Decision-making processes of children in the context of sustainable diets

Part 1: The role of knowledge in decision-making processes

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Abstract

The qualitative research project EKoN-E (*Entscheidungsprozesse von Kindern im Kontext einer Nachhaltigen Entwicklung mit dem Fokus Ernährung* [Decision-making processes of children in the context of sustainable development with a focus on diet]) aims to investigate how school pupils (age 11–12 years) carry out decision-making processes and the role that their knowledge and values play in this. Part 1 of the article focuses on the role of knowledge. Using a learning sequence, school pupils (N = 97) were prepared to make decisions through the development of knowledge, among other measures. Afterwards, the course of their decision-making processes was recorded through individual interviews (n = 27) using the thinking aloud method. Qualitative analysis of the content was then performed using Mayring's method. The results show that the level of knowledge generally does not determine how the decision-making process plays out. However, "expert knowledge" about certain individual aspects of sustainable development appears to be a prerequisite for children using knowledge of the relevant aspects in their decision-making processes. Therefore, it follows that lessons should support both the development of knowledge and the incorporation of knowledge into decision-making processes in a targeted manner.

Keywords: sustainable diet, decision-making skills, knowledge, children and adolescents, sustainable development, nutrition education

Introduction

As part of the Global Action Program on Education for Sustainable Development, the United Nations has made the strategic decision to continue the program established by the UN decade of "Education for Sustainable Development (ESD)" [1]. In addition, ESD is given special consideration in the fourth of the United Nations' 17 Sustainable Development Goals (Goal 4, Section 7) and, according to the German Standing Conference of the Ministers of Education and Cultural Affairs *(Kultusministerkonferenz)*, it should be promoted as a matter of priority in schools [2]. The development of decision-making skills – which is to say the skills to reflect on and make responsible decisions that are conducive to sustainable development (SD) – among learners is the clear aim of ESD in the relevant educational policy concepts, curricular concepts, and pedagogical and didactic concepts [3–5].

As has been addressed in the key German-language didactic concept "REVIS" (*Reform der Ernährungs- und Verbraucherbildung in Schulen* [Reform of Nutrition Education and Consumer Education in Schools], 2003–2005), consumers can contribute to the societal process of SD as a whole through considered consumption behavior in the field of nutrition. This can also effectively support their own health [6–8].

But how can the needed decision-making skills be acquired in school lessons and what are the prerequisites for the pupils that play a role in acquiring these skills? The EKoN-E research project deals mainly with the question of what the prerequisites are and focuses on learners' prior knowledge and values. This first part of the article focuses on the role of knowledge.

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Phase	Process steps (PS)
pre-selectional	1. Identification of a decision-making situation 2. Processing and linking up the relevant factual information a. With regard to the aspects of SD: - Incorporating the perspectives of various stakeholders - Taking account of wider global and local contexts - Taking account of time-related aspects b. With regard to aspects that are not directly related to SD, such as aspects to do with situational, personal, or family conditions, or the social milieu. 3. Recognizing and generating further possible alternatives for action 4. Identifying and/or generating relevant decision-making criteria
selectional	5. Becoming aware of one's self as a stakeholder with one's own opportunities and limits (in particular: values, knowledge, emotions, experiences, needs and interests, as well as areas of control) and modifying the decision criteria if appropriate 6. Comparing different alternatives for action while taking account of the consequences of each alternative based on specific criteria 7. Considering, weighing up and ruling out alternatives for action using decision-making strategies 8. Selection of one or more alternatives for action 9. Final selection (decision), combined with an intention to act in accordance with that decision (volition)
post-selectional	10. Formulation of an intention for action or implementation of a selected alternative 11. Implementation of the decision

Transition to the selectional phase

Transition to the post-selectional phase

Fig. 1: **Ideal model for a decision-making process in the EKoN-E study, based on the model by Eggert and Bögeholz** [9]
EKoN-E = the research project *"Entscheidungsprozesse von Kindern im Kontext einer Nachhaltigen Entwicklung mit dem Fokus Ernährung"* (Decision-making processes of children in the context of sustainable development with a focus on diet); SD = sustainable development

Current state of research and research questions

In the EKoN-E study, a model was first developed based on various theoretical models from empirical research – mainly from the natural sciences – for the development of decision-making skills among school pupils in the context of ESD [9]. This model represents an ideal decision-making process (◆ Figure 1) and also refers to the areas of nutrition and health. In the theoretical models for a "sustainable diet", in addition to the three known aspects of sustainable development (ecology, economics and society), the aspects of health [10] or health and food culture [11] also come into play. In addition, taste and enjoyment are also of crucial importance when it comes to decisions in the area of diet [12, 13]. To allow for this, the process model used in the EKoN-E study makes it possible to take account of these aspects adequately by increasing the focus on personal aspects or emotions that could influence a decision (◆ Figure 1).
Since decisions to do with diet are particularly likely to be made through "fast thinking" [14] and are therefore often made in a routine and "intuitive" manner [15], the adapted process model used in the EKoN-E project aims to allow the participants to gain access to their "fast" or "intuitive" decisions through the process of conscious reflection and thus use "slow thinking" or "deliberate processing modes" to allow a process of consideration to take place.

The targeted development of decision-making skills in the context of sustainable development and diet (which is to be the aim of future lessons) requires that the pupils learn how to use "slow thinking" [14]. The multi-faceted nature of sustainable development and sustainable diets means that because of the many different aspects that come into play, there are many possible alternatives for action, some of which conflict with each other. Recognizing these alternatives, thinking through their consequences (process step [PS] 6, ◆ Figure 1) and in particular using "slow thinking" to carry out a process of careful consideration (PS 7) is especially important for the development of decision-making skills [16, 17]. However, empirical studies in the context of ESD have shown that it is precisely these steps in the decision-making process that learners find hard to grasp [16, 18].

With a view to developing decision-making skills in the context of sustainable development in classes, researchers have also investigated the extent to which knowledge previ-

	Main study: February–December 2017					
Pilot (October 2016)	**Sample 1**	**Preparation**	**Data collection 1**	**Sample 2**	**Data collection 2**	**Evaluation**
	N = 97 (5 classes) **Composition by location:** - town - urban agglomeration - rural	N = 97 **Methods:** learning sequence (10 hours of lessons) topic: sustainable diet with a focus on meat consumption	N = 83 **Methods:** - test of knowledge - questionnaire about values (PVQ) and SES	n = 27 **Composition according to criteria:** - location - level of knowledge - value type - sex - SES	n = 27 **Methods:** interviews/thinking aloud: - unstructured thinking aloud - retrospection	**Methods:** - transcription - coding - interpretation

Fig. 2: **Research process used in the EKoN-E study**
EKoN-E = the research project *"Entscheidungsprozesse von Kindern im Kontext einer Nachhaltigen Entwicklung mit dem Fokus Ernährung"* (Decision-making processes of children in the context of sustainable diets); PVQ = Portrait Values Questionnaire [24]; SES = socioeconomic status

ously gained is brought to bear in the decision-making process [17, 19, 20]. Four studies on this are summarized below:

The study by Sakschewski and colleagues [17] appears to show that previously gained knowledge plays an important role in decision-making processes among school pupils, but no systematic data collection was carried out with regard to the prior knowledge that the pupils had in this quantitative study (N = 850; year 6–12 of Gymnasium (secondary school allowing access to higher education).

Ratcliffe [21] made audio recordings of the decision-making processes of 14-year-olds in small groups during science lessons. In this case, the groups were guided through the individual steps of making a decision through detailed tasks. Although the learners were able to collect comprehensive knowledge relevant to the decision questions prior to making a decision, only a few of the groups actually incorporated this knowledge into their decision-making processes. However, no data was collected on knowledge gained prior to this. Nevertheless, all groups were able to come up with alternatives for action, but it should be noted that they were directly instructed to do this as part of the group work tasks.

In the qualitative study by Gausmann et al. (N = 8) [19], the learners were given two informational texts about ecological issues and were asked to use these to help them make fictional decisions. In this case, it was found that learners (school years 6–12) had difficulty with taking the information about the various aspects of sustainable development into account adequately during their decision-making process and with processing the conflicts between the various aspects.

In the study by Wettstädt and Asbrand [22], a video recording was made of the "normal" class on the topic of "global development" in various subjects (school years 10–12), and group discussions were also held. The researchers found that the information that was worked on in lessons increased the level at which the adolescents reflected on the possible alternatives for action [22].

The studies summarized here employed different methodologies and their findings contradict each other. In the cases where the studies indicate that previously gained knowledge plays a role in decision-making processes during lessons (as in the first and last study mentioned above), it remains unclear how complex the learners' previously gained knowledge actually was. Where knowledge was built up systematically, as was the case in the study of Gausmann et al., there are indications of the use of knowledge in decision-making processes and of the difficulties that learners have with this.

The EKoN-E research project makes reference to these findings and takes "one step back" by first investigating how children carry out individual decision-making processes *without any additional support in lessons*, provided that they have the necessary knowledge and have also completed the other steps of the pre-selectional phase (◆ Figure 1). The empirical data collection in this project concentrates on the key selective phase of the decision-making process, which according to the process model is when the key steps of "slow thinking" should in theory take place among the interviewees.

The topic of meat is at the core of the study. The overarching research question is:

How do 11- and 12-year-old school pupils carry out the selectional phase of an individual decision-making process in the context of sustainable development with a focus on diet?

Other subordinate questions that will be investigated include: *What is the role of knowledge in terms of how the selectional phase plays out? What is the role of the pupils' values in terms of how the selectional phase plays out?*

In addition, the aspects of sex, socioeconomic status (SES) and background were taken into account in the composition of sample 2 (◆ Figure 2). These aspects could influence the pupils' dietary behavior [23] and must be taken

Economics	Ecology

• prices and costs
• supply and demand
• income situation
• financial means of individuals and societies
	• the natural resources that humans rely on to live
	  • land suitable for cultivation
	  • biodiversity
	  • clean water
	  • environmental pressures
	• animal husbandry
	  • forms of animal husbandry
	  • transport times
	  • suckler cow husbandry/calf rearing

Socio-cultural aspects	**Health**

• political, cultural, social, and ethical perspectives
  • nutrition security
  • fair distribution and use of food
  • fair distribution and use of water
  • cultural influences on style of eating
  • country of origin
  • religion
  • family
	• how meat consumption affects health
	  • components of meat
	  • the effects of different nutrients
	  • red and white meat
	  • the advantages and disadvantages of meat consumption

Fig. 3: **Topics of the learning sequence and their associated thematic aspects**

into account when evaluating the results. Part 1 of this article focuses on the role of knowledge in decision-making processes.

Methodology

The project is based on an explorative research design and it has various stages (◆ Figure 2). The logging instruments for data collections 1 and 2 were piloted prior to the start of the main study.

Sample 1 is made up of children from school year 6 from various regions of German-speaking Switzerland. In Switzerland, there is still a mix of abilities at school year 6 (children have not yet been streamed into different secondary schools according to ability/the level of education provided). In order to ensure that the pupils had the prior knowledge necessary for all of the subsequent process steps of the pre-selectional phase (steps 1–4) (◆ Figure 1), all of the pupils took part in a learning sequence consisting of 10 hours of lessons on the topic of meat.
The learning tasks focused on four aspects of a sustainable diet (health, ecology, economics, and socio-cultural aspects) – the aspects of "culture" and "society" were thus put together in the same category. ◆ Figure 3 shows the individual topics. The learning sequence was carried out by two specially trained teachers who do not normally teach the classes in order to ensure that the experiment was conducted under quasi-experimental conditions.

After the learning sequence, all pupils in the first sample took part in a test of knowledge that was specifically designed for the project. They were also asked about their values using the PVQ (Portrait Values Questionnaire) [24]. The PVQ is a validated instrument for use in studies in children.
Sample 2 was put together with the help of categories (knowledge, value type, sex, SES, types of location) in order to achieve the "desired heterogeneity" [25]. Therefore, sample 2 is intended to have the maximum level of differentiation. The categories mentioned above should ensure that this is the case [25]. All of the pupils who took part in data collection 2 have at least a satisfactory level of knowledge, meaning that all of the children who took part in the interview achieved at least 60% out of the maximum overall number of points available and at least 50% out of the maximum number of points available for each aspect of sustainable development. Different types of values, and boys and girls with different SES from different types of location (town, rural, urban agglomeration) are also represented in sample 2.
Therefore, the main function of data collection 1 is to collect the findings that are necessary to put together sample 2 for data collection 2 in the heterogeneous, controlled manner described above. The mixed-method design of the study therefore combines both quantitative (data collection 1) and qualitative (data collection 2) approaches, but these are given different weightings in the study as set out here.
In data collection 2, each child was introduced to the method of thinking aloud through an exercise where they answered two

Category	Definition	Anchor examples	Coding rules
BA: knowledge originating from the learning sequence carried out as part of the research project	This category covers statements relating to knowledge that was covered as a topic and/or built up in a structured and organized manner as part of the research project, and which is relevant to the decision-making process.	"Chicken or beef or veal or something like that. So not um ostrich or (.) something like um (4) rabbit or that sort of meat. (4)"	only use if no sub-category applies
BA02: knowledge originating from the learning sequence carried out as part of the research project *knowledge of ecology*	This code covers all statements relating to the effects of meat production on the natural resources that humans rely on to live. These resources include land suitable for cultivation, biodiversity, and clean water. Knowledge about types and methods of animal husbandry is also included in this category.	"(...) that like meat is produced fairly, and (.) according to the labels that we (.) learned about (2)."	only use if the ecological knowledge relating to meat production and consumption was built up or covered in the learning sequence, e.g.: meat production and preservation of the countryside; meat production and overfertilization; meat production and types of animal husbandry
BB: other knowledge	This category covers knowledge that was not covered as a topic or built up in the learning sequence. This knowledge may originate from other areas of formal education or from informal education.	"and at home we usually have a lot of poultry and stuff."	only use if no sub-category applies
BB02: other knowledge *knowledge of ecology*	This code covers all statements relating to the effects of human actions on the natural resources that humans rely on to live. These include, for instance, natural resources such as agricultural land, clean water, and clean air, and the code also covers environmental pressures caused by the production, processing, and disposal of foodstuffs. This code also covers knowledge of aspects of animal husbandry that was not covered as a topic and/or built up in a structured and organized manner as part of the research project.	"(2) There are like animals that are in danger of going extinct and so you shouldn't (2) eat too much meat or else they will die out completely."	only use if the ecological knowledge relating to meat production and consumption did not originate from the learning sequence or if the origin of the knowledge cannot be clearly determined

Fig. 4: **Excerpt from the coding rules**

everyday questions as practice (e.g. "It's your birthday. Think out loud about who you want to invite"). After that, the participants were presented with a realistic decision-making situation where the topic was meat:

"Imagine it's summer and you are going to a school camp for a whole week. The kitchen team there is very flexible and they want to take each child's individual decision into account when planning the menu for the week. The main thing that the kitchen team want to take care with is meat because they know that different children think very differently about eating meat. What do you think about the topic of meat? Decide for yourself what the kitchen team should be careful about for you personally when it comes to meat. Speak out loud everything that goes through your mind as you think about this."

The interviews are made up of two phases: unstructured thinking aloud [26] and retrospection [27, 28]. In the unstructured thinking aloud phase, the children freely explore their decision making process. Next, the interviewer decides which statements should be explored further in the retrospection phase in consultation with the observers. The aim of the retrospection phase is to clarify any unclear wording. Special care is taken here to only ask questions about the child's understanding and to only touch on aspects that the child has already brought up. Under no circumstances may certain statements be suggested to the child – words must never be "put in their mouth". Video and audio will be recorded in both phases.

In order to allow the data to be evaluated, a set of coding rules was developed in advance. These coding rules are in accordance with the Mayring method of qualitative content analysis [29]. The categories, codes, anchor examples, etc. for the coding rules were generated through a deductive process, which means that they are based on the theoretical prerequisites of the study, in particular the process model. Keeping the pupils' knowledge in mind, categories, codes, anchor examples, etc. that corresponded to the various aspects of sustainable development and the topics of the learning sequence were formulated. ◆ Figure 4 shows an excerpt from the coding rules.

It was assumed that during the interview, the children would draw upon knowledge that did not originate from the learning sequence ("other knowledge"). Since we know precisely what knowledge was covered in the learning sequence, all other knowledge-related state-

ments were allocated to this category in the evaluation. Inductive categories were added to the evaluation process. The coding was done using the MAXQDA software. This software also allows quantifying statements to be made, which may provide a starting point for the analysis and interpretation of the results.

Results

In line with the research questions, the interviews were analyzed firstly (1) with regard to the individual steps of the decision-making process that the child in question used and secondly (2) with regard to the entire decision-making process as a whole to determine the extent to which previously gained knowledge about sustainable diets was used by the child in question and how it was used.
The following was investigated:
a) what level of knowledge the child exhibited in the knowledge test (data collection 1) and
b) what aspects of sustainable diets the child touched upon and which thematic aspects they referred to when doing so (data collection 2).
(1) The analysis showed that overall, the children quickly identified with the question they were asked to decide upon and that all of them came to a decision in the interview. This means that all of the children completed step 1 and step 9 (◆ Figure 1).
However, there was wide variation in the rest of the decision-making process; various divergent "steps sequences" and "step combinations" were observed. As indicated by the coding of the knowledge-supported statements made by the children in MAXQDA, there was also wide variation in terms of the steps at which the children used the various aspects of knowledge in the decision-making process. It is therefore not possible to infer any patterns or preferred associations, for example with regard to the use of aspects of knowledge in step 6 in particular.
(2a) 68.7% of the children passed the knowledge test, i.e. they achieved between 60% and 100% of the maximum performance level. The analysis of the interviews showed that the overall level of knowledge of the individual children was only associated with which process steps they completed *to a limited extent*. For example, on the one hand, we determined that all of the children that completed process step 6 or 7 (n = 8) had either a good level of knowledge (at least 77% of maximum) or a very good level of knowledge (at least 88% of maximum), but on the other hand, the reverse was not true. Some of the children with a good (n = 8) or very good (n = 5) level of knowledge *did not* complete the aforementioned steps. In addition, none of the children with a good or very good level of knowledge who verbalized process step 7 (n = 7) also completed process step 6. Process step 6 was only completed by one child.
Therefore, the overall level of knowledge was not clearly associated with the completion of these two process steps that are required for making competent decisions in the context of sustainable development. However, given the low number of interviewees in sample 2, the quantified data stated above can only provide a limited indication of the true picture.
(2b) In both phases of thinking aloud, the children mainly formulated statements that drew upon knowledge of just one or two aspects of sustainable development. Because bringing up thematic aspects that were not touched upon by the interviewees themselves was deliberately avoided as part of the thinking aloud method, the interviewer did not ask about any further aspects.
The children tended to focus most on the aspect of ecology (n = 12) and the sociocultural aspect (n = 11). With regard to the ecological aspect, the children focused on animal husbandry (n = 8). For example, when expressing where care should be taken with regard to meat, one child said: *"Um: just that the animals are kept in a way that's animal-friendly."* 0301VP04[1]; 90[2]. Another child also said *"(…) it's nice to eat organic meat because you know that um the cows or just the animals can go outside (…)."* 0401VP12; 63. This child previously suggested also consuming organic meat at the camp and then added this statement to that suggestion.
When the children integrated "sociocultural" aspects into their decision-making process, this mainly took place in the form of associations between religion and eating habits (n = 7). For example, when deciding what the kitchen team should take into account with regard to meat, one child said: *"(…) a few people don't eat pork because of their religion (…)"* 0301VP16; 59, although when the child said "people", they meant their classmates.
When the children took economic perspectives into account in the decision-making process (n = 2), they only talked about the price of meat. In these cases, they touched upon the high price *"Meat isn't like exactly the cheapest thing (…)"* 0101VP11; 69 and the association between animal husbandry and the price of meat *"(…) because like they aren't made to suffer so like it costs more. (…)"* 0201VP01; 78.
In the context of sustainable diets, the researchers were also very interested in how the children referred to the health aspect when talking about meat. Six of the children referred to this aspect. In their statements, these children referred to both the health-related advantages and disadvantages of meat consumption.

[1] The number corresponds to the identification code of the child who was taking part.
[2] The number corresponds to the line number of the quote in the MAXQUDA 12 software.

With regard to the health benefits, two children talked about the protein and vitamin content and the content of the mineral zinc and also the association with physical performance. One of these children also reached the conclusion that less meat is healthier. In terms of the health-related disadvantages of meat, one child spoke about intolerances, and another spoke about pathogens and stomach aches and also mentioned the association between high consumption of red meat and cancer: *"It could be that when you eat too much red meat (.) um (.) you could actually (.) get (.) cancer."* 0101VP11; 105. Another child talked about frequency of consumption and concluded: *"Always eating meat is definitely not very good for your body (…)"* 0301VP15; 71. In addition, it was mentioned that whether meat was healthy or unhealthy depended on the amount, and the trace element of iron was also mentioned here.

Such differentiated considerations, for example with regard to the intake level, were found in the statements of all of the children only when referring to health-related knowledge. At the same time, we found that those children who included health-related aspects exhibited a good or very good overall level of knowledge in the test and also gained close to the maximum number of points in the questions on health-related aspects in the knowledge test (on average approx. 92% of the maximum level of knowledge). This was not the case for the aspects of ecology or economics, or the sociocultural aspect.

Since we put sample 2 together not only according to the criterion of level of knowledge, but also according to other criteria including sex, SES, and location, there was an opportunity here to search for associations by taking an explorative approach. Sample 2 was made up of 16 girls and 11 boys. There were only very weak sex-related associations among the children who touched upon the aspect of ecology when using their knowledge. Those who did this were mainly girls (n = 9). SES and background played no role in the knowledge that was used.

Discussion

The overall level of knowledge has no effect on the quality of the decision-making process

The results of the EKoN-E research project show that the children's previously measured overall level of knowledge is only associated with the decision-making steps that they complete to a limited extent. The results do indicate that children with a good or very good level of knowledge are more able to consider alternatives for action, weigh them up against each other, and rule alternatives out (i.e. complete process step 7), but they are missing process step 6 which should ideally also be completed here (◆ Figure 1). With step 6 in particular, being the step in which alternatives for action are developed and, above all, their possible consequences compared, it would be reasonable to assume that comprehensive prior knowledge could motivate decision-makers to take the step, but in fact, even children with a very high level of knowledge do not take this step as part of their decision-making processes.

Although at first glance these findings may appear to contradict the findings of Ratcliffe [20], which found that all learners completed the step of developing alternatives for action in class, it should be noted that the pupils in Ratcliffe's study were motivated to develop and compare alternatives for action through work tasks. By contrast, in the EKoN-E study, the children were "left to their own devices" when making the decision during data collection 2.

In addition, we were unable to confirm the assertion of Wettstädt and Asbrand [22] that "the more specialist knowledge the young people are able to acquire and the more they are exposed to and become able to recognize diverse perspectives, information, and positions, the more carefully they reflect on their alternatives for action" – at least this was not possible with regard to the alternatives/options for action. However, this may also be due to the fact that when making this statement, the two researchers were referring to communication in groups during the lesson and so the participating pupils were able to build up their knowledge and decision-making processes together. Therefore, our mode of data collection (individual as opposed to in groups) was also very different from the one used in the other project.

However, these different methods could provide insights into how future lessons that require the use of knowledge in decision-making processes could be structured (▮▮▮ "Conclusions" section).

Furthermore, our study results did not support the assertions of Sakschewski and colleagues [17] that a higher level of prior knowledge improves decision-making processes in learners in the context of sustainable development. However, the above statements should not lead to the assumption that children did not use prior knowledge at all in their decision-making processes within the context of EKoN-E – they certainly did – but we can state that there is *no* association between the overall *level* of knowledge measured in advance and whether and how children carry out the two key steps, steps 6 and 7, which are required for a high-quality decision-making process within the context of sustainable development.

Knowledge used refers to one or two aspects of sustainable development

The children mainly spoke about aspects of knowledge that had to do with animal welfare. The great importance placed on these aspects of knowledge in decision-making processes within the context of sustainable nutrition is consistent with our own research in young people and students, whose knowledge on the ecological aspect of sustainable development also clearly focused on this topic [13, 30]. The children's focus on this topic may also have something to do with the fact that knowledge aspects and *values* are closely related when it comes to animal husbandry [31] – an assumption that is dealt with in the second part of this article.

In the learning sequence before the interviews, many other aspects of knowledge to do with ecology were covered and developed, and these did not find their way into the children's decision-making processes. The same applies to the sociocultural aspect. Therefore, with regard to these two aspects, the children who talked about them did so at a level that was far "behind" the level of knowledge that they exhibited in the test. Does this mean that only "inert knowledge" acquired in the learning sequence [32]? In our view, this assumption does not provide a convincing explanation because the material for the learning sequence came from a very sound textbook that was developed through the project "ZMiLe – *Zukunft mitgestalten lernen*" ("Learning to Shape the Future Together") [33]. The knowledge and skills required for the pre-selectional phase of a decision-making process were built up in the learning sequence through a didactically differentiated teaching/learning arrangement with concept mapping, role-play, or a marketplace method. The learning sequence was also executed in a way that was suitable for the age group and relevant to everyday life. The pupils participated with enthusiasm, as was confirmed by the researchers' observation of the learning sequence. In addition, the knowledge test covered both factual knowledge and concept knowledge, as well as possible everyday applications.

The children live in the "here and now"

It was also found that the children's answers referred to the "here and now", meaning that they spoke about aspects of knowledge to do with their present circumstances and their own local and social environment.

As stated in the "Results" section, they tended to think about forms of animal husbandry that are common in Swiss agricultural production. They also took account of the sociocultural or religious needs of their classmates. These predominantly local and current associations can be reasonably explained by the fact that for adults too, one of the challenges when it comes to making decisions in the context of sustainable development is that it is necessary to take account of *inter*-generational (temporal) and *intra*-generational (spatial) contexts. Such challenges are considerable, especially because the aforementioned contexts are often very complex [34, 35].

A similar rationale can be used to explain the fact that in the EKoN-E project, the children tended to limit themselves to one or two aspects of sustainable development, even though they "actually" had knowledge of all four aspects. The same finding was found by Gausmann and colleagues [19]. Once again, the same behavior is found in adults [36], and it is in part attributed to the fact that taking account of various aspects at the same time and linking them up with each other often leads to contradictions [34, 37, 38]. However, studies indicate that children would in principle be able to link up knowledge of different aspects [39–41], although primary school children have varying abilities when it comes to this [42].

There is a "threshold" effect when it comes to the health aspect

A particularly interesting finding becomes evident when individual children integrate aspects of knowledge from the health category into their decision-making processes. As shown by the statements quoted here, in contrast to the other two aspects, a wide range of knowledge is used here in the interviews. Furthermore, these children exhibited extensive knowledge on the health aspect specifically in the knowledge test and therefore appear to have aspect-related "expertise". It can be assumed that such expertise leads to a feeling of certainty to some degree.

Both of these factors could be the prerequisites for making use of prior knowledge or expertise in the decision-making process and also for comparing alternatives for action with regard to the possible consequences of the action or for weighing up options.

Here we see some similarities to the "threshold model" of Sadler and Donnely [43]: This model was developed based on empirical research in adolescents and it refers to the argumentation that pupils use in decision-making processes. The cornerstone of the model is the idea that learners must cross "expertise thresholds" in individual areas of knowledge before they can draw upon the knowledge in question in their argumentation.

Even though the main focus of our study is not the pupils' argumentation, but rather the completion of decision-making steps, it is possible that here too the crossing of certain "knowledge thresholds" is a prerequisite for making use of knowledge during decision-making. When we look at this assumption in conjunction with the previous explanations about the ecological and sociocultural aspects, it is understandable that the children experience their own "expertise" with more focus on individual, low-complexity aspects of animal welfare (ecology) or eating habits (sociocultural) rather

than on other ecological aspects of higher complexity, such as the effects of high meat consumption on soil and water.
Therefore, there is no discernible association between the overall level of knowledge and the decision-making processes being carried out, but there is a discernible association between prior "expert knowledge" in some very specific areas and the integration of this expert knowledge into the decision-making process.

Limitations

The question that was to be decided upon in the interview was conceived in such a way that the children were able to focus on their own opinions and desires rather than trying to make a socially desirable decision. However, it is possible that some individual children may have initially focused on the social good and thought mainly of the other children.
The individual interviews were conducted in a very supportive, friendly way, but it is possible that some individual children felt insecure and did not express everything that went through their minds when asked to think out loud.

Conclusions

The results show that lessons aimed at developing decision-making skills are likely to support both knowledge building and the development of decision-making strategies (in particular the implementation of PS 6 and PS 7) and the integration of knowledge into decision-making processes in a targeted manner.
In the EKoN-E project, the learning sequence was limited to the pre-selectional phase only for methodological reasons and it did not include the selectional phase. Using role play and simulation games that simulate decision-making processes and allow them to be expressed communicatively in the classroom might be helpful as a way of encouraging the implementation of the selectional phase.
Children likely make use of their knowledge during decision-making processes when they see themselves as experts and are allowed to express themselves as such – for instance in group and class discussions or in simulated "expert panels". Therefore, both the building of knowledge combined with the development of decision-making strategies and the integration of knowledge in decision-making processes should be strengthened, above all through the use of methods that encourage communication in the classroom.

Conflict of Interest
The authors declare no conflict of interest.

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