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Block and unplugged programming can be mutually beneficial: A study of learning activities in a 6th grade class in Norway

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In the new Norwegian national curricula, programming and interdisciplinary work have been introduced as two central elements. Furthermore, computational thinking is part of the core elements of the mathematics curriculum. In this paper, we present the findings from a small-scale study within the subjects of mathematics and food and health. The aim was to see if these two subjects could be used as an arena for working with parts of computational thinking, in this case algorithmic thinking and collaboration, and expanding the students' understanding of what programming can be. We think there is a gap in the research regarding this topic, and therefore we wanted to look into this. The students who took part in the study carried out two lessons, one in each subject. In mathematics, the focus was on block programming, while food and health can be seen as unplugged programming. Our findings are based on feedback from 36 students and observations from the lessons. The main finding is that most of the students could not see a link between programming and food and health. Only seven students expressed something that indicated that they did see a link. Thus, it seems like most of the students could not see similarities between the algorithmic thinking in block programming and recipes in food and health.

KEYWORDS

computational thinking, unplugged programming, block programming, mathematics, food and health

1. Introduction

In Norway, programming has entered as a central element in the Norwegian national curricula from 2020 (Sevik, 2016). In this article, we present a small study we have carried out together with pre-service teachers. The purpose was to investigate whether students in the 6th grade could recognize parts of computational thinking in two lessons involving block programming and unplugged programming in the subjects mathematics and food and health. Elements of computer science, including programming and computational thinking, have been included in the school curricula in an increasing number of countries in the later years (Nouri et al., 2020). To our knowledge there is done little research on the topic of using the subject food and health as an arena for programming. Therefore, we believe this research could not only be of interest to Norwegian schools, but also a wider audience.

Computational thinking is closely linked to programming and coding (Gjøvik and Torkildsen, 2019), and has been included as a part of the core elements of the mathematics curriculum (Ministry of Education and Research, 2019). Computational thinking can be seen as a thought process that involves creating solutions that can be executed by computers or humans (Bocconi et al., 2018), or involves problem-solving (Ardito et al., 2020). Algorithmic thinking is one of several key concepts within computational thinking (Bocconi et al., 2018), and collaboration is a key component (Ardito et al., 2020). Many of the concepts and approaches within computational thinking can be practiced through unplugged programming (Bell and Vahrenhold, 2018).

By giving different kinds of problems to students, programming can be used to practice collaboration and discussions/reasoning (Sevik, 2016). Furthermore, it is pointed out that students can use their creativity and imagination in the work from idea to action. Interaction, communication and exploring and creating have been highlighted as important competences to be emphasized in the school of the future with the intention of educating future professionals (NOU, 2015: 8). A central element in the new Norwegian core curriculum, that decides the values and principles for primary and secondary education, is interdisciplinary, and one of the goals is that students achieve understanding and see connections across subjects (Ministry of Education and Research, 2017). We wanted to try to combine mathematics and a practical-aesthetic subject, such as food and health, and see if this combination could give some benefits. Food and health was chosen because it is an arena where following instructions is often used, which requires algorithmic thinking. Thus, perhaps one can use block programming in mathematics and unplugged programming in food and health to work on students' algorithmic thinking and their understanding of what programming can be.

Therefore, our research question was:

> In what way can two lessons within the subjects of mathematics and food and health make possibilities in programming visible to the students?

2. Materials and methods

In this project we used two types of programming: block programming and unplugged programming. Block programming can be described as a visual representation of programming code, for instance graphic icons or blocks. These blocks can be put together to form a code or an algorithm (Humble et al., 2019). An algorithm is step-by-step instructions that describe how to do something. Humble et al. (2019) describes unplugged programming as programming without using a computer. Board games and controlling each other with commands or written instructions are some examples of unplugged programming.

Another example of unplugged programming is recipes in food and health. A recipe is an example of an algorithm (Berry, 2014), which tells you step by step what you should do to make the desired dish. As mentioned, algorithmic thinking is a part of computational thinking and it consists of following and explaining step-by-step instructions (Gjøvik and Torkildsen, 2019). Therefore, as recipes can be seen as an algorithm, we think it can be used to practice algorithmic thinking.

Ardito et al. (2020) also includes collaboration as a skill within computational thinking, which can also be an element when several people cook together. Wang et al. (2021) emphasize the importance of collaboration when learning computational thinking. These are some of the similarities that can be found between computational thinking and cooking, which made us think that working in food and health can provide an opportunity to increase students understanding of algorithmic thinking and programming and broaden their view of what programming can entail.

Furthermore, Eidslott (2021) argues that the motivation of students who initially have a greater interest in other subjects than science can be increased by combining learning objectives from several subjects and making programming something practical. Thus, perhaps food and health can be used as an introduction to programming for students who are initially not interested in it.

2.1. Study design

Action research can be seen as a small-scale intervention that combines action and reflection on what has been done (Cohen et al., 2018). Furthermore, in action research, the researcher can take an active role in the studied field (Tiller, 2006). In our project, we wanted the students to experience several aspects of programming. As programming is relatively new in the curriculum, we assumed that the students had a limited image of what programming is or could be. Thus, we wanted the students to make use of computational thinking in other areas than digital programming, in the form of unplugged programming. An action research process consists of planning, implementation and evaluation of a scheme, preferably in several rounds (Carr and Kemmis, 1986). In our project, we only carried out the lessons in one round. The reason for this is presented under descriptions of the lessons.

2.2. Participants

Two sixth grade school classes from a regular city school participated in the project. Both classes consisted of 22 students, therefore the total amount of students which participated were 44. Of these students, 36 gave feedback. A small sample size fits with action research. At the same time, it will not be possible for us to generalize the results from this project beyond the project's participants, but hopefully we can draw some inferences from it.

2.3. Lessons

The project consists of two lessons, one within food and health and one in mathematics, where the students participate in both. Both lessons were planned by pre-service teachers in collaboration with university lecturers and were carried out by the pre-service teachers.

To prevent the size of the student groups to be too large, we chose to carry out the project over 2 days where one class visited us at the university each day. Furthermore, each class was divided into two groups. One group started with mathematics, while the other one started with food and health. Halfway through the day the two groups switched places. As this was on consecutive days, we were not able to evaluate and plan and make any major changes from 1 day to the next, which is one of the main ideas of action research. In addition, we did not make any changes on the overall structure of the implementation of the lessons because we wanted the students to have the same experiences so that they had a common starting point for any conversations that took place at a later stage. Furthermore, as all the students did more or less the same, we got a larger number of responses that can give us an indication on the study rather than doing two separate run-troughs and getting half the responses on each.

Below follows a description of the two lessons.

2.3.1. Mathematics

A competence aim after year five in mathematics is student "is expected to be able to create and programme algorithms with the use of variables, conditions and loops" (Ministry of Education and Research, 2019, p. 9). Before the study the students have followed the curriculum for a year and should be familiar with this competence aim and it was plausible that they needed some of the same competence in this lesson. We chose to use block programming, including micro:bit and Bit:Bot, as the students already had some familiarity with this. The students were divided into groups of two or three students in each group, where each group had a micro:bit and Bit:Bot. The groups were given two to three tasks to solve, depending on how quickly they solved the first two tasks. The first task was to get the Bit:Bot to drive one meter forward, turn around 180°and drive back to start. This task gives the students information about how the Bit:Bot moves. For example, how many milliseconds it takes to drive one meter or turn around at the selected percentage of maximum speed. The students could use this information in the next task, which consisted of making the Bit:Bot to drive around a track. The track contained five straight stretches with two 90° turns and two 45° turns. The groups that finished driving the track, could try to make a traffic light. The traffic light consisted of a red, a yellow and a green LED. The traffic light had to be programmed to change to a new colour every 2 s. The tasks were taken from: https://www.vitensenter.no/superbit/elev/superbit-ogsätning/.

2.3.2. Food and health

The students were divided into four groups of three or four students and in the first session the students were organized into groups with the same recipe, while in the second session each group had four different recipes. For the first group, the recipes consisted of counting, brushing, washing and boiling potatoes, preparing trout and butter sauce, making raw carrot salad with dressing and dessert Greek yogurt with strawberries and toasted oatmeal. The other group had to make fish gratin from scratch, with raw carrot salad and potatoes. For dessert the students made fruit salad. In addition, the groups had pre- and post-work in connection the making of the food, such as preparation and cleaning afterward. The unplugged programming consisted of understanding and following the given recipes and working together in groups. Throughout the process, pre-service teachers were available to give guidance to the students on "decoding" the recipes.

2.4. Data collection

To answer the research question, we collected data through observation and a questionnaire. A questionnaire consists of written questions requiring written responses (Kemmis et al., 2014).

The day after the students had participated in the lessons, they answered the questionnaire together with their teacher at their own school. It was voluntary for the students to answer the questionnaire and it was anonymous. We had no way of finding out which students had answered what because it was anonymous and we were not present when they answered the questionnaire. The questionnaire consisted of three open ended questions that they had to answer. Open-ended questions is useful for research on a smaller scale (Cohen et al., 2018). The questions we asked were:

- Describe the programming you did at UiT.
- Describe how you experienced programming in mathematics.
- Describe how you experienced the programming in food and health.

With the first question, we wanted to get the students' overall picture of the day (both lessons). Next, we wanted the students to describe the programming within the two lessons. Open-ended questions could provide answers which might not otherwise have been possible in a questionnaire, and allow the respondents to answer in their own words (Cohen et al., 2018). Therefore, we chose to have open-ended questions where the students had to describe what they did because we wanted to get their own thoughts. At the same time, we did not know what the students would answer. If we had closed questions, possibly with answer categories, we could perhaps get answers to exactly what we wanted. On the other hand, we did not want to steer the students toward any answers. We chose to use the term programming which the students have heard about before, and we did not know whether the students were familiar with what computational thinking was or some of the concepts or components of computational thinking.

As the pre-service teachers had the main responsibility for the implementation of the lessons, we made our observations as non-participants. As there was only one student teacher at the mathematics lesson, the one of us who were there occasionally had to help some groups of students to progress in their work. We chose to make use of unstructured observation, as we wanted to have the opportunity to write down interesting events we captured. During the lessons we observed and subsequently wrote what we observed after the lessons.

2.5. Data analysis

In the planning phase, we had expectations that the pupils would most likely not see the connection between block and analog programming on the basis that LK20 had only been in use for two and these were pupils in the 6th grade. Before the analysis process started, all the student answers were imported into an excel-document, and each question was placed on a separate sheet in this document. This allowed us to analyse one question at a time, while at the same time we had an overview of what each student had answered on every question. The analysis process of qualitative data is often inductive (Cohen et al., 2018). Thus, we started the analysis without predefined categories.

We used thematic analysis following the phases of Braun and Clarke (2006). To familiarize ourselves with the data we read through the answers from the students several times and noting down ideas, patterns and interesting answers. In the second phase we identified initial codes in the responses. Third, we gathered similar codes into larger categories. For questions two and three, answers could often contain more than one code and could fit in more than one category. Fourth we reviewed the categories that had emerged to see if anything had been left out or if it was natural to combine some of them. To get a better overview of the data, all categories that we experienced as consistent was noted in the excel-document which made it possible for us to count and categorize the qualitative answers. Fifth, we settled on names for the categories.

After we had finished the thematic analysis of the questionnaire we discussed the categories against our observations. Through the observation, we had more control over what we saw, but we did not have that in the students' feedback and in that way we experienced that they gave information about each other. This repeated and multi-sided systematization can have an impact on reliability. The results of the analysis were in line with our expectations.

3. Results

In this section, we will present the parts of the data material that can shed light on the problem. In other words, not everything the students have answered will be presented here. Because the students answered the questions in Norwegian, the responses presented here is our translation from Norwegian to English of what the students have answered.

3.1. Students did not recognize programming in food and health

It seems that there is a clear difference to what extent the students think programming was involved in the two lessons. After the completion of these two lessons, it may appear that the students did not link programming to the lesson that was carried out in food and health. On question one where the students were asked to describe the programming, they did on the day they were at the university campus, food and health were only mentioned in four out of 36 answers. In contrast, 34 out of 36 of the answers can be directly linked to the lesson that was carried out in mathematics. In these answers, students wrote that they programmed a Bit:Bot, a car or a robot.

Below are the four answers that mentioned the lesson in food and health.

- *"I programmed and cooked. In the programming we programmed Bit:Bots to follow a line and drive one meter forward, turn and go back one meter."*
- *"We programmed a robot to drive one meter back and forth, we also made it drive on a track and we also made a mini traffic light. We also made fish gratin and fruit salad in food and health."*
- *"It was fun, but a bit challenging sometimes, for example with the traffic lights. But everything was a lot of fun, both food and programming."*
- *"First, I had food and health in the kitchen, and after that I had programming. We programmed the car to go one meter back and forth."*

If you look at these responses, the lesson in food and health are not linked to programming. The students just answered that they cooked or made food. From these four responses it seems like the students think they programmed in one lesson and made food in the other. Furthermore, food and health were never mentioned alone in these answers, but programming in mathematics was also mentioned.

3.2. Some programming in food and health nonetheless

It seems like seven of the students were, nonetheless, able to see the connection between programming and the recipe they used in food and health on the question "Describe how you experienced the programming in food and health." In two of these answers, the students clearly state a connection between the two lessons that were carried out. If seven students could see a connection, this means that 29 students gave answers that did not give any indication that they saw a connection between programming and the lesson in food and health.

In **Table 1**, there is an overview of all the categories on this question where we believe that we can see answers that can be related to programming in one way or another. It is worth adding that none of the students who mentioned food and health in the first question answered anything that could be linked to programming to this question.

The most obvious link to programming can be found in the category *Description of roles*. In the answers in this category, the students have linked the lesson in mathematics together with the lesson in food and health by seeing the similarity between themselves in the kitchen and the car/Bit:Bot. Below are the two answers that ended up in this category.

- *"I'm kind of the micro:bit and the recipe is the MAKER."*
- *"The recipe was what we had to follow and it's a bit like the car as well because in a way it gets a recipe."*

As you can see from the first response above, the student draws a direct link between itself in food and health and the micro:bit (which is in the Bit:Bot), and the recipe and the person who programs the Bit:Bot. We can see the same in the second response, where the student wrote that in the same way that student followed the recipe in food and health, the Bit:Bot also follows a recipe that determines what it will do.

The category *Recipe* contains the answers that, in one way or another, mentions recipe or part of a recipe. In five of the six answers in this category, it seems like the students have realized

TABLE 1 Categories that can be connected to programming on the question: "Describe how you experienced the programming in food and health".

Category	Number of responses
Recipe	6
Description of roles	2
Mentions the word programming	3

that it is the recipe in food and health that can be the link to programming. Below are all the answers in this category.

- *"I think that it is that we are reading a recipe."*
- *"The recipe."*
- "*The recipe! It was actually easy since we didn't use the recipe, since we were told what to do.*"
- "*I experienced programming in the recipe.*"
- *"I followed a line of code most of the time. I let the potatoes cook for 40 and occasionally look at them."*
- *"I don't know, I just did what was written on the recipe."*

It varies how certain the students seem to be about whether the recipe can be programming or not. For example, the first answer shows that the student is somewhat unsure about this, while others seem more certain. In the fifth answer, the word recipe is not mentioned like the other answers. Here it can seem like the student connects lines of code to the description of how to cook the potatoes. As mentioned earlier, a recipe is step-by-step instructions, and this can be compared to lines of code in an algorithm. This can thus be interpreted as the student linking the recipe in food and health to lines of code and algorithms in programming. Although the recipe is mentioned in the sixth answer, the student expressed that they did not know and just followed the recipe. Thus, it can be interpreted that this student does not see the programming in the recipe.

All answers where the word programming has been mentioned has ended up in the category *Mentions the word programming*. In these responses, the students answered that the programming in food and health was fun or good. Thus, it is not easy to say whether they have seen what the programming can be in food and health. It is worth mentioning that in addition to the categories shown in Table 1, there were also six students who answered: "I don't know" or "I do not understand the question."

3.3. Other interesting categories

Table 2 shows two of the categories that cannot be directly linked to programming, but which nevertheless can be interesting. These categories are *Fun* and *Collaboration*. In the fun category, 25 out of 36 students answered that they thought the mathematics lesson was fun. Correspondingly, 16 of the students wrote that the lesson in food and health was fun.

A total of seven of the responses about the experience of programming in food and health have ended up in the collaboration category, six of these refer to a functioning collaboration and one case where the collaboration has not worked. These answers describes whether the group members worked well as a team and whether everyone did their part of the work. On the question of the experience of programming in mathematics, two answers can be categorized as the collaboration worked well and three where the collaboration has not worked. Here, too, the answers focus on whether each group member had done their part of the job or not.

TABLE 2 Number of responses in two categories that cannot be directly linked to programming to the questions that asked how students experienced the programming in mathematics and food and health.

Question	Fun	Collaboration	
		Good	Bad
Describe how you experienced programming in mathematics	25	2	3
Describe how you experienced the programming in food and health	16	6	1

3.4. Observations

Here we will present some of the things which we observed that can be related to our research question.

In food and health, we saw that the pre-service teachers were active tutors in reading and following the recipes. In the event of a lack of description or ambiguities in the recipe, the pre-service teachers supported the students in their process. An example of this is in the procedure for white sauce, one instruction is: "Melt butter in a large saucepan." The student opened the kitchen cupboard and wondered which pot was big enough and took out the largest pot, whereupon a pre-service teachers guided the student to take a smaller one and which the pre-service teacher considered suitable for the amount of sauce that was going to be made. In food and health, it was also observed that the pre-service teachers did not tell the students they were doing unplugged programming.

The observations of very happy students who worked as if they were highly motivated were very prominent both in mathematics and in food and health. It felt as if the students found the assignments meaningful. Despite much joy, two individual students were observed in food and health who did not participate in the work and one student who finished early with his part of the work and did not help the rest of the group. In mathematics, certain groups or group members were also observed who occasionally opted out and did not participate in the lesson. In one of the cases, it seemed like the group just needed some guidance on how to think in order to figure out how to get the Bit:Bot to follow the track and how to work together.

In mathematics, it was observed that the majority of the groups largely used trial and error as a way of working to solve the tasks. The students made some changes to their code and then tested the Bit:Bot on the track.

4. Discussion

The purpose of this study was to investigate whether two lessons in the subjects mathematics and food and health could highlight possibilities in programming for the students. In particular, whether the students recognized the programming in both subjects.

4.1. Transfer of learning

Our main finding was that none of the students answers to the first question could be linked directly to programming in food and health. This is further supported by the fact that the majority could not clarify what the programming was in question three either, and six students answered that they did not know or understand this question. This may indicate that the majority of the students did not see the connection between programming and food and health.

Zhuang et al. (2020) defines transfer of learning as the result of generalization of experiences. If a person generalizes his experiences, it is possible that he can transfer knowledge from one situation to another. An advantage of transfer of learning between two areas is that it can strengthen learning in the new area you are studying. A prerequisite for transfer of learning is that there must be a link between the two learning activities (Zhuang et al., 2020). The fact that most of the students were unable to see the connection between the lessons may indicate that they were unable to generalize their experiences. One can speculate whether it could be because the students may think of programming as a separate area and not linked to other subjects, and thus they did not see the link between block programming and unplugged programming in food and health. In addition, maybe the students did not consider reading recipes in food and health to be the same as reading algorithms in programming. In food and health, the pre-service teachers filled in gaps in the recipe so that the students succeeded in the process, or as one student wrote that they did not need the recipe as they were told what to do. In contrast, a Bit:Bot will follow the algorithm and steps exactly as the students have set it up, and if something is wrong or missing, compared to the students' intention, the Bit:Bot will not do what the students want.

In contrast, 34 out of 36 answers could be connected to the lesson that was carried out in mathematics. Thus, it can appear that students largely associate programming with block programming, and not unplugged programming. In light of the intention of the school of the future to facilitate students to develop problem-solving skills and critical assessment skills (NOU, 2015: 8), it may appear that students did not automatically express competence in computational thinking. However, we cannot rule out that students are aware of how they think (Ways of Thinking) and work (Ways of Working), which tools they use (Tools for Working) in relation to the world they live in (Living in the World) (Binkley et al., 2012) in this case in mathematics or food and health.

One of the reasons why the majority of students may not connect programming and lesson in food and health may be that the term *unplugged programming* was not used in food and health, at least not that we could observe. We chose not to use the term unplugged programming to avoid influencing the results and we wanted to see if the students themselves would make the connection, this in line with the criticism of action research that the researcher can influence the action. If the term was more actively used, it is conceivable that the result could change, but at the same time we would not have given the students opportunity to discover the connection themselves.

When the students were asked directly about programming in food and health, there were seven who expressed in writing what programming could be. Here, connections were made between algorithm and recipe, and some students saw the similarity between themselves and Bit:Bot. Thus, it may appear that some students nevertheless managed to generalize their experiences so that they saw the connections that we hoped to find in the project, and maybe would be able to transfer some of their knowledge from one situation to the other. The fact that there are only seven students who saw the connection does not necessarily mean that the other students cannot make use of the knowledge they acquired in both block and unplugged programming.

4.2. Programming as an approach to learning

A prominent research result was that 25 out of 36 students experienced programming in mathematics as fun. Our interpretation of fun can show that this arrangement in programming made the students more active participants. According to Jordet (2020), school today is still characterized by students sitting on their chairs doing theoretical work. A more practical school is in line with Dewey's (1915) "Learning by doing," and the importance of stimulating the senses and use the body while learning. In our project the students did not sit still but were in motion. In the kitchen, they used their bodies and senses to prepare the food, while they had to walk between the table they were working on and the track the Bit:Bot was driving on. This can be linked to the intention in "embodied cognition" where the body is in interaction with the brain and the world around (Shapiro, 2019) and to bodily learning which in the OECD report is highlighted as important in pedagogy (Paniagua and Istance, 2018). Embodied cognition can take place in both the digital and the analog space (Østern and Knudsen, 2021) and can be summarized through Vygotskij et al. (1978) socio-cultural perspective where all intellectual development is based on social activity. Based on this, programming can be a learning arena, where the students work together with other students and the pre-service teachers where knowledge is exchanged and contributes to the tasks being solved. Vygotskij et al. (1978) calls it the zone of proximal development where a student can solve problems under guidance or in collaborations with more capable peers. The pedagogical challenge lies in making use of the zone by providing help and support, so that next time the students can manage to do the task on their own.

In both lessons, we hoped to challenge the students to try both unplugged and digital tasks that they had not done before. We tried to arrange for the students to experience two sides of programming and which could hopefully clarify programming and algorithmic thinking. The students explored together with the guidance and encouragement of fellow students and pre-service teachers. We experienced that this created a positive feeling of mastery among most of the students, which may be due to the fact that it was an informal learning situation where students and pre-service teachers developed good relationships with each other. Bruner et al. (1997) emphasizes that human learning is an interactive process where people learn from each other. Jordet (2020) summarizes that "Recognition is, in other words, the most central psychosocial prerequisite for children's academic and social learning at school, for the development of good self-esteem and for good mental health," and highlights three forms of mutual recognition; love, justice and social values where the sum is included in and helps to shape the self-worth or identity of a person. Through the programming lessons where everyone was active in one way or another, an opportunity was created for the pre-service teachers to meet the students with friendly eyes, interest and support and in that way could help to form the student's self-esteem. The students could contribute through their rights and duties and in that way strengthen their self-respect (Jordet, 2020). However, it was observed that some students did not make use of their rights or that the task was too small in relation to the student's capacity to perform his duty. The reason for this may be poor planning of work tasks or supervision of the pre-service teachers. This could prevent the students from showing their skills and competence in a social community and thus may not get recognition (Jordet, 2020). The social interaction may be related to that.

Eidslott (2021) writes that programming is more than just writing codes. He thinks that it is more about that the students, through their creativity and ability to collaborate, can be able to solve problems by getting an overview of the problem and are able to divide it up to smaller problems or tasks, and arrive at a solution through trial and error. Shute et al. (2017) also highlight that collaboration and problem-solving skills such as trial and error as elements of computational thinking. In conjunction with Eidslott's (2021) point that students can use their ability to cooperate to solve challenges, there were six students who described a functioning collaboration in food and health and only one who experienced a malfunctioning collaboration. In mathematics, only two mentioned that the collaboration was good, while there were three who chose to point out that it was bad. As the answers largely focused on the distribution of work in the groups, it may be that the students fulfilled their duty in the collaboration to varying degrees. Of course, we cannot rule out that, in the groups that did not work, there may be other reasons why the collaboration did not work, such as a lack of skills.

In the lesson in mathematics, the most used method of working was trial and error. The students constantly made small adjustments to their code, followed by testing if the Bit:Bot did as they wanted. In contrast, trial and error can result in an undesirable result in food and health. It is always possible to use trial and error in food and health too, but it is not sustainable to throw away ingredients or food due to experimentation in terms of the UN's Sustainable Development Goals (United Nations, 2021), especially goal number 12 about ensuring sustainable consumption and production patterns.

4.3. The connection between unplugged and block programming

There were 34 students that related programming to the lesson in mathematics and only a few to the lesson in food and health. There can be many reasons for this. Firstly, maybe the students did not know how to answer. secondly, it may be due to the students' prior knowledge, they could possibly have encountered digital programming both inside and outside of school. It is not necessarily that they relate programming to mathematics either, but as an independent activity. Based on our understanding that the students acquired different skills through programming, it seems like they did not see the connection between block and unplugged programming. Dewey (1938) and Vygotskij et al. (1978) are known for their philosophy that learning takes place through words. Dewey (1938) sees it in the context of doing, experiencing and reflecting. The students' exploration takes place based on what they already know. They have previously had a visit from *The Science Centre of Northern Norway* which focused on programming, and perhaps some of the students have done some programming in their spare time. They could share experiences with and understanding of programming with the others in the group. This is in line with the intention of the school of the future to educate workers for the future, and that students should acquire competence in learning, communicating, interacting and participating in addition to exploring and creating (NOU, 2015: 8).

One of the goals in the national core curriculum is to find a solution to issues by using approaches from various subjects through interdisciplinary work (Ministry of Education and Research, 2017). Initially, our intention was to create an interdisciplinary collaboration between mathematics and food and health, in order to fulfill this part of the core curriculum where interdisciplinary is emphasized. On the other hand, this project probably cannot be called interdisciplinary, as the two lessons are carried out in parallel and are not closely connected. We planned to have a common theme of programming, but the lessons could have been carried out individually since they do not build on each other. On the other hand, the project may perhaps fall under the concept of multidisciplinary as it's called by Drake and Reid (2020). In both lessons, students work with programming and computational thinking, where mathematics and food and health illuminate this from their respective viewpoints, and the subjects are coordinated, but are carried out separately.

5. Conclusion

In our project, we carried out two lessons with unplugged and block programming in the subjects of mathematics and food and health, where we looked at whether these can contribute to developing computational thinking in students in the 6th grade and whether the students could see the connection between the lessons. As we have a limited sample, we cannot say anything that applies in general, but for the students we have, we can summarize that it may appear that most of the students did not see the link between programming and the lesson in food and health/unplugged programming. But we cannot know for sure whether the students can use computational thinking in areas other than digital programming. The same applies to other possibilities in programming. The students may have acquired skills in, for example, collaboration, communication and problem solving.

6. Implications

This is a small study, almost a pilot, we think the article is relevant for a larger audience because, based on our knowledge, there has not been much research into programming where there is a combination of practical-aesthetic subjects, such as food and health, and mathematics. There are a few reasons why we think this study may be relevant to others. This article may help to make accessible and clarify what programming can be, and perhaps motivate others to work with programming in several arenas and angles. One of the approaches could be to work with in-depth learning through multidisciplinary and different activities. This is an example of a multidisciplinary scheme that can perhaps be developed into an interdisciplinary one. It can show how to strengthen the natural bond between food and health as a practical aesthetic subject and mathematics as a science subject. Perhaps an opportunity can be created for practical aesthetic subjects and science subjects to develop familiarity, understanding and respect for the special nature of the subjects–content and working methods.

If we look a little ahead, we have made a couple of thoughts about what we think might be interesting for us to work on later. One possibility is to further develop our lessons so that it becomes more interdisciplinary, or at least so that the lessons in the two subjects are more closely linked. Hopefully, it can make the programming in food and health more apparent to the students. One way to do this could be for students to a greater extent "code" more themselves in food and health. It could, for example, be that they do some research in order to make their own recipes with precise instructions, such as in an algorithm.

Another possibility is to do something similar again in a few years. As the new mathematics curriculum was introduced in the autumn of 2020 and the students have had a lot of home schooling during the corona pandemic, the students in this study have had limited programming lessons. In a few years, students will have had more programming in the mathematics education and perhaps in several subjects. Thus, it can be interesting to compare the results to, among other things, see if there are changes in the students' approach to programming.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements.

Author contributions

Both authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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