sustainability

MDPI

Article

Drinking-Related Metacognitive Guidance Contributes to Students' Expression of Healthy Drinking Principles as Part of Biology Teaching

Michal Zion * and Hagit Cohen

School of Education, Bar-IIan University, Ramat-Gan 5290002, Israel; hagitc10@gmail.com
* Correspondence: michal.zion@biu.ac.il

Abstract: Biology education has adopted the goal of educating future generations about sustainable, healthy habits. The current paper focuses on drinking-related nutritional literacy—the characteristic of health education that refers to aspects of healthy drinking: drinking enough water and fewer sugar-sweetened beverages (SSBs). The study aims to foster school students' critical thinking about the quality and the quantity of what they drink in everyday life. Facilitating students' metacognitive awareness was achieved, as they were engaged in a biology learning activity centered on the importance of healthy drinking in everyday life. The study focused on two research questions: 1. What is the contribution of drinking-related metacognitive guidance to the development of metacognitive awareness concerning healthy drinking among students? 2. What is the contribution of drinking-related metacognitive guidance to the way students express the principles and importance of healthy drinking as part of their metacognitive awareness thinking process? The findings indicate a quantitative and qualitative improvement in drinking-related metacognitive awareness among those students who received metacognitive guidance as part of biology teaching. This paper suggests that metacognitive guidance has a significant pedagogical potential to improve sustainable healthy habits among children.

Keywords: healthy drinking; metacognition; metacognitive guidance; sugar-sweetened beverages

Citation: Zion, M.; Cohen, H. Drinking-Related Metacognitive Guidance Contributes to Students' Expression of Healthy Drinking Principles as Part of Biology Teaching. *Sustainability* **2021**, *13*, 1939. https://doi.org/10.3390/su13041939

Academic Editor: José Carmelo Adsuar
Received: 23 January 2021
Accepted: 8 February 2021
Published: 11 February 2021

1. Introduction

Overabundance and growing consumerism accompany the rising quality of life in the developed world. One aspect of this is the excessive consumption of sugar-sweetened beverages (SSBs) [1]. Obesity, dental caries, diabetes, cardiovascular disease, fatty liver, and metabolic syndrome are just some of the harms associated with consuming SSBs [2–4]. In this regard, obesity is considered one of the most serious public health challenges of the 21st century [5]. People should, therefore, be nutritionally literate about their drinking in order to maintain proper health in the modern world [6]. Biology educators have a vital role in developing the knowledge, skills, attitudes, and values that enable people to stay healthy [7]. Biology education can relate to health education in two broad aims. The first aim is the learning of those aspects of biology that are essential to one's well-being. The second is the opportunity for discussion, reflection, and evaluation of one's understandings of the importance of those aspects of biology that are essential to one's well-being [8].

The current paper focuses on one aspect of health education—drinking-related nutritional literacy, which refers to aspects of healthy drinking: drinking enough water and consuming fewer SSBs. It presents a study in education that aims to foster school students' critical thinking about the quality and the quantity of what they drink in everyday life to help them lead a healthier lifestyle. Development of critical thinking was achieved by arousing students' metacognitive awareness, as they were participating in a biology learning activity centered on the importance of healthier drinking in everyday life, an activity that was part of their biology class. The study focused on two research questions:

1. What is the contribution of drinking-related metacognitive guidance to the development of metacognitive awareness concerning healthy drinking? 2. What is the contribution of drinking-related metacognitive guidance to students' expression of the principles and importance of healthy drinking as part of their metacognitive awareness thinking process?

2. Literature Review

2.1. Drinking-Related Nutritional Literacy and Its Relationship to 21st-Century Health

Health literacy develops through an understanding of human biology and the role of humans in global ecosystems [9]. It includes concepts of basic biology, disease transmission, nutrition, biotechnology, and bioethics. Health literacy, in general, focuses on the enhancement of knowledge, attitudes, self-efficacy, and the confidence to take action towards improving personal and community health [10,11]. Moreover, general health status, health outcomes, and healthy behaviors are positively correlated with educational achievement [11–14]. People make better health-related decisions when they have greater information-processing skills, rather than having more specific health knowledge. Children who have a higher level of health literacy can actively participate in making decisions concerning their health. They can develop skills that promote healthy behavior as adults [15].

Nutritional literacy is an element of health literacy, defined as the level at which individuals can obtain, process, and understand nutritional information [15]. Professionals studying nutritional literacy examine what we drink. Drinking enough water and fewer SSBs in everyday life serve as principles of healthy drinking. Studying the principles of healthy drinking is important for several reasons: water serves to maintain freshness, remove toxins in the body, and help digestion. Water has other benefits for human health, as it assists in maintaining fitness, improving blood circulation, keeping the heart healthy, pregnancy, providing the effects of relaxation, and beauty care [16–18]. Insufficient water consumption causes many problems. It affects concentration, short-term memory, and alertness. Dehydration can also reduce physical performance, and chronic moderate dehydration can be a risk factor for several diseases, which means that what we drink significantly influences our health [16,19].

With the spread of consumerism, people began drinking SSBs instead of water [18]. Consequently, obesity among children has been increasing, and there are growing concerns about the quality of food and drink that children consume [14,20,21]. Added sugar is a critical factor in the quality of food and drink—children obtain sugar from drinks in a ratio far higher than the recommended amount. US dietary guidelines advisory committee recommended to consume no more than 10% of our calories from added sugar [22].

Many factors, such as knowledge, attitudes, perceptions, and culture, influence nutritional habits [23,24]. Programs that encourage adequate water consumption and reduce the amount of SSB consumption are essential for effective public health interventions. Health programs targeted at children's nutrition must make accurate and meaningful connections between the health information that children encounter and their own lives. Children should be empowered to critically examine the bias in health communications, so they can increase their ability to participate in their health decisions [25,26]. In an experiment where water consumption was increased in school, it was shown that there was a reduced rate of obesity [6]. Unfortunately, interventions aimed at reducing SSB intake may inadvertently lead to the replacement of SSBs with other calorie-laden beverages, such as whole milk or juice, resulting in no significant change in calorie intake [27].

Developing decision-making and goal-setting skills is an essential element for influencing nutritional behavior [28]. A study by Olson and Moats claims that school is the best environment to introduce change in nutritional habits, using peer learning. Considering the advantages that metacognitive awareness provides for decision making, our current study will attempt to determine how metacognitive thinking in biology class enables students to improve their awareness about healthier drinking.

2.2. Metacognition and 21st-Century Skills

Educators are setting primary goals for 21st-century education. Preparing learners to become participating citizens in a complex, dynamic world means going beyond just preparing for the basics [29,30]. According to Wilson [29], people should not drown in information while starving for wisdom. People should be able to put together the right information at the right time, think critically about it, and make important choices wisely. A report from the National Research Council, entitled "Education for Life and Work" [31], identifies three domains of 21st-century skills—cognitive (thinking and reasoning), intrapersonal (regulating one's behaviors and emotions to achieve goals), and interpersonal (relating to others and understanding others' points of view). Based on these domains, 21st-century curriculum experts have emphasized four dimensions: knowledge, skills, character, and meta-learning [32]. The knowledge dimension refers not only to basic knowledge as it appears in the curriculum but also to interdisciplinary knowledge, such as wellness-related knowledge—to use an example relevant to health education. The skills dimension refers to higher-order skills such as the four Cs (communication, collaboration, critical thinking, and creativity) that are essential for more in-depth learning of content knowledge, as well as for being able to demonstrate understanding through performance [31–33]. The character dimension refers to mindfulness, curiosity, courage, resilience, ethics, and leadership. Meta-learning, which is often called learning to learn, or metacognition, is the term used to describe the internal processes by which we reflect on and adapt our learning [34]. It is an essential component of a 21st-century education that teaches students *how* to learn.

Metacognition is the "thinking about thinking," which refers to the ability to reflect upon, understand, and control one's cognitive processes [35,36]. Accounts of metacognition distinguish between two major components: knowledge about cognition, which includes three sub-processes that facilitate the reflective aspect of metacognition, and regulation of cognition, which includes several sub-processes that facilitate the control aspect of learning [37]. Various studies make strong claims for the significance of metacognition on pupils' learning. For example, researchers suggest that metacognition accounts for roughly 17% of a child's ability to be successful at school, while intelligence accounts for approximately 10% [38]. This variance between metacognition and intelligence is statistically significant and is reinforced by other studies [39,40], which suggests the necessity for schools to teach metacognitive skills effectively. In this spirit, metacognition serves as a good predictor of problem-solving ability concerning everyday problems [41].

2.3. The Importance of Metacognition in Maintaining Health

Most health-related professional organizations and accrediting bodies encourage lifelong learning to promote health at all ages. Lifelong learning requires self-directed learning, which allows learners to make decisions about the information they want to experience or attain [42,43]. Researchers claim that with health as a core foundation, people can understand and act on the knowledge that will keep them healthy throughout their lifetime [42]. This entails people's capacities, skills, knowledge, motivation, and the confidence to access, understand, appraise, and apply health information. With this as a base they can form valid judgements to improve their quality of life by making responsible decisions concerning healthcare, disease prevention, and health promotion. New accreditation standards in biology, pharmacy, medical, and nursing education emphasize metacognitive skills and related critical thinking and self-directed learning skills. Studies published in recent years point to the connection between metacognitive awareness and nutrition [44,45].

Pereira et al. [46] pointed out that the design of future interventions may focus not only on transmitting knowledge about healthy eating and drinking habits but also on combining that knowledge with training related to self-regulation strategies such as metacognition concerning healthy eating and drinking behaviors.

2.4. Research Rationale

Metacognitive awareness helps to promote significant learning in the 21st century, with accumulating evidence that metacognitive awareness can improve a learner's ability to apply critical thinking in the everyday maintenance of health. According to Schraw, metacognitive guidance has at least three functions [36]. First, it "helps students focus their attention more selectively and better integrate information" [36] (p. 124). Second, it develops an explicit awareness of problem-solving processes. Third, it enables students to use external representations whenever possible to reduce unnecessary cognitive load. Furthermore, metacognitive self-addressed questions guide the solvers to identify the problem's specific characteristics and apply appropriate strategies. This means that students can "reallocate limited resources and solve problems more efficiently" [36] (p. 124).

The current paper focuses on one facet of health education—drinking-related nutritional literacy. This refers to two aspects of healthy drinking: drinking enough water and consuming fewer SSBs. The paper describes a study in education aiming to foster school students' critical thinking about the quality and the quantity of what they drink in everyday life to help them lead a healthier lifestyle. Development of critical thinking was achieved by arousing students' metacognitive awareness, as they were participating in a biology learning activity centered on the importance of healthier drinking in everyday life, an activity that was part of their biology class.

Metacognitive awareness is important for critical thinking processes, since maintaining a healthy lifestyle in the context of healthy drinking requires the use of higher-order thinking processes. This study aims to quantitatively examine and identify the contribution of drinking-related metacognitive guidance to the development of metacognitive awareness concerning healthy drinking. It can be hypothesized that the metacognitive guidance that is explicitly aimed at thinking about healthy drinking will significantly contribute to metacognitive awareness concerning healthy drinking in three categories: planning, monitoring, and evaluation.

The study then focuses on a qualitative analysis of drinking-related metacognitive awareness about healthy drinking, expressed as part of students' metacognitive awareness thinking process. The combination of the quantitative goal and the qualitative goal may lead to an in-depth understanding of the processes of metacognitive thinking that occurs when students learn biological concepts related to their health—both as children now and as adults in the future.

3. Method

3.1. Research Design

The present mixed methods study combines quantitative and qualitative research tools. The quantitative analysis focused on the examination of metacognitive guidance as an independent variable. Metacognitive guidance oriented the students toward thinking in terms of regulation of cognition, all in the context of healthy drinking: drinking enough water and fewer SSBs. The study included two research groups: an intervention group receiving metacognitive guidance (meta) and a control group (control). The study examined metacognitive awareness concerning healthy drinking as the dependent variable, focusing on the ability of an individual to plan, monitor, manage, and evaluate the process of making decisions about what and how much to drink. The qualitative part of the research analyzed the drinking-related metacognitive awareness of both research groups, as it concerned healthy drinking.

3.2. Participants

The participants were 402 elementary school students. Of these, 202 (50.2%) were boys and 200 (49.8%) were girls, with similar sex distribution by experimental condition ($\chi^2(1) = 0.18$, $p = 0.674$). They came from 13 classes (four schools—which we shall designate as a–d) of fifth and sixth grades (aged 10 to 12). The schools are ranked in the same socio-economic index (medium-high). Seven classes from three different schools (four

from school a, one from school b, and two from school d) were randomly assigned to metacognitive guidance (n = 207, 51.5%). Six classes from three different schools (two from school a, two from school b, and three from school d) were randomly assigned as the control group (n = 195, 48.5). There were 202 boys (50.2%) and 200 girls (49.8%), with similar sex distribution by experimental condition ($\chi^2(1) = 0.18$, $p = 0.674$).

3.3. Intervention

During three biology lessons, the students studied a drinking-related nutritional literacy learning unit that emphasized the importance of sufficient water drinking and the hazards of SSB consumption. They also learned how to check whether they were drinking enough. Then, over five months, they worked in teams of four, planning a Health Day that aims to encourage younger pupils, in the first through fourth grades, to drink more water and fewer SSBs. Each team was required to prepare a three-part learning activity that they would later facilitate for the younger pupils during the Health Day.

For the first part of the learning activity, every team wrote a script for a live performance or a video depicting daily situations and conveying knowledge about two topics. Topic A—Why should we avoid drinking too much high sugar beverages?—explained the hazards of excessive consumption of SSBs, especially the idea that drinking excessive amounts of sweetened beverages results in dental problems. Topic B—What do we gain when we drink enough water?—explained that being sufficiently hydrated improves our concentration and our achievements in studies and sports. Within this topic, signs of dehydration were explained, such as learning to notice the color of our urine to determine whether we have had enough water to drink.

For the second part of the learning activity, every student team prepared a game that would help younger pupils recall what they had learned in the first part, while verifying whether they properly understood the material. For the third and final part of the learning activity, the student teams made souvenirs for the younger pupils to take home, to remind them of their experiences on the project, and to help share the project's message with parents and siblings. One example of a souvenir was a magnet with a slogan to help someone determine whether they were sufficiently hydrated. The learning process peaked with the Health Day, in which the fifth- and sixth-grade students presented the younger pupils with the products of their educational labor: the performances, the games, and the souvenirs.

Students of both meta and control groups met with the teacher for twenty minutes every other week over five months. During each meeting with the teacher, students presented the tasks they had completed, devised solutions to problems encountered along the way, and received new tasks to accomplish. Intervention group students (meta) received drinking-related metacognitive guidance in addition to the above. The drinking-related metacognitive guidance included instructions about how the students could regulate their cognition, i.e., direct their thoughts, beliefs, and effects toward attaining the specific goals of proper hydration and decreased SSB consumption. (Appendix A) [37,47].

The aim was to promote reflective thinking about the learning process and encourage students to apply aspects of the regulation of cognition when they think about healthy drinking. Guidance, including metacognitive questions, was presented to students at three different times during the learning process: a month after beginning to prepare the activities, a month before conducting the Health Day, and finally, one month after completing the Health Day. In order to eliminate different influences by different teachers, a single health educator taught all the teams.

3.4. Research Tools

(1) Research tool for quantifying metacognitive awareness concerning healthy drinking.

We developed a questionnaire to assess metacognitive awareness. It is based on a metacognitive awareness inventory focusing on drinking-related regulation of cognition [37]. The questionnaire had three regulation of cognition sections: planning, moni-

toring, and evaluation. Statements making up the questionnaire were designed to refer to attitude or behavioral changes. The questionnaire included 28 items that the student rates on a scale between 1 (never/not important at all) to 5 (always/very important). The questionnaire defined four factors. Planning about water (8 items), for example: To manage to drink more water, I should have bottles of water in the house to take with me to school. Planning about SSBs (4 items), for example: To reduce my soft drink consumption, I should order fewer soft drinks when I go to a restaurant. Monitoring (4 items), for example: To increase my water consumption, I should check the color of my urine to see whether I have had enough to drink. Evaluation (12 items), for example: At the end of the day, I examine what helped me drink more water.

Three senior science education professionals validated the questionnaire. A preliminary study was carried out. Following an analysis of the replies, some of the questions were modified and adjusted to the participants' age. Principal components factor analysis was conducted for the 28 items, with oblique rotation and eigenvalue greater than 1. Four factors were detected, explaining 62.15% of the variance. The first factor is evaluation (eigenvalue = 9.65, loadings 0.62 to 0.83, Cronbach $\alpha = 0.93$). The second factor is planning about water (eigenvalue = 3.13, loadings 0.53 to 0.76, Cronbach $\alpha = 0.78$). The third factor is planning about SSBs (eigenvalue = 1.89, loadings 0.71 to 0.82, Cronbach $\alpha = 0.85$). The fourth factor is monitoring (eigenvalue = 1.15, loadings 0.52 to 0.75, Cronbach $\alpha = 0.93$). A total score for metacognitive awareness was composed as well (Cronbach $\alpha = 0.93$) from the means of the items. The questionnaire was administered at the beginning and again at the end of the study.

(2) Qualitative research tools analyzed students' expression of the principles and importance of healthy drinking as part of their metacognitive awareness thinking process. Three sources were used for the qualitative analysis: interviews, analysis of the scripts, and analysis of the replies to metacognitive guidance questions.

Interviews (Appendix B). After having facilitated the first through fourth-grade pupils' activities, the fifth- and sixth-grade students were interviewed. The interviews were semi-structured and referred to drinking-related metacognitive awareness. The questions were open-ended, inviting the subjects to elaborate on their argument and supply examples based on personal experience. The interview questions can be divided into two subjects: 13 questions relating to metacognitive awareness and 11 questions to nutritional literacy—of which two were knowledge questions, five were attitude questions, and four were behavior questions. The interviews were carried out with the explicit consent of the students themselves and their parents. Eight students were chosen from each group, based on their expression skills. A total of eight students were chosen (five from school a, one from school b, and two from school d) to represent the intervention group (meta). An additional eight students were chosen (three from school b, four from school c, and one from school d) to represent the control group. Each interview lasted roughly 45 min and was conducted in a quiet room as a pleasant, unintimidating conversation. A pilot interview was carried out with four students to verify that the questions were clear enough and the answers comprehensive enough. Following the pilot, a few questions were revised for better clarity and some were discarded altogether if the responses they provoked did not produce results specifically relevant to the present study's research questions. The interviews were recorded and transcribed.

Scripts for the activity written by student teams. Students of both research groups were divided into four-student teams by the teacher. Every team wrote a script for a performance or video they planned to present before the younger pupils. The scripts consisted of two parts: one focused on reducing the consumption of SSBs, while the other focused on the importance of drinking enough water. Eight scripts written by the meta group and six written by the control group were chosen for analysis based on the level of writing and their reference to the relevant issues.

Replies to metacognitive guidance questionnaire. All meta group students answered a metacognitive guidance questionnaire (Appendix A) on three different occasions. Twenty-

six questionnaires, 13 that were filled-in by girls and 13 that were filled-in by boys, were chosen for analysis based on their writing level and broader reference to the relevant issues.

3.5. Data Analysis

(1) Quantitative data analysis. Data were analyzed with IBM SPSS Statistics® version 25 (NY, USA). To assess the need to control for sex differences, pre-test group scores were examined with a series of t-tests, and initial school differences were examined with analyses of variance. To assess the hypothesis of the study concerning changes according to group (meta/control) and time (pre/post), changes by time and group (2 × 2) were examined with repeated measures analyses of covariance, controlling for sex (1—boys, 0—girls) and school (1—two schools, 0—other two schools). Significant interactions of time and group in the study variables were interpreted with estimated marginal means, applying the Bonferroni correction for multiple comparisons.

(2) Qualitative data analysis.

Qualitative data analysis was performed according to the grounded theory approach [48]. In order to analyze students' drinking-related metacognitive awareness concerning healthy drinking, expressed as part of their metacognitive awareness thinking process, we looked at recurring, characteristic expressions in the interviews, the scripts, and the students' answers to the metacognitive guidance questionnaire. The analysis was based on "sensitizing concepts" identified in the literature concerning the metacognitive awareness criteria "regulation of cognition" [38]. An inventory, detailed in Table 1, was used for the qualitative analysis. Multiple sources of data collection and multiple voices of students were used to triangulate the data for this study. Interview questions were structured to lead students to reflect on the connection between drinking-related metacognitive awareness and the learning activities in which they took part. As teams, students expressed these aspects through their collaborative script-writing activity. During metacognitive guidance, students were individually asked guiding questions in writing, requiring them to apply highly focused metacognitive thinking. Collecting results with different research tools and examining different perspectives of the learning process have considerably benefited the reliability of the study and our understanding of the findings. During the analysis of the data, expressions that show reference to the various metacognitive awareness criteria "regulation of cognition" were marked in bold. The results of the qualitative research are presented by examples and accompanied by a concise relevant analysis. Results from the interviews and scripts are presented for both research groups; results depending on the analysis of students' answers to the metacognitive guidance questionnaire are listed only for the group that received this guidance (meta).

Table 1. Qualitative analysis inventory.

	Theoretical Definition	**Operational Definition**	**Examples**
Planning	Setting goals and finding resources.	Students plan ahead, set goals. Do X to achieve Y. Indicative phrases include: in order to, so as to, aiming to Explicit planning	Drink water, it is very important to succeed today in training, it is important to drink enough water.
Monitoring	Assessing performance throughout the process.	Students point out monitoring (assessment of behavior/attitudes/knowledge throughout the process)	Did you bring water for the exam? I heard it helps to concentrate.
Evaluation	Evaluation at the end of the learning process.	Students conduct a retrospective evaluation If I had drunk enough, I would have aced the test/competition.	I was thirsty but I did not have the energy to go and get a drink. I did not think that it could help me on the test. Too bad I didn't drink enough.

4. Results

4.1. The Contribution of Drinking-Related Metacognitive Guidance to the Development of Metacognitive Awareness Concerning Healthy Drinking

Initial group differences in the metacognitive variables were not significant ($p = 0.138$ to $p = 0.894$). Initial sex differences were significant for monitoring, which was higher for boys ($M = 3.95$, $SD = 0.87$) than for girls ($M = 3.78$, $SD = 0.87$) (t (406) = 2.13, $p = 0.034$). Initial scores for evaluation were higher for boys ($M = 3.01$, $SD = 1.12$) than for girls ($M = 2.73$, $SD = 1.08$) as well (t (406) = 2.55, $p = 0.011$). Similarly, school differences were significant for monitoring ($p = 0.047$) and evaluation ($p = 0.034$), with the scores in two schools being generally higher than in the other two schools. In light of these differences, analyses were conducted while controlling for sex and school differences. The analysis presented here considers only those students for which there are both pre- and post-questionnaire results.

Table 2 shows means, standard deviations, and F values for the drinking-related metacognitive awareness variables by time and group. Results show significant time by group interactions for the total score, for "planning about water" and for "planning about SSBs". For all, a significant increase was noted in the meta group, while no change was found in the control group (total score: meta group F (1, 398) = 15.30, $p < 0.001$, $\eta^2 = 0.037$; control group F (1, 398) = 0.64, $p = 0.425$, $\eta^2 = 0.002$. "Planning about water": meta group F (1, 398) = 26.35, $p < 0.001$, $\eta^2 = 0.062$; control group F (1, 398) = 0.33, $p = 0.564$, $\eta^2 = 0.001$. "Planning about SSBs": meta group F (1, 398) = 20.97, $p < 0.001$, $\eta^2 = 0.051$; control group F (1, 398) = 3.43, $p = 0.065$, $\eta^2 = 0.009$). Regarding monitoring, a general increase was noted, beyond group (from $M = 3.87$ $SE = 0.04$ to $M = 4.07$ $SE = 0.04$), and no change was found for evaluation.

Table 2. Means, standard deviations, and F values for the metacognitive awareness variables, by time and group ($n = 402$).

	Meta (n = 207)		**Control (n = 195)**		**Time**	**Group**	**Time x Group**
	Pre *M* (*SD*)	**Post *M* (*SD*)**	**Pre *M* (*SD*)**	**Post *M* (*SD*)**	***F* (1, 398) (η^2)**	***F* (1, 398) (η^2)**	***F* (1, 398) (η^2)**
Total score	3.57 (0.76)	3.79 (0.74)	3.62 (0.74)	3.67 (0.76)	1.53 (0.004)	0.66 (0.002)	5.07 * (0.013)
Planning about water	4.29 (0.62)	4.52 (0.56)	4.37 (0.60)	4.41 (0.60)	1.83 (0.005)	0.21 (0.001)	8.34 ** (0.021)
Planning about SSBs	4.05 (0.98)	4.40 (0.75)	3.90 (1.06)	4.11 (0.98)	6.25 * (0.015)	10.05 ** (0.025)	9.49 ** (0.023)
Monitoring	3.87 (0.90)	4.10 (0.84)	3.86 (0.85)	4.05 (0.86)	4.42 * (0.011)	0.47 (0.001)	0.79 (0.002)
Evaluation	2.82 (1.14)	2.99 (1.18)	2.93 (1.08)	2.89 (1.25)	0.01 (0.001)	0.01 (0.001)	1.85 (0.005)

* $p < 0.05$; ** $p < 0.01$. Scale 1–5. Higher scores indicate better metacognitive outcomes.

4.2. The Contribution of Drinking-Related Metacognitive Guidance to Students' Expression of the Principles and Importance of Healthy Drinking as Part of Their Metacognitive Awareness Thinking Process

A qualitative analysis of interviews and scripts, detailed in Tables 3–5, enables us to compare metacognitive awareness in both the meta and control groups. A summary of the analysis of the results is supplied under every aspect within the tables. We can see a more prominent expression of drinking-related metacognitive awareness among the meta group in all three aspects—goal setting and planning, monitoring, and evaluation. Meta group students refer to aspects of healthy drinking in their metacognitive thinking. However, when control group students refer to scientific content they acquired about the subject, they do not refer to changes in everyday behavior regarding healthy drinking. Table 6

provides student responses as evidence of metacognitive guidance in accordance with the three components of cognition: goal setting and planning, monitoring, and evaluation. The evidence indicates that the students apply drinking-related metacognitive awareness to their learning process. Looking at goal setting and planning as well as monitoring, we can see a match between students' metacognitive awareness and the initiative's aim to influence healthy drinking behavior. In the evaluation aspect, while students refer to the learning activities they facilitated in terms of possible future improvements, they do not express changes in their own behavior.

Table 3. Drinking-related metacognitive awareness expressions in interviews and scripts —goal setting and planning.

A (interviews)	**Meta**	**Control**
Increasing consumption of water	• Now **I prepare*** the bottle **in advance**. I had no idea that it influences my ability to focus. I used to drink mostly out of the water cooler. **Today I bring a bottle and make sure to finish it.** I am mindful of drinking more when I cannot focus. (DM **) • Following the activity we facilitated, **I bought a new flask** that keeps the water cool, **helping me drink more** during practice. (EH 2)	• I am physically active and lose water so **I should drink even when I am not thirsty.** Now I take strict care to drink when I go to after school programs, whereas before I would not drink if I were not thirsty. (MY 1) • Before, I would not even bring a water bottle to school. **Now I do, and I drink more water. I also bring water when I go the scouts meeting**, which I would not do before". (TG 1)
Decreasing consumption of SSB	• **We were trying to figure out how to convince them to drink less SSBs**. In the play that we staged, we referred to **dental cavities**, to how people need to get fillings and it hurts. (EH 2) • To stop them from wanting so much SSB, **the performance needs to refer to everyday situations**. (AS 2)	• They should be taught that drinking sweetened beverages is harmful to their teeth and generally bad for you". (YZ 1)
Analysis of difference between control group and meta group***	Clear evidence of **planning to drink more water themselves**, such as purchasing a flask or designating a water bottle to bring to school. As for **reducing SSB consumption**, students emphasize that it is important that their staged performance includes everyday situations illustrating the notion that consuming sweetened beverages leads to tooth decay. That is, they plan what elements the activity should include to convey a warning message about SSBs.	Control group students drink more water and understand why it is important, but there is no process of goal setting and planning **in the context of drinking more water. As for reducing SSB consumption**, there is no evidence of planning what elements the learning activity should include in order to get pupils to cut down on sweetened beverages. Control group students understand that they need to convey the notion that SSBs lead to tooth decay.
B (scripts)	**Meta**	**Control**
	• I always bring water **because** I do not want to dehydrate. (Team C) • Mom, please put a jug of water on the table. (Team D) • I always drink water before an exam. If you do not—that is your problem. I will be able to focus, you will not. (Team D) • I will help you. Every time you are thirsty, **I will remind you to prefer water**, until you get used to it. **I will remind you to dilute the juice** you bought with water, and when we go shopping, **I will remind you to avoid buying juice** altogether. (Team E)	• We have a science test coming up. **You should hydrate a lot**—I learned that it **helps you concentrate**. (Team B) • **Come and hydrate—there is an exam after recess**. I drink so I can focus during the exam. (Team A) • We want to drink less SSBs **to keep our teeth healthy**. Less sugar in your drink means less cavities. (Team A)

Table 3. *Cont.*

B (scripts)	**Meta**	**Control**
Analysis of difference between control group and meta group	The performance script shows evidence of planning: Team C exhibits planning to drink water and avoid dehydration, while members of Team D plan to place a jug of water on the table and to have a drink of water before an exam to improve focus. In Team E, a strategy was applied where every sibling that has a drink of water reminds the other sibling to do the same. Two methods were applied to reduce SSB consumption: diluting sweetened juice with water, and simply not buying sweetened juice on one's next visit to the grocery store. These tactics indicate planning: how to drink more water, how to drink less sweetened juice.	The performance script indicates that the students understand why it is important to hydrate: they understand that drinking water improves focus and SSB increases the chance of tooth decay. Yet there is no indication of planning how to reduce SSB consumption, and only limited indication of planning to drink water—before taking an exam to improve focus.

* The words in bold highlight the main theme. ** Students' code for research purposes. *** In the gray boxes the data analysis is summarized.

Table 4. Drinking-related metacognitive awareness expressions in interviews and scripts —monitoring.

A (interviews)	**Meta**	**Control**
Examining whether the prepared activity can actually influence behavior	• At every step, **we stopped to check what we did wrong and what we did right**:* will this help them remember and want to drink more water? (DM 2)** • We stopped to ask ourselves: **how** will what we write **help children drink more water and less SSBs**? How will they remember this? How will it affect them? (NS 2) • We initially drew a table for the children to fill in, recording what they drank. We thought it was a clever idea. We later realized that **it would not actually help them remember to drink more**. (DM 2) • Getting them to want to cut down on SSBs, we have to show on stage scenes of everyday life. (AS 2)	• The Monopoly set had different factories—both SSB and water factories. I was not sure that including SSB in the game was a good idea. After all, our aim was reducing its consumption. I eventually decided to include sweetened beverage but **to price the water plants higher—to indicate their higher value**. (MY 1) • We prepared a bingo but eventually **realized that will not encourage the pupils to drink more water or less SSBs**. (EG 1) • We have to visualize on stage that if they drink a lot of SSBs they could harm their teeth. (HB 1)
Examining how explaining the process of reducing SSB consumption is difficult	• We thought it would be difficult for the children to drink fewer **SSBs** because it sweet and tasty and fun to drink. (NS 2) • I kept thinking about how difficult it is for children reduce **SSB** consumption, because they are so used to it. It even took me a while to cut down on it. (ER 2)	• **We thought it would be difficult for children to reduce SSB consumption**, because it is a habit that is hard to quit, like smoking. It is addictive. But I myself was able to quit. (YK 1) • Children are used to drinking sweet juice. **We have to find some way to teach them so that they do not forget after a couple of days**. (AK 1) • We spent too little time figuring out what would actually be more difficult for the children. (ER 1)

Table 4. *Cont.*

A (interviews)	**Meta**	**Control**
Analysis of difference between control group and meta group***	Students of this group can clearly be seen monitoring their progress. They stop to consider whether what they have prepared will actually help pupils change their behavior, and which of their ideas best serves the goal they had set—getting pupils to drink more water and fewer SSBs. They also paused to consider the difficulties that pupils might face in attempting to reduce SSB consumption, and planned how to help them overcome these obstacles.	The students are focused on the pricing of the in-game water plants instead of changing the everyday behavior of the younger pupils. The students understand the need to drink more water and fewer SSBs. They understand that it is important to show the hazards of SSBs and that simply listing those hazardous by-products on the board will not reduce their consumption by the pupils. Only a few of the control group students realize how difficult it is to cut down on SSBs, perhaps indicating that they did not give this aspect much thought.
B (scripts)	**Meta**	**Control**
	Interviews	
	• **I am going to get a drink of water, I am so thirsty! I have not noticed that we have not had anything to drink since recess began**. (Team C) • **Did you bring water to drink during the exam? I heard it helps to focus**. (Team D) • You just **didn't drink enough** water. You should have a look at the color of your urine. If it is yellow—you did not hydrate enough. (Team A)	• Teacher, did you drink water today? No. That explains everything. Do not expect a good grade. (Team B) • Lia, you are drinking a lot of coke. Stop it! It is not good for you. If you continue to drink so much coke, you will get painful cavities. (Team B)
Analysis of difference between control group and meta group	The scripts written by the meta group indicate they received metacognitive guidance. They pause to consider whether their behavior would help them succeed on an exam, that is, whether they had hydrated properly.	Hardly any of the scripts prepared by the control group contain evidence of monitoring a person's behavior for change. There is reference to knowledge about the potential hazards of SSBs, and reference to external factors such as the teacher as some sort of monitoring figure.

* The words in bold highlight the main theme. ** Students' code for research purposes. *** In the gray boxes the data analysis is summarized.

Table 5. Drinking-related metacognitive awareness expressions in interviews and scripts —evaluation.

A (interviews)	**Meta**	**Control**
Evaluation of the activity's success in changing behavior	• At the end of the activity, **we handed out droplets** on a string **with slogans** on them. Something for them to keep as reminder of the activity and **a reminder to hydrate more**. (AD 2)** • I learned how to tell whether what I prepared actually serves the goal. If we had handed out a simple word search puzzle, they would have quickly discarded it and forgotten about it. **Because we applied an experiential approach—they will remember to hydrate more**. The performances we put on were hilarious. (DM 2)	• **We achieved our goals of getting the pupils to drink more water and less SSB**. They answered the questions we wrote. I believe we accomplished our goal. (FR 1) • **I believe the activity will help them drink more water**. They told us so. (SS 1) • If we don't facilitate the activity, they will keep drinking SSBs, but if we teach them, they will believe us and consume fewer SSBs. (YK 1) • We **showed** them everything wrong with SSBs, **all the damage** they do, and this is how **they learned that they can cut down on consumption**. (FR 1) • The performance we wrote will best help them remember drinking water. We conveyed the message that you should hydrate more: it is healthier for the body; it is better for competitive sports. (EK 1)
Evaluation of changes in behavior of the students themselves	• Today I take better notice to hydrate when I can't focus. (AD 2) • When I go to the restaurant and they offer me water or coke, **I recall what we learned** in class and opt for water. **I tell myself: drink water**, drink more water—and then I decide to have water. (DM 2) • **I managed to cut down** on SSBs because **I know what I am gaining** by drinking less of it. (HK 2)	• I got to examine how much water and how much SSBs I consume, and then I attempted to drink more water and less SSBs. (EK 1)
Analysis of difference between control group and meta group***	Meta group students show that they critically examine their achievements at the end of the process and contemplate what actually made the younger pupils hydrate better. The students also express contentment at having facilitated such activities, drawing a positive connection between these activities and healthier drinking. The excerpts show that they appreciate the changes in their own behavior—consuming less SSBs.	We can see no proper process of evaluation—the students did not verify whether the younger pupils drank more water or less SSBs following the learning activity. The control group students do not go beyond the stage of knowledge transfer—referring only to the fact that they did their part in presenting this knowledge before the pupils. They also hardly refer to evaluating their own change in drinking behavior.
B (scripts)	**Meta**	**Control**
	Interviews	
	• I told you that you should hydrate—**it helps you focus and succeed in sports**. (Team C) • You grew tired because you did not hydrate enough. **Water helps you concentrate**. (Team B)	• Now I understand that **if you do not hydrate enough you do not succeed.** I learned the lesson and I will always hydrate before class. (Team A)
Analysis of difference between control group and meta group	The excerpts indicate that students evaluate at the end of a process what was the most appropriate course of action. They evaluate why they had not succeeded on an exam or a sports competition and conclude that a failure can be related to not having hydrated enough.	Evidence indicates the students know that it is important to hydrate in order to improve focus. There is no evidence of an evaluation process. The student testifies she learned from experience that in the future she should drink water.

* The words in bold highlight the main theme. ** Students' code for research purposes. *** In the gray boxes the data analysis is summarized.

Table 6. Drinking-related metacognitive awareness expressions in student replies to metacognitive guidance questions.

Aspect of Metacognitive Regulation	Excerpts from Student Replies	Analysis of the Evidence of Metacognitive Awareness
Planning	• We tried to figure out **what the purpose of the activity should be and what would make children hydrate more**.* We tried to divide the assignments between us and draw up a schedule. (NS 2)** • It was important for us **to make the children remember, even after they return home**, to hydrate and to examine urine color, to remember **the cons of drinking SSBs and the pros of drinking water, to remember what dehydration is**. (DM 2)	These excerpts clearly indicate that the students contemplate what they need to do to get the younger pupils to adopt the notion that drinking more water and less SSB is healthier for them. The students plan what are the most important elements to include so that the activity succeeds in changing the younger pupils' behavior.
Monitoring	• There was a game that we were wondering about—**will this actually make them hydrate more**? There was a bottle craft activity about—**how will it make them hydrate more**? We eventually concluded that writing slogans would work best. (TM 2) • As we were designing a quartets game, we paused to consider—**will this actually help them drink less SSBs**? (GS 2) • **We stopped to think**: how can we show them that you have to hydrate more during effort and sports, and that if you do not drink a lot of water—you might dehydrate? (GS 2) • **It is hard to drink more water when you are not used to it**. Plus, hardly anyone examines the color of their urine. (EM 2) • It will be **hard to cut down on SSBs because they are tasty and because you can see them everywhere**. It will be hard to drink more water because they won't take the time to examine whether they did. (TS 2) • **The children will drink more water because they believe that if they don't—they'll have a headache**. But they might also forget to drink. (GA 2)	Students that received metacognitive guidance monitor their progress on numerous occasions throughout the process. They examine whether the activity they prepared will actually help younger pupils drink more water and less SSBs. They also consider which elements of the intended change might be more difficult for the pupils, and what the learning activity can include to respond to these difficulties and to better support the change.
Evaluating	• We must improve the activity we prepared by examining whether we indeed convey our purpose to the children. (AA 2) • Before every step, I would stop to think: does this activity serve the goal? (DM 2) • It is important to divide the assignments between us before diving into them. (HA 2)	While students refer to the learning activity itself, they do not refer to changes in their own behavior, past or present.

* The words in bold highlight the main theme. ** Students' code for research purposes.

5. Discussion

The present study examined how drinking-related metacognitive guidance given while studying the importance of water to human health and the principles of healthy drinking during primary school biology classes contributes to students' metacognitive awareness in the context of healthy drinking. The quantitative results show that metacognitive guidance that is explicitly aimed at thinking about healthy drinking significantly contributed to metacognitive awareness concerning healthy drinking in general. Out of all factors examined, planning showed the most significant improvement attributed to metacognitive guidance, as the components "planning about water" and "planning about SSBs" show. Monitoring also improved in both groups, while evaluation did not. We may conclude that the planning component has been significantly assimilated and that the students indeed apply goal-oriented planning. In relation to the less prominent contribution of monitoring and evaluation component to metacognitive awareness, we can suggest that primary-school students struggle to comprehend the meaning of monitoring and evaluation processes, and that the quantitative questionnaire should have included some introductory clarification of these concepts.

The qualitative results indicate the students' use of both planning, monitoring, and evaluation in the context of healthy drinking. The qualitative analysis indicates that the students indeed invested great metacognitive efforts into learning about healthier drinking while preparing activities for the younger pupils. Metacognitive guidance also probably helped the students prepare the learning activities for the younger pupils—a complicated task that required a considerable planning effort. A project requiring students to become facilitators and engage younger pupils appears to be a good platform for encouraging the facilitating students to think metacognitively—on an implicit level (script-writing), an explicit level (interviews), and an explicit level reinforced by guidance (metacognitive guidance).

The findings of the present study indicate a quantitative and qualitative improvement in drinking-related metacognitive awareness only among those students who received metacognitive guidance. Both quantitative and qualitative research tools examined metacognitive awareness among the older students preparing activities for the younger pupils. It would be interesting to follow up on the metacognitive awareness skills of these students sometime after the intervention discussed here and see whether they have implemented into their everyday lives the insights they gained during their participation in this project.

Perhaps the most important reason for developing metacognition is that it can improve the application of knowledge, skills, and character qualities in realms beyond the immediate context in which they were learned [32]. Metacognition can result in the transfer of competencies within and across disciplines—essential for students preparing for real-life situations where a clear-cut division of disciplines falls away [49]. Wellness and well-being are multidisciplinary spheres that require an individual to apply critical thinking and informed life management to maintain health and quality of life [7]. Indeed, metacognitive awareness skills in these contexts can prove very useful in building solid ground to fulfill one's potential to become a healthy person and a responsible participant in society. Metacognitive guidance enables students to transfer their knowledge to new situations and new problems in real life [41,50].

In the case of healthy drinking, applying metacognitive awareness in the sphere of media literacy seems critically important and requires future research [51]. Advertisements increasingly present a branding strategy that promotes a connection between the consumption of SSBs and a dynamic, youthful lifestyle. Pushing back against this trend, educators should place great importance on imparting thinking tools such as metacognitive awareness during the early years of elementary school [52].

The qualitative analysis of this paper was performed on data collected from a sample of students whose linguistic ability generated data that could be analyzed. Although the young age of the students is a limitation for research, the comparison between the two research groups shows a clear picture. Following the metacognitive awareness of

young elementary school students is challenging because the linguistic literacy of these students is also in the early stages of development. While it is essential to begin developing metacognitive awareness at an early age [52], it is also important to perform intervention activities similar to those outlined in this study in the framework of middle school biology studies. Within the middle school age cohort, external factors such as media literacy and social pressure can heavily influence drinking behavior, so it is especially significant to direct the thinking of students at these ages in favor of healthier drinking. The results of the present study point to the positive impact of incorporating content that addresses the health importance and the scientific importance of wiser drinking into the biology curricula. This study offers a teaching method that can potentially achieve both of these goals.

6. Conclusions

The present study suggests that drinking-related metacognitive awareness can be improved by metacognitive guidance that directs students to think critically about healthy drinking. As elaborated above, drinking-related metacognitive guidance has been shown to contribute to the way students express the principles and importance of healthy drinking when they discuss their metacognitive awareness thinking process. These results reinforce the need to emphasize and implement metacognition into schools' curricular learning processes in fields relevant to everyday life, such as nutrition and health. As nutrition and health concepts are often included in school biology curricula, the present study emphasizes the need to incorporate into existing curricula the regulation of cognition components of metacognition, thereby encouraging healthier behavior. Metacognitive guidance holds a significant pedagogical potential to improve sustainable healthy habits among children.

Author Contributions: Conceptualization, M.Z. and H.C.; methodology, M.Z. and H.C.; software, H.C.; validation, M.Z. and H.C.; formal analysis, M.Z. and H.C.; investigation, M.Z. and H.C.; resources, H.C.; data curation, H.C.; writing—original draft preparation, M.Z.; writing—review and editing, M.Z.; visualization, M.Z.; supervision, M.Z.; project administration, H.C.; funding acquisition, M.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: We would like to thank Ori Stav and Ze'ev Kaplan for their editorial assistance and Edna Guttmann for her statistical assistance. This research was part of the Ph.D. thesis of the second author.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Examples of Questions—Drinking-Related Metacognitive Guidance

Planning

- Consider the activity you planned—what were your goals?

Monitoring

- **Will the activity I prepared** help kids drink more water?
- Is the activity I prepare help kids drink fewer soft drinks?
- Describe a moment when you **stopped to consider** whether this activity will really make kids drink more water and/or fewer SSBs.
- **What** was the difficulty? **How** was it solved?

Evaluating the activity

- Explain why the kids who participated in the activity would **drink** more water.

- Explain why the kids who participated in the activity would drink fewer soft drinks.
- Explain why the kids who participated in the activity would not drink fewer soft drinks.
- If you had to prepare the activity all over again, what would you do differently?

Self-evaluation

- To what degree has preparation of the activity made you drink more water?
- To what degree has preparation of the activity made you drink fewer soft drinks?
- How has preparation of the activity for first and second graders affected **your behavior**? Elaborate.

Appendix B. Examples of Questions—in-Depth Interview

Planning

- How much did you understand what you need to do on your activity to help children drink more water and fewer SSBs?

Monitoring

- Give an example of a case where you paused to consider whether the activity will actually help children drink more water.
- Did you run into any **difficulties** in planning the activity to encourage drinking more water and fewer SSBs?

Evaluation

- In your opinion, how much will the activity you facilitated actually help children drink fewer SSBs? Explain what specific part of the activity will help them reduce the consumption of SSBs.
- In your opinion, how much will the activity you facilitated achieve its goal to increase water drinking and decrease SSB consumption?

References

1. Currie, C. *Inequalities in Young People's Health: HBSC International Report from the 2005/2006 Survey*; World Health Organization: Copenhagen, Denmark, 2008.
2. Hu, F.B. Resolved: There is sufficient scientific evidence that decreasing sugar-sweetened beverage consumption will reduce the prevalence of obesity and obesity-related diseases. *Obes. Rev.* **2013**, *14*, 606–619. [CrossRef] [PubMed]
3. Malik, V.S.; Popkin, B.M.; Bray, G.A.; Després, J.P.; Willett, W.C.; Hu, F.B. Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes a meta-analysis. *Diabetes Care* **2010**, *33*, 2477–2483. [CrossRef] [PubMed]
4. Zoellner, J.; Chen, Y.; Davy, B.M.; You, W.; Hedrick, V.E.; Corsi, T.; Estabrooks, P. Talking health, a pragmatic randomized-controlled health literacy trial targeting sugar-sweetened beverage consumption among adults: Rationale, design & methods. *Contemp. Clin. Trials* **2014**, *37*, 43–57. [PubMed]
5. World Health Organization (WHO). *Adolescent Obesity and Related Behaviours: Trends and Inequalities in the WHO European Region, 2002–2014*; WHO Regional Office for Europe: Copenhagen, Denmark, 2017.
6. Muckelbauer, R.; Libuda, L.; Clausen, K.; Toschke, A.M.; Reinehr, T.; Kersting, M. Promotion and provision of drinking water in schools for overweight prevention: Randomized, controlled cluster trial. *Pediatrics* **2009**, *123*, e661–e667. [CrossRef] [PubMed]
7. Schlüter, K.; Vamos, S.; Wacker, C.; Welter, V.D.E. A Conceptual Model Map on Health and Nutrition Behavior ($CMM^{HB/NB}$). *Int. J. Environ. Res. Public Health* **2020**, *17*, 7829. [CrossRef]
8. Harrison, J.K. Science education and health education: Locating the connections. *Stud. Sci. Educ.* **2005**, *41*, 51–90. [CrossRef]
9. Li, A.M.L. Ecological determinants of health: Food and environment on human. *Environ. Sci. Pollut. Res.* **2017**, *24*, 9002–9015. [CrossRef] [PubMed]
10. Borzekowski, D.L. Considering children and health literacy: A theoretical approach. *Pediatrics* **2009**, *124* (Suppl. S3), S282–S288. [CrossRef] [PubMed]
11. Nutbeam, D. Health literacy as a public health goal: A challenge for contemporary health education and communication strategies into the 21st century. *Health Promot. Int.* **2000**, *15*, 259–267. [CrossRef]
12. Hahn, R.A.; Truman, B.I. Education improves public health and promotes health equity. *Inter. J. Health Serv.* **2015**, *45*, 657–678. [CrossRef]

13. McDaid, D. *Investing in health literacy: What do we know about the co-benefits to the education sector of actions targeted at children and young people? (Policy Brief No. 19)*; European Observatory on Health Systems and Policies, WHO Regional Office for Europe: Copenhagen, Denmark, 2016.
14. Lissau, I.; Overpeck, M.D.; Ruan, W.J.; Due, P.; Holstein, B.E.; Hediger, M.L. Body mass index and overweight in adolescents in 13 European countries, Israel, and the United States. *Arch. Pediatrician Adolesc. Medien.* **2004**, *158*, 27–33. [CrossRef] [PubMed]
15. Silk, K.J.; Sherry, J.; Winn, B.; Keesecker, N.; Horodynski, M.A.; Sayir, A. Increasing nutrition literacy: Testing the effectiveness of print, web site, and game modalities. *J. Nutr. Educ. Behav.* **2008**, *40*, 3–10. [CrossRef] [PubMed]
16. Popkin, B.M.; D'Anci, K.E.; Rosenberg, I.H. Water, hydration, and health. *Nutr. Rev.* **2010**, *68*, 439–458. [CrossRef] [PubMed]
17. Bardosono, S.; Morin, C.; Guelinckx, I.; Pohan, R. Pregnant and breastfeeding women: Drinking for two? *Ann. Nutr. Metab.* **2017**, *70* (Suppl. S1), 13–17. [CrossRef]
18. Patel, A.I.; Hecht, C.E.; Cradock, A.; Edwards, M.A.; Lorrene, D. Drinking water in the United States: Implications of water safety, access, and consumption. *Ritchie Annu. Rev. Nutr.* **2020**, *40*, 345–373. [CrossRef]
19. Wu, J. Challenges for Safe and Healthy Drinking Water in China. *Curr. Environ. Health Rep.* **2020**, *7*, 292–302. [CrossRef]
20. Kaluski, D.N.; Mazengia, G.D.; Shimony, T.; Goldsmith, R.; Berry, E.M. Prevalence and determinants of physical activity and lifestyle in relation to obesity among schoolchildren in Israel. *Public Health Nutr.* **2008**, *12*, 774–782. [CrossRef]
21. Reisch, L.A.; Gwozdz, W.; Beckmann, S. Consumer behavior in childhood Obesity research and policy. In *Epidemiology of Obesity in Children and Adolescents*; Moreno, L., Pigeot, I., Ahrens, W., Eds.; Springer: New York, NY, USA, 2011; pp. 431–454.
22. McGuire, S. US Department of Agriculture and US Department of Health and Human Services, Dietary guidelines for Americans. *Adv. Nutr. Int. Rev. J.* **2011**, *2*, 293–294. [CrossRef]
23. Lakin, L.; Littledyke, M. Health promoting schools: Integrated practices to develop critical thinking and healthy lifestyles through farming, growing and healthy eating. *Int. J. Consum. Stud.* **2008**, *32*, 253–259. [CrossRef]
24. Lin, W.; Yang, H.C.; Hang, C.M.; Pan, W.H. Nutrition knowledge, attitude, and behavior of Taiwanese elementary school children. *Asian Pac. J. Clin. Nutr.* **2007**, *16* (Suppl. S2), 534–546.
25. Bhagat, K.; Howard, D.E.; Aldoory, L. The Relationship between health literacy and health conceptualizations: An exploratory study of elementary school-aged children. *Health Commun.* **2018**, *33*, 131–138. [CrossRef] [PubMed]
26. World Health Organization (WHO). Shanghai declaration on promoting health in the 2030 agenda for sustainable development. *Health Promot. Int.* **2017**, *32*, 7–8. [CrossRef] [PubMed]
27. Finkelstein, E.A.; Trogdon, J.G.; Cohen, J.W.; Dietz, W. Annual medical spending attributable to obesity: Payer-and service-specific estimates. *Health Aff.* **2009**, *28*, w822–w831. [CrossRef] [PubMed]
28. Olson, S.; Moats, S. *Nutrition Education in the K-12 Curriculum: The Role of National Standards—Workshop Summary*; National Academies Press: Washington, DC, USA, 2013.
29. Wilson, W. *Consilience: The Unity of Knowledge*; Vintage: New York, NY, USA, 1999.
30. Dean, C.; Lynch Ebert, C.M.; McGreevy Nichols, S.; Quinn, B.; Sabol, F.R.; Schmid, D.; Shauck, R.B.; Shuler, S.C. *21st Century Skills Map: Arts*; Partnership for 21st Century Skills: Tucson, AZ, USA, 2010.
31. Pellegrino, J.W.; Hilton, M.L. *Educating for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*; National Research Council; The National Academies Press: Washington, DC, USA, 2012.
32. Fadel, C.; Bialika, M.; Triling, B. *Four-Dimensional Education: The Competencies Learners. Needed to Succeed*; The Center for Curriculum Redesign: Boston, MA, USA, 2015.
33. Kralik, J.D.; Lee, J.; Rosenbloom, P.S.; Jackson, P.C.; Epstein, S.L.; Romero, O.J.; Sanz, R.; Larue, O.; Schmidtke, H.; Lee, S.W.; et al. Metacognition for a common model of cognition. *Procedia Comput. Sci.* **2018**, *145*, 730–739. [CrossRef]
34. Azevedo, R. Reflections on the field of metacognition: Issues, challenges, and opportunities. *Metacogn. Learn.* **2020**, *15*, 91–98. [CrossRef]
35. Flavell, J. Metacognitive aspects of problem solving. In *The Nature of Intelligence*; Resnick, L., Ed.; Erlbaum: Hillsdale, NJ, USA, 1976; pp. 231–236.
36. Schraw, G.; Crippen, K.J.; Hartley, K. Promoting self-regulation in science education: Metacognition as part of a broader perspective on learning. *Res. Sci. Educ.* **2006**, *36*, 111–139. [CrossRef]
37. Schraw, G.; Dennison, R.S. Assessing metacognitive awareness. *Contemp. Educ. Psychol.* **1994**, *19*, 460–475. [CrossRef]
38. Veenman, M.V.J.; Beishuizen, J.J. Intellectual and metacognitive skills of novices while studying texts under conditions of text difficulty and time constraint. *Learn. Instr.* **2004**, *14*, 621–640. [CrossRef]
39. Muijs, D.; Kyriakides, L.; van der Werf, G.; Creemers, B.; Timperley, H.; Earl, L. State of the art—Teacher effectiveness and professional learning, school effectiveness and school improvement. *Int. J. Res. Policy Pract.* **2014**, *25*, 231–256.
40. Perry, J.; Lundie, D.; Golder, G. Metacognition in schools: What does the literature suggest about the effectiveness of teaching metacognition in schools? *Educ. Rev.* **2019**, *71*, 483–500. [CrossRef]
41. Aurah, C.M.; Koloi-Keaikitse, S.; Isaacs, C.; Finch, H. The Role of Metacognition Everyday Problem Solving among Primary Students in Kenya. *Probl. Educ. 21st Century* **2011**, *30*, 9–21.
42. Medina, M.S.; Castleberry, A.N.; Persky, A.M. Strategies for improving learner metacognition in health professional education. *Am. J. Pharm. Educ.* **2017**, *81*, 78. [CrossRef]
43. Norman, E.; Pfuhl, G.; Sæle, R.G.; Svartdal, F.; Låg, T.; Dahl, T.I. Metacognition in psychology. *Rev. Gen. Psychol.* **2019**, *23*, 403–424. [CrossRef]

44. Quattropani, M.C.; Lenzo, V.; Faraone, C.; Pistorino, G.; Di Bella, I.; Mucciardi, M. The role of metacognition in eating behaviour: An exploratory study. *Mediterr. J. Clin. Psychol.* **2016**, *4*, 1–15.
45. Gezer-Templeton, P.G.; Mayhew, E.J.; Korte, D.S.; Schmidt, S.J. Use of exam wrappers to enhance students' metacognitive skills in a large introductory food science and human nutrition course. *J. Food Sci. Educ.* **2017**, *16*, 28–36. [CrossRef]
46. Pereira, B.; Rosário, P.; Silva, C.; Figueiredo, G.; Núñez, J.C.; Magalhães, P. The mediator and/or moderator role of complexity of knowledge about healthy eating and self-regulated behavior on the relation between family's income and children's obesity. *Int. J. Environ. Res. Public Health* **2019**, *16*, 4207. [CrossRef]
47. Cohen, H.; Zion, M. Water is the taste of life—The contribution of metacognitive guidance to drinking-related nutritional literacy. *Sci. Educ. Int.* **2020**, *31*, 84–91. [CrossRef]
48. Chun Tie, Y.; Birks, M.; Francis, K. Grounded theory research: A design framework for novice researchers. *Sage Open Med.* **2019**, *7*, 2050312118822927. [CrossRef]
49. Scharff, L.; Draeger, J.; Verpoorten, D.; Devlin, M.; Dvorakova, L.S.; Lodge, J.M.; Smith, S.V. Exploring metacognition as a support for learning transfer. *Teach. Learn. Inq.* **2017**, *5*. [CrossRef]
50. Batha, K.; Carroll, M. Metacognitive training aids decision making. *Aust. J. Psychol.* **2007**, *59*, 64–69. [CrossRef]
51. Higgins, J.W.; Begoray, D.L. Exploring the borderlands between media and health: Conceptualizing 'critical media health literacy'. *J. Media Lit. Educ.* **2013**, *4*, 136–148.
52. Chatzipanteli, A.; Grammatikopoulos, V.; Gregoriadis, A. Development and evaluation of metacognition in early childhood education. *Early Child Dev. Care* **2013**, *184*, 1223–1232. [CrossRef]