to assess the SSI method as a way of improving students' nutrition know-how on DS, and to describe how students experience learning nutritional issues through the SSI method.

Materials and methods

Study design and participants

Health education intervention by using the SSI method was conducted during health education lessons at a comprehensive school in Eastern Finland. Participants were seventh graders (13–14 year olds) from three classes ($n = 42$), 14 girls and 29 boys. All participants, except three students, got permission from their parents to participate the study. During the intervention, the students studied in small groups of 3–5 persons (altogether 15 groups). The health education teacher, three student teachers, and two researchers were in charge of the instruction.

Application of the SSI method. During the intervention, students were instructed to familiarize themselves with the nutritional state of a fictitious person, search for proper information on the possible need for DS and with the aid of this new knowledge they were to counsel the fictitious teenagers. Teaching intervention lasted 7 h and it embodied the three-stage model: the scenario, the inquiry and the decision-making stages (Hartikainen-Ahia *et al.*, 2014; see Bolte *et al.*, 2012). During the intervention, there were 15 different study groups altogether, with 3–5 students in each.

The scenario stage comprised one lesson of 75 min, in which the students familiarized themselves with fictive teenagers (Table I), who had written blog texts on an e-learning

Case	Fictive teenager's description on blog text	Nutritional status behind the fictive teenager's descriptions	Correct instruction for the use of DS problems
Anne	She thinks that she has lactose intolerance. She is a vegan. She uses multivitamin preparations and vitamin C	Anemia and problems with the rational use of supplemental iron	Dietary counseling and adding vitamin B12 as a supplement to daily diet. The proper use of iron supplementation
Antti	He has an idea to replace meals with DS	Anorexia nervosa	Dietary and psychological counseling where emphasis is on balanced eating and no need for DS. He is encouraged to self-acceptance
Niko	He is uncertain about getting enough protein from his daily diet	Distorted big muscles ideals	Dietary counseling on protein contents of different foods and healthy snacking. Niko is encouraged to eat more food (such as low-fat milk, cheese and yogurt which have high protein content). Also a critical attitude toward advertisements is advised
Milla	She appreciates appearance. She wants to be thin. She consumes a variety of vitamin B preparations and she only has certain foods. She is vegan	Distorted beauty ideals and the unnecessary use of a wide variety of vitamin B preparations	Discussions about beauty ideals, the need for more food, the need for vitamin B12
Sanni	She has milk, egg and fish allergies	Allergy	Dietary counseling due to an elimination diet. DS is needed. Also a critical attitude toward the advertising is emphasized

Table I. Nutritional problems in fictive teenage cases and proper dietary guidelines including possible dietary supplements (DS) to correct the nutritional state

environment (Google blogger) about their health problems and their vitamin consumption. Students debated the fictive cases and tried to solve their nutritional issues brought up in the blogs. Based on their pre-knowledge, students counseled the fictive teenagers on their health problems by writing blog texts in Google blogger.

In the inquiry stage (one lesson, 75 min), students studied nutritional issues through structured inquiry assignments on an e-learning environment (Google sites). One student group worked with one particular teenage case and used trusted internet websites for inquiry with the aid of teacher and researchers.

In the decision-making stage (one lesson, 75 min), the students applied their new knowledge and ethical reasoning for making decisions and once again supplied new instructions for their fictive case concerning DS. Student groups also presented their cases to other students and they explained and argued the kind of guidance they had given to their cases. In addition, the whole class discussed the cases, made applied assignments and summaries about the rational use of vitamins and DS. The characteristics of the fictive teenage cases are presented in Table I.

Data collection

Students' nutrition know-how was explored by using an open-ended questionnaire before and after the intervention. The contents of questions are in line with the aims of this SSI intervention as well as with the aims of Finnish National core curriculum. By using open-ended questions, students were asked to define "what vitamins are, what are their best sources, why vitamins are essential, and what aspects one should consider when using vitamin supplementation?" After the intervention, questions were also included on students' learning experiences such as "What did you think about the scenario, inquiry and decision stages, what kind of things supported or disrupted your learning process, what did you learn during the study process?" Using open-ended questions gave students a possibility to explain the possible change in their knowledge more thoroughly (explicitely) and by using their own words. Only a few students left unanswered questions Data collection took place during the classes and the teachers as well as researches were present when they filled the questionnaire. Every student filled out the questionnaire independently and it took approximately 45 min.

Data analysis

The data from questionnaires were carefully read in order to obtain the holistic picture of research themes. Data were analyzed using a qualitative content analysis, which contains both concept driven and data-driven processes (Hsieh and Shannon, 2005; Vaismoradi *et al.*, 2013). Content analysis suits well to analyze multifaceted and sensitive phenomena (Elo and Kyngäs, 2008). Analysis was started by identifying and quantifying students' nutrition know-how (definition of vitamin, functions and sources of vitamins, etc.) and experiences of the SSI method.

The questionnaires were coded by using school class sign (A–C) and students' sex (girl or boy) and numbers, e.g. Class A boy 1. First constructed main content categories (e.g. positive and negative experiences) and after this in the organization phase, the data were organized into subcategories (e.g. in the scenario stage "pleasantness," "authenticity," "interest," "intelligibility," "knowledge" and "excitement" (see Table II). The student's responses could be included in more than one category if the answer included different contents. In addition, the frequencies of the categories and subcategories were counted (cf., e.g. Schreier, 2014; Vaismoradi *et al.*, 2013). During the data analysis process, the researchers co-operated on the coding system to aid the credibility and trustworthiness of the analysis (cf., e.g. Elo *et al.*, 2014). Data analysis was conducted in triangulation between researchers.

Table II. Students' ($n = 42$) responses about the scenario stage according to the individual questionnaires (6 no answer)

Subcategory	Main category Positive experiences ($n = 24$ questionnaire)	Main category Negative experiences ($n = 12$ questionnaire)
Pleasantness	Generally pleasant experience ($n = 15$) "It was nice [...]" (Class B, Girl 4) "It was okay!" (Class A, Boy 1)	
Authenticity		Truthfulness/authenticity of the cases ($n = 3$) "the teenagers' cases were too perfect" (Class B, Boy 3) "the teenagers of the stories could have been realistic persons." (Class A, Boy 8)
Interest	Interesting teenagers' cases ($n = 4$) "It was interesting. Especially the case Sanni." (Class C, Girl 5) "The first lesson was best, because I got to know Niko's life" (Class A, Girl 1)	Not interesting teenagers' cases (or study stage) ($n = 7$) "It was boring" (Class A, Girl 2) "Sometimes the study was boring" (Class C, Boy 3)
Intelligibility	Easily understandable teenagers' cases ($n = 2$) "[...] Good text. I immediately understood the plot of the story" (Class B, Boy 2) "Good text. I quickly understood the text." (Class B, Boy 8)	Obscure stories about teenagers' cases ($n = 2$) "the text had to be read carefully over and over again" (Class C, Boy 2)
Knowledge	Informative teenagers' cases ($n = 2$) ($n = 2$ questionnaire) "[...] I got a lot of new information." (Class B, Girl 5) "It was nice to got new information" (Class A, Boy 7)	
Excitement	Exciting teenagers' cases ($n = 1$) "Exciting" (Class A, Boy 3)	

Ethical issues. This study is a part of a larger health education research project. Permission to conduct the research was granted by the Committee on Research Ethics, at the University of Eastern Finland. Research permissions were also asked from the school and the students' parents. Participation in the study was voluntary for both the teacher and the students. This study did not deal with the students' personal illnesses or use of medicines.

Results

Students' nutritional knowledge

The effects of the SSI method for improving students' nutrition knowledge were researched by mapping students' nutrient knowledge on vitamins before and after the intervention by using a questionnaire. Students were asked to define a concept "a vitamin" in the questionnaire. Before intervention most of them do not know what this was and they gave general descriptions such as "it is an important thing for the body" or "it gives you energy." However, after intervention, students tended to be more explicit, they wrote that "a vitamin is a nutritional supplement" or they wrote a specific function of a vitamin such as a "protective nutrient." Students recognized vitamins A, B, C, D, K and E, and some students mentioned also vitamin H, B2 and B12. They also knew the vitamin classes, i.e. that there are water and fat-soluble vitamins.

Students knew before and after the intervention that one gets vitamins from fruits, vegetables, cereals, food, vitamin products, tablets, drops or medicines. After the intervention they also mentioned more specifically sun, fish, meat, eggs or milk products as sources of vitamins.

The most common answers before and after the intervention was that you need to use vitamin products if you do not get enough vitamins from food and if you have a vitamin deficiency. After the intervention students explained if you are a vegetarian you need vitamin B12 or if you do not get enough calcium or iron from your food, or you have been

diagnosed as having a deficiency of calcium or iron. They argued that vitamins are needed to stay healthy and during the Winter (vitamin D) because vitamins make your body work as well as improve night vision, strength and resilience. After the intervention, students highlighted how to use vitamins: one needs to read the package leaflet, not overdose, consider the possible allergic effect and not replace food with vitamin products. One can get information on vitamin preparations by asking a doctor, pharmacist, parents or by reading from the internet or from the package leaflet.

Students' experiences on the SSI method in health education

After intervention, students were asked in questionnaires about their experiences in the different stages of learning (scenario, inquiry and decision-making stages). They also did self-evaluation and reflected on their learning process. Students' responses about the scenario stage were categorized into five different subcategories and two main categories (Table II). The scenario stage was considered, as a whole, a positive experience. Students regarded the fictive teenager cases as realistic, interesting, easily understandable, informative and exciting: "[...] Counselling was a fun, different and interesting task" (Class B, Girl 5).

Alternatively, there were also students who were not so fond of the scenario stage. They criticized the authenticity, interest and intelligibility of the cases. What is remarkable is that the students' perceptions about the cases' counseling in the scenario stage and the decision stage were also contradictory; for the some students the counseling was a pleasant experience while unpleasant for other: "For me the task was difficult and I did not initially invent any advice for the teenagers, but together with other students we invented some advice" (Class C, Girl 1).

Most of the students related positive experiences to the inquiry stage (Table III). The students expressed that the inquiry stage was generally pleasant, educational, interesting and offered different learning experiences. The students preferred the conduct of the given research tasks, and especially the use of information technology, i.e. internet sources, the acquisition of information, assignments and questions on websites (in Google blogger and Google sites) and the use of websites as an e-learning environment. Some students mentioned that data acquisition was sometimes difficult from web pages. In addition, the use of a computer for writing and reading and some assignments on web sites caused problems for some students.

The decision-making stage was also experienced as positive by most of the students (Table IV). In particular, other students' presentations were regarded as positive, especially different teams' presentations at the end of the lesson. Students did not like introducing their own cases and research work to other students even though they followed the other students' presentations with pleasure.

Students' perceptions about their learning processes

Students perceived that pedagogical practices during the intervention (collaborative working, the use of ICT, teacher's support and instruction, individual learning factors, and the arrangements of the learning environment) all supported their learning. Students expressed that in collaboration, successful discussions, information sharing (in and between the groups) and the small sizes of working groups promoted their learning. According to the students, the group work was unanimity, active (all participants were involved), efficient and well scheduled: "The best thing was discussion with peers, because I got new view points from other students" (Class A, Boy 4).

Some students, however, expressed problems with collaboration, such as difficulties concentrating, communication, diverse attitudes toward learning, different activity level and group spirit: "For me the studying in a small group was a supportive thing. In the big

Table III.
The students' ($n = 42$) responses about the inquiry stage according to the individual questionnaires

	Positive experiences ($n = 36$ questionnaire)	Negative experiences ($n = 6$ questionnaire)
Pleasantness	Generally pleasant experience ($n = 16$) "It was okay." (Class B, Boy 7)	
Knowledge	Educational study stage ($n = 1$) "That was fun, because I learn new things." (Class A, Boy 1)	
Interest	Interesting study stage ($n = 1$) "[...] That was interesting." (Class A, Boy 4)	Not interesting ($n = 2$) "It was boring" (Class A, Boy 11)
Learning experience	Different learning experience ($n = 1$) "[...] that was fun and different" (Class B, Girl 5)	
Inquiry assignments	Pleasant research tasks ($n = 7$) "The best thing was to study vitamin supplements" (Class C, Girl 3) "[...] It was nice, because we were investigating the teenagers' cases (Class B, Boy 8)	
Information and communication technology	Good internet sources ($n = 2$) "It was good that there was a lot of information available on the websites" (Class A Boy 8) Acquisition of information by using internet sources ($n = 3$) "The best thing was searching information from the websites. This way I learned new things" (Class A, Boy 1) "[...] The best thing was searching information from the websites, because we did not need schoolbooks" (Class B, Boy 9) Good websites assignments ($n = 2$) "Good." (Class A, Boy 15) Website as e-learning environment ($n = 3$) "It was good that there was a lot of information available on the websites." (Class A, Boy 8)	Data acquisition problems ($n = 2$) "It was hard to find knowledge from many different web sites" (Class B, Girl 5) Difficult assignments ($n = 1$) "It was difficult work" (Class A, Boy 9) Difficulties on e-learning environment ($n = 1$) "We had key/saving problems on the websites. That was not nice." (Class A, Boy 4)

Table IV.
The students' ($n = 42$) experiences of the decision-making stage according to the individual questionnaires

	Positive experiences ($n = 31$ questionnaire)	Negative experiences ($n = 11$ questionnaire)
Knowledge	Educational presentations ($n = 5$) "The best part was following the presentations of the student groups, because I got new information." (Class A, Girl 1) "The best part was other students' presentations. I got compact information from the presentations." (Class B, Girl 5)	Generally difficult study stage ($n = 8$) "It was a bit difficult stage" (Class C, Girl 3) "It was difficult." (Class A, Boy 9)
Pleasantness	Generally pleasant experience ($n = 27$) "It was nice." (Class C, Boy 3) "It was fun." (Class A, Boy 4)	Generally unpleasant study stage ($n = 3$) "It was boring" (Class A, Boy 2) Unpleasant presentation situation ($n = 3$) "Unpleasant thing was to give presentation and be front of the classroom, because I do not like it" (Class C, Girl 1) "The giving presentation was unpleasant experience" (Class C, Boy 6)

groups we usually talk nonsense" (Class B, Girl 1). "It helped me when we finally talked about what we had been studying. Then I understood things well" (Class B, Girl 2).

The students also argued that the use of computers, internet and the e-learning environment facilitated the information acquisition and writing (reporting) processes and

hence supported their learning. Although the use of ICT supported the students' learning, the students had some technical problems with computers, web sites and e-learning environments. They wrote that they had, e.g. difficulties finding useful information and using many web sites and e-learning environment at the same time. Only one student argued that the use of ICT and web sites was meaningless and boring for her/him. As a whole, the students expressed that the use of ICT in the learning processes was a positive experience, describing it as useful. It was also regarded as educational, and a different kind of experience, which offered success experiences: "The supportive thing was versatile sources on the web sites. There was all the information that we needed" (Class B, Boy 2). "The supportive thing was website links, were we found information about vitamins" (Class C, Boy 2).

The results also indicated the meaning of the teachers' support. The students expressed the nature of teachers' support at a very general level, e.g. that the teachers helped with doing the assignments: "The teacher helped us when we needed help" (Class B, Boy 6). Only one student expressed that the teachers gave unclear instruction to students. The students perceived that individual learning factors, like their own pre-knowledge and a subject of interest and motivation had a positive role in their learning processes. The pupils regarded the arrangements of the physical learning environment in two different ways. Some students thought that the timetable needed for studying was enough and the assignments and the other learning materials, e.g. vitamin packages, were good. On the other hand, students were disturbed by the presence of the researchers and video and audio recording during instruction, and loud conversation in the classroom.

Discussion

The aim of this study was to assess the SSI method as a way of improving students' nutrition know-how on DS and to describe how students experience learning about nutritional issues through the SSI method. Students' nutrition know-how tended to expand. Students' perceptions on different vitamins, vitamin sources and the need for vitamins as a dietary supplement deepened. Gaining knowledge on essential dietary supplements, and having more knowledge on human physiology and nutrient metabolism, helped students in making decisions, and with risk evaluation, concerning the consumption of DS. It was notable, however, that adolescents' dietary supplement knowledge varied a lot, and in some cases it was still inadequate and poor after the intervention. In this respect, the present study is in accordance with the results from the previous studies concerning students' knowledge about DS (Sobal *et al.*, 1988; Dorsch and Bell, 2005; Kostanjevec *et al.*, 2011).

DS is frequently reported in the media, and addressed in local, national and global dimensions (see Barnes *et al.*, 2016; Cowan *et al.*, 2018; Jun *et al.*, 2018; Lowry *et al.*, 2015; Parry *et al.*, 2018; Parviainen *et al.*, 2017). Thus the evaluation of the need for DS is hence fruitful topic for seventh graders and topic interested students. A fictive teenage who is consuming a special diet and possibly in need of DS is an example of a complicated every day nutritional issue. Also at a society level today, consumption of lifestyle related special diets are often justified from the standpoint of values when there are no right answers.

According to the main aim of an SSI method in teaching is to equip adolescents with skills such as problem solving, decision making, communication skills, collaboration skills and reasoning skills (see Ratcliffe and Grace, 2003; Sadler *et al.*, 2007). The study showed that students expressed widely that the SSI method helped their learning. According to a previous study (Hartikainen-Ahia *et al.*, 2014), it is possible that it leads students toward more analytical thinking when solving the need for DS of their fictive case.

An e-learning environment (Google blogger and Google sites) gave students possibilities to work collaboratively. Students highlighted working with computers, and the possibilities to discuss and share ideas. In this study, the students evaluated information on the internet, which sometimes provides controversial or incorrect information (see Lowry *et al.*, 2015).

Also, according to Colditz *et al.* (2018) and Kiili *et al.* (2018), the quality of internet-based health information is extremely variable and it is necessary to assess the credibility of health information found on the internet concerning DS. In this study, the teacher and researchers gave websites and the content of websites based on the rational use of DS (National Nutrition Council, Ministry of Agriculture and Forestry, 2014). The contents of websites were experienced as mainly interesting and given as task relevant. This in line with previous studies (e.g. Ekborg *et al.*, 2013; Ottander and Ekborg, 2012), which have also shown that the SSI method might raise students' interest in health in general as well as school health education health issues. Students' autonomy, the use of ICT and group work seemed to be important aspects of successful learning in this study.

In the scenario stage, fictive cases were probably experienced as interesting due to their special diet consumption habits or a nutritional deficiency. Special diets that the fictive cases consumed (a vegan diet, a sports related diet, an allergy related diet and dieting) are close to Finnish adolescents' everyday life, since consumption of these diets has increased in all adolescent age groups and in both sexes during the last 30 years (see Parviainen *et al.*, 2017). The big question is how do adolescents maintain a good nutritional status when consuming a special diet? In order to compose a balanced diet one needs to understand the basis of a balanced diet, the physiological basis of a special diet demand, and have an ability to argue for the need for DS. According to Eisenberg *et al.* (2012), adolescents who consume lifestyle related diets, such as sports related diet have misconceptions on nutrient physiology and are prone to adopt dietary behaviors that do not promote health. This includes the unnecessary consumption of dietary supplements.

Students' experiences of learning nutritional issues through the SSI method were generally positive, especially in the inquiry and decision-making stages. However, some students did not like working in this study. In this study, possible reasons for negative experiences may be that the SSI method challenges students' social skills, ethical reasoning, emotions, values and knowledge, and this might feel strange to some students (cf. Sadler, 2004; Sadler *et al.*, 2007; Zeidler *et al.*, 2009). Students also realized the role offered by technology as teacher and peer in the scenario, inquiry and decision-making stage.

The experiences found in all data were coherent, focusing on very similar issues. These results cannot be generalized but may be utilized in planning and implementing students' further health education. By developing secondary school health education with the aid of the SSI method, the importance of trustful know-how on DS can be promoted. In this study, to increase the internal validity and therefore authenticity, the context has been emphasized in describing it suitable and the study design has been set in terms of the context in which the study was carried out (cf. Elo *et al.*, 2014). The plausibility and integrity of the research has been made explicit by giving authentic data and interpreting this data in a transparent manner. In the scenario and decision stages the instruction for blog writing was open because the aim of data gathering was to find the things that were significant for students. The benefit of open instruction is that it makes it possible to use concepts that are "natural" to them. However, the open instruction may have had an influence on students so that even though he or she has experienced the health education as significant, she or he did not write about it. Also, Ottander and Ekborg (2012) found that lower secondary school students did not especially highlight their learning experiences when they used the SSI method. The validity of the research results is based principally on the process of data analysis.

This study was conducted in one school, which impacts the generalizability of the results. However, the SSI intervention was conducted in three different classes by one individual teacher, and the results gained were similar. Thus, the results may well be transferable to other school environments in Finland. By the aid of the qualitative open-ended questionnaire, we got information that revealed nutritional issues, which are most important to the respondents.

In this study, we had no methodological triangulation and in-depth individual interviews or group interviews might support the results from the open-ended questionnaire (Krippendorff, 2004; Vaismoradi *et al.*, 2013). Our results are similar to those found in previous Finnish studies which indicate that the experiences expressed by these students are in general by nature. In this study, it was possible to use researcher triangulation in order to increase the credibility and validity of research.

Conclusions

Solving the need for DS is a complex nutritional issue, which is an important SSI for society and individuals all over the world. In the educational context, this research increases our knowledge by focusing on the SSI method. To enhance future students' knowledge about DS it is essential, in health education, to help students to develop their information seeking and critical thinking skills regarding DS as well as the rational use of DS.

The intervention was based on an SSI method and proceeded in three stages; it raised students' interest in dietary supplementation and health issues. This study underlies the promotion of internet-based health education in a secondary school context. More experience is needed for a profound understanding of the roles of advertisements and the dietary supplement industry.

References

- Barnes, K., Ball, L., Desbrown, B., Alsharairi, N. and Ahmed, F. (2016), "Consumption and reasons for use of dietary supplements an Australian university population", *Nutrition*, Vol. 32 No. 5, pp. 524-530.
- Blumberg, J.B., Frei, B., Fulgoni, V.-L., Weaver, C.M. and Zeisel, S.H. (2018), "Contribution of dietary supplements to nutritional adequacy by socioeconomic subgroups in adults of the United States", *Nutrients*, Vol. 10 No. 1, p. 4.
- Bolte, C., Streller, S., Holbrook, J., Rannikmäe, M., Hofstein, A., Mamlok, R. and Rauch, F. (2012), "Introduction into the PROFILES project and its philosophy", in Bolte, C., Holbrook, F. and Rauch, F. (Eds), *Inquiry-Based Science Education in Europe: Reflections from the PROFILES Project*, Freie Universität Berlin, Berlin, pp. 31-42.
- Colditz, J.B., Woods, M.S. and Primack, B.A. (2018), "Adolescents seeking online health information: topics, approaches, and challenges", in Moreno, M. and Radovic, A. (Eds), *Technology and Adolescent Mental Health*, Springer, Cham, pp. 21-35, available at: https://doi.org/10.1007/978-3-319-69638-6_2
- Cowan, A.E., Jun, S., Gahche, J.J., Toozé, J.A., Dwyer, J.T., Eicher-Miller, H.A., Bhadra, A., Guenther, P.M., Potischman, N., Dott, K.W. and Bailey, R.L. (2018), "Dietary supplement use differs by socioeconomic and health related characteristics among US adults, NHANRS 2011-2014", *Nutrients*, Vol. 10 No. 9, p. 1212, available at: <https://doi.org/10.3390/nu10091212>
- Darmon, N. and Drewnowski, A. (2015), "Contribution of food prices and diet cost to socioeconomic disparities in diet quality and health. A systematic review and analysis", *Nutrition Review*, Vol. 73 No. 10, pp. 643-660.
- Dorsch, K.D. and Bell, A. (2005), "Dietary supplement use in adolescent", *Current Opinion in Pediatrics*, Vol. 17 No. 5, pp. 653-657.
- Eisenberg, M.E., Wall, M. and Neumark-Sztainer, D. (2012), "Muscle-enhancing behaviors among adolescent girls and boys", *Pediatrics*, Vol. 130 No. 6, pp. 1019-1026.
- Ekborg, M., Ottander, C., Silfver, E. and Simon, S. (2013), "Teachers' experience of working with socio-scientific issues: a large scale and depth study", *Research in Science Education*, Vol. 43 No. 2, pp. 599-617.
- Elo, S. and Kyngäs, H. (2008), "The qualitative content analysis process", *Journal of Advanced Nursing*, Vol. 62 No. 1, pp. 107-115.

- Elo, S., Kääriäinen, M., Kanste, O., Pölkki, T., Utriainen, K. and Kyngäs, H. (2014), *Qualitative Content Analysis: A Focus on Trustworthiness*, Sage, New York, NY, pp. 1-10.
- European Commission (2016), "Managing health data", available at: <https://ec.europa.eu/digital-single-market/en/managing-health-data> (accessed December 13, 2018).
- Günter, T. and Demir, F.E.O. (2018), "The effect of using a case study on the academic achievement of students in learning about the topic of 'vitamins'", *Journal of Biological Education*, Vol. 53 No. 3, pp. 288-301, available at: <https://doi.org/10.1080/00219266.2018.14695338>
- Hartikainen-Ahia, A., Kärkkäinen, S., Nikkanen, N. and Keinonen, T. (2014), "Health education through the PROFILES teaching approach", in Bolte, C., Holbrook, J., Mamlök, R. and Rauch, F. (Eds), *Science Teachers' Continuous Professional Development in Europa. Case Studies from the PROFILES Project*, Freie Universität Berlin, Berlin, pp. 86-93.
- Hsieh, H.-F. and Shannon, S.E. (2005), "Three approaches to qualitative content analysis", *Qualitative Health Research*, Vol. 15 No. 9, pp. 1277-1288.
- Hutchinson, N., Baird, G.L. and Garg, M. (2016), "Examining the reading level of internet medical information for common internal medical diagnoses", *American Journal of Medicine*, Vol. 129 No. 6, pp. 637-639.
- Joseph, J., Vardhini, C. and Jaikumar, M. (2017), "Effectiveness of STP on knowledge and attitude regarding prevention of iron deficiency anemia among adolescent girl", *International Journal of Scientific Research*, Vol. 6 No. 8, pp. 22-23.
- Jun, S., Cowan, A.E., Tooze, J.A., Gahche, J.J. and Dwyer, J.T. (2018), "Dietary supplements use among US children by family income, food security level, and nutrition assistance program participation status in 2011-2014", *Nutrients*, Vol. 10 No. 9, p. 1212, available at: <https://doi.org/10.3390/nu10091212>
- Kärkkäinen, S., Kukkonen, J., Kontturi, S. and Keinonen, T. (2018), "Promoting health literacy: sixth graders working in partnership with local pharmacy", *Health Education*, Vol. 118 No. 6, pp. 470-482.
- Kiili, C., Leu, D.J., Marttunen, M., Hautala, J. and Leppänen, P.H. (2018), "Exploring early adolescents' evaluation of academic and commercial online resources related to health", *Reading and Writing*, Vol. 31 No. 3, pp. 533-557, doi: 10.1007/s11145-017-9797-2.
- Kostanjevec, S., Jerman, J. and Koch, V. (2011), "The effects of nutrition education on 6th graders knowledge of nutrition in nine-year primary schools in Slovenia", *Eurasian Journal of Mathematics, Science & Technology Education*, Vol. 7 No. 4, pp. 243-252.
- Krippendorff, K. (2004), *Content Analysis: An Introduction to its Methodology*, 2nd ed., Sage Publications, London.
- Little, J.C., Perry, D.R. and Volpe, S.L. (2002), "Effect of nutrition supplement education on nutrition supplement knowledge among high school students from a low-income community", *Journal of Community Health*, Vol. 27 No. 6, pp. 433-450.
- Lowry, S.A., Alaunyte, I. and Amirabdollahian, F. (2015), "Diet quality, usage and perceived benefits of nutritional supplements in young healthy adults", *Proceedings of the Nutrition Society*, Vol. OCE5, p. e334, doi: 10.1017/S002966511500381x.
- National Nutrition Council, Ministry of Agriculture and Forestry (2014), "Finnish nutrition recommendations 2014", available at: www.evira.fi/globalassets/vrn/pdf/ravitsemussuosituksset_terveytta-ruoasta_2014_fi_web_v4.pdf
- O'Dea, J. (2003), "Consumption of nutritional supplements among adolescents: usage and perceived benefits", *Health Education Research*, Vol. 18 No. 1, pp. 98-107.
- Ottander, C. and Ekborg, M. (2012), "Students' experience of working with socioscientific issues – a quantitative study in secondary school", *Research in Science Education*, Vol. 42, pp. 1147-1163.
- Parry, D.A., Oepfen, R.S., Amin, M. and Brennan, P.A. (2018), "Can dietary supplements improve clinician's well-being and health?", *British Journal of Oral and Maxillofacial Surgery*, Vol. 56 No. 2, pp. 85-89.

- Parviainen, H., Elorinne, A.-L., Väisänen, P. and Rimpelä, A. (2017), "Consumption of special diets among adolescents from 1999 to 2013 a population-based study in Finland", *International Journal of Consumer Studies*, Vol. 41 No. 2, pp. 216-224.
- Ratcliffe, M. and Grace, M. (2003), *Science Education for Citizenship*, Open University Press, Milton Keynes.
- Ronis, J.J., Pedersen, K.B. and Watt, J. (2017), "Adverse effects of nutraceuticals and dietary supplements", *Annual Review of Pharmacology and Toxicology*, Vol. 58, pp. 583-601.
- Sadler, T.D. (2004), "Informal reasoning regarding socioscientific issues: a critical review of research", *Journal of Research in Science Teaching*, Vol. 41 No. 5, pp. 513-536.
- Sadler, T.D., Barab, S.A. and Scott, B. (2007), "What students gain by engaging in socioscientific inquiry?", *Research in Science Education*, Vol. 37 No. 4, pp. 371-391.
- Sadler, T.D., Romine, W.L. and Topcu, M.S. (2016), "Learning science content through socio-scientific issues-based instruction: a multilevel assessment study", *International Journal of Science Education*, Vol. 38 No. 10, pp. 1622-1635.
- Schreier, M. (2014), "Qualitative content analysis", in Flick, U. (Ed.), *The SAGE Handbook of Qualitative Data Analysis*, SAGE, London, pp. 170-183.
- Sobal, J., Herbert, L. and Muncie, J.R. (1988), "Vitamin/mineral supplement use among adolescents", *Journal of Nutrition Education*, Vol. 20 No. 6, pp. 314-318.
- Thompson, P.A., Terry, R.D. and Amos, R.J. (1987), "Adolescent's beliefs about and reason for using vitamin/mineral supplements", *Journal of the American Dietetic Association*, Vol. 87 No. 8, pp. 1063-1065.
- Tsarouhas, K., Koikia-Fougia, N., Papalexis, P., Tsatsakis, A., Kouretas, D., Bacopoulou, F. and Tsitsimpikou, C. (2018), "Use of nutritional supplements contaminated with banned doping substances by recreational adolescent athletes in Athens, Greece", *Food and Chemical Toxicology*, Vol. 115, pp. 447-450.
- Vaismoradi, M., Turunen, H. and Bondas, T. (2013), "Content analysis and thematic analysis. Implications for conducting a qualitative descriptive study", *Nursing and Health Sciences*, Vol. 15 No. 3, pp. 398-405.
- Webb, G.P. (2011), *Dietary Supplements and Functional Food*, 2nd ed., Wiley, New York, NY.
- Zeidler, D.L., Sadler, T.D., Appelbaum, S. and Callahan, B.E. (2009), "Advancing reflective judgment through socioscientific issues", *Research in Science Teaching*, Vol. 46 No. 1, pp. 74-101.
- Zeyer, A. and Kyburz-Graber, R. (2012), *Science/Environment/Health. Towards a Renewed Pedagogy for Science Education*, Springer, New York, NY.

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