Learning democratic participation? Meaning-making in discussion of socioscientific issues in science education

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ABSTRACT

Learning democratic participation as future citizens is an important goal for science education for all students. To take part in debates and decision-making involving socioscientific issues, such as sustainability, students need to become aware of different positions and dilemmas regarding such issues. This study seeks to understand how democratic participation is constructed by 45 student participants aged 16 years, for whom science is not the main course of study. Students worked in small groups on tasks that involved discussion of two different socioscientific issues. The analysis of student discourse used a theoretical perspective from discursive psychology, and shows how students deal with ideological dilemmas and resolve different positions within their discussions. Five 'interpretative repertoires' were identified from student talk illustrating the dilemmas occurring in the specific SSIs and also the function of science within the discussion. Through identifying interpretative repertoires used by the students, the stances they take and the function of science in their discussions, the study sheds light on how democratic participation can be learnt in a science education context.

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Introduction

A major aim of science education is to provide all students with scientific knowledge and skills so they can contribute to societal discussions about socioscientific issues (SSIs) (Osborne & Dillon, 2008; Roberts, 2007; Sadler et al., 2007). One important objective ought to be for students to identify themselves as willing and able to engage in socioscientific discourses so that they see themselves as legitimate participants in social dialogs (Sadler, 2009). Of particular importance is how students develop their own stance on sustainability issues, such as the world’s energy consumption and food production. These issues can involve conflicting interests between social, environmental and economic aspects that make positioning and decision-making processes complex (Scott & Gough, 2003). One way of developing knowledge about conflicting stances around sustainability is for school students to work on activities that address issues of global
concern, where they have to take into account not only the science but other considerations, such as ethical and social dimensions.

Working with socioscientific issues is regarded as a means of developing scientific literacy (Roberts, 2007; Roberts & Bybee, 2014). Roberts (2007) makes the distinction between two forms of scientific literacy. Vision I refers to literacy in the scientific disciplines, such as that obtained by graduate science teachers, whereas Vision II is literacy in science associated with real life situations and issues that all students are likely to encounter as citizens. Kidman and Fensham (2020), in their review of changing values in science education over the last three decades, highlight the challenges for teaching Vision II and refer to initiatives in different countries that have promoted the teaching of socioscientific issues (e.g. Sadler and Zeidler (2005) in the USA and Ratcliffe and Grace (2003) in Britain). In 2011, Sadler edited a collection of international studies where authors adopted perspectives consistent with Vision II (Sadler, 2011). Thus approaches that focus on Vision II have been established in many curriculum projects internationally. Haglund and Hultén (2017) draw attention to the tensions between Roberts’ Visions in the Swedish context, as though Vision II has gained importance in the curriculum (Skolverket, 2011), it is in competition with the established science content of Vision I.

Vision II is particularly relevant to the Swedish science syllabus, Science Studies, for non-major science students in upper secondary schools in Sweden. The syllabus states that by discussing and exploring SSIs students should be given the opportunity to consolidate, deepen and develop their scientific knowledge to be able to meet, understand and influence their own contemporary conditions (Swedish National Agency for Education, 2011). Two main purposes of teaching can therefore be seen within this course. The first purpose is to develop students’ knowledge-based competences, where they learn about a specific SSI and how to use science knowledge within the SSI (Lundegård & Caiman, 2019). The second is to facilitate learning democratic participation, by students experiencing democratic processes in their education and constructing their own role in democratic processes (Lundegård & Caiman, 2019). Teaching based on SSIs in science education has the potential to promote democratic participation for students (Sadler et al., 2007) but raises questions about what form of democratic participation is experienced, how it is constructed, and what function students give to science in SSI- discussions. This study aims to understand how democratic participation is experienced during discussion of SSIs, and constructed as discussions evolve, by focusing on how meaning is created and how scientific knowledge is used while students are engaged in SSI tasks. The study involves students aged 16 years, for whom science is not the main field of study, as they study science as part of their civic education in a three year social science program in Sweden. The long term aim for students taking part in this course is that they develop a way to enter debates about SSIs so that they feel able to participate in societal discussions which involve science, so their voices will be heard and they can critically examine others’ standpoints. Our research aim is to gain knowledge about how these students construct democratic participation in their meaning-making process and how they use science when discussing SSIs. The study is based on audio-recorded group discussions arising from two different sustainability tasks which afford opportunities for developing democratic participation whilst using scientific knowledge. The tasks and recordings were made and initially analysed.
for an earlier publication, written mainly in Swedish (Ottander, 2015). The analysis presented here provides further interpretation of the same empirical data, more fully explaining and building on the analytical procedures from the earlier study. The analytical approach is described in the methods section below.

**Background**

There is a mutuality of aims in the fields of scientific literacy and SSIs, as each of these areas is concerned with strengthening students’ opportunities for democratic participation in society. To establish a background for this work, we have examined research on democratic participation and meaning-making in SSIs, to design suitable tasks that will engage students in discussions where the processes of democratic participation will be revealed. The Swedish teaching traditions in environmental and sustainability education (ESE), identified as fact-based, normative and pluralistic (Borg et al., 2012; Öhman, 2006), have also influenced the research. Fact-based teaching traditions focus on the transfer of knowledge to students for taking a stand on sustainability issues, normative teaching traditions focus on students learning environmentally friendly behaviours and pluralistic teaching traditions are characterised by looking at sustainability issues as value issues which include conflicts of interests and the importance of exploring issues from several perspectives. The research and teaching approach in this study is inspired by the pluralistic teaching tradition, in which students are encouraged to reflect critically on different perspectives within the SSI. In our research we see sustainability issues as one of many socioscientific issues, and sustainability education as part of science education.

**Democratic participation within SSI teaching**

Science teaching affords opportunities for students to develop their democratic participation in society (Levinson, 2010; Östman, 1995). How curricula are designed and how teachers choose to teach science leads to construction of democratic participation in different ways.

There is no simple definition of democratic participation, as it can take different forms depending on how it is addressed in different teaching traditions. We draw on research studies showing different perspectives of how students might exercise democratic participation in science education and in teaching traditions in the Swedish context of environmental and sustainability education (ESE) (Borg et al., 2012; Öhman, 2006).

The literature indicates different perspectives which involve democratic participation in science education. The first perspective focuses on the importance of scientific knowledge for informed decision-making and scrutinising arguments (e.g. Grace, 2009), thus as a basis for democratic participation, which is considered to be important for understanding environmental and sustainability problems. This perspective is reflected in the teaching tradition that centres on fact-based science teaching, and has been criticised for focusing on knowledge of the existence of environmental problems without addressing social and societal aspects (Gough, 2002; Jensen & Schnack, 1997; Osborne & Dillon, 2008; Scott & Gough, 2003).
In the second perspective the purpose is to facilitate a transition to a more environmentally friendly society by teaching students environmentally friendly attitudes and behaviours. Experts are seen to hold a privileged position here by being considered to have information that determines what is environmentally friendly or not. This perspective, reflected in what is referred to in Sweden as the normative teaching tradition (Borg et al., 2012; Öhman, 2006), has been criticised for being the opposite of an education that leads to independent and free-thinking individuals (Jensen & Schnack, 1997; Jickling & Wals, 2008). Democratic participation in this perspective would be influenced by reliance on experts.

In the third perspective environmental and sustainability problems are seen as conflicts between people and/or different stakeholders. This perspective is reflected in the teaching tradition known in Sweden as pluralistic (Borg et al., 2012; Öhman, 2006). Sustainability issues are seen as value issues that are surrounded by norms on how to act, and critical thinking is seen as an important aspect of environmental and sustainability education (ESE) (Jensen & Schnack, 1997; Mogensen, 1997; Mogensen & Schnack, 2010; Roth & McGinn, 1997; Rudsberg & Öhman, 2010; Simonneaux & Simonneaux, 2012). In this perspective students learn to critically examine different standpoints on environmental and sustainability issues. Thus critical thinking, free opinion-making and conflicts of interest are at the core of the teaching that reflects this perspective (Lundegård & Wickman, 2007; Rudsberg & Öhman, 2010). An important aspect of ESE is to develop the ability to critically review and evaluate different voices within a sustainability debate. Therefore multiple perspectives should be included in school activities, so that students have the opportunity to evaluate different viewpoints (Öhman, 2006). Each teaching tradition has value, but for the aims of the course that is the focus of this research, the pluralistic teaching tradition was adopted so that students could learn to critically evaluate different viewpoints.

In addition to the three perspectives outlined above, it is argued that the political aspects of environmental and sustainability issues must also be considered (Hasslöf, 2015; Van Poeck & Vandenabeele, 2012). There is a need to talk about sustainability issues in political terms such as power and conflict, rather than simply speaking in moral terms such as good/bad or in rational terms such as right/wrong (Van Poeck & Vandenabeele, 2012). A fourth perspective on democratic participation therefore involves an activist approach, where researchers argue for a science education that includes social change and socio-political actions in relation to learning (e.g. Bencze & Carter, 2011; Hodson, 2003).

The main objective of the students’ tasks in this study was most aligned with the third perspective on democratic participation in science education, by engaging the students in socioscientific reasoning which can eventually lead to critical reflection. The objective was that all students should feel that they could contribute to the socioscientific discussions and thereby feel competent to engage in societal discussions that involve science. We see the classes and their science teaching as a community of practice (Lave & Wenger, 1991) in this study. The social and cultural context in a community of practice determines the learning that can take place (Sadler, 2009) because students learn how to talk about different objects and events, such as sustainability issues. In addition, we were interested to see whether the students’ meaning-making processes provided opportunities for the students to position themselves as actors and reflect over power relations.
(fourth perspective on democratic participation) as well as critically examining and evaluating different norms and perspectives when exploring the SSIs (third perspective on democratic participation). Finally, we considered the function that science had in their meaning-making process. The function of science could be in terms of how students referred to scientific knowledge directly (first perspective on democratic participation), or how they referred to wider science discourses, such as making reference to ‘they’, meaning experts (second perspective on democratic participation).

Lundegård and Caiman (2019) explored when and how democracy becomes a part of teaching science and they argue that learning democratic participation is achieved by experiencing democratic processes. They see students’ opportunities to participate in democratic processes as an essential part of learning democratic participation. They suggest that teaching that embraces democracy as a ‘way of life’ is core to this approach and they present five forms of participation that the teaching needs to offer the students. Students need to: (i) engage in deliberative conversations, (ii) initiate and drive urgent issues, (iii) create new solutions to problems, (iv) reflect critically and (v) engage in areas of discussion that are authentic to them. The discussion tasks in this study are designed for students to experience these kinds of participation where values, norms and ethical aspects are interwoven with science aspects and different perspectives are relevant in the SSIs. The tasks are constructed so that students experience democratic processes, critical reflection and deliberative conversations on authentic issues when working with them. Our aim is to know more about how students construct democratic participation and engage in democratic processes when working with SSI tasks.

Reasoning in SSIs

Previous research has shown that students who are engaged in open and informed discussions about sustainability issues create discourses that are insightful, complex and critical (Christenson et al., 2012; J. Öhman & Öhman, 2012; Santos, 2014). In using the term discourse, we mean it to refer to a certain way of talking about and understanding the world or sections of the world (Winther Jørgensen & Phillips, 2000), for example in our study students’ discussions draw on a discourse about the individual’s right to decide for themselves. The process of meaning-making in students’ discussions is complex because students’ informal reasoning of SSIs includes rational reasoning together with emotional and intuitive reasoning, and these are often interwoven (Sadler & Zeidler, 2005). Students also integrate scientific aspects with values and personal experiences and draw on these differently, depending on the context and the SSI (Christenson et al., 2012). In addition to learning science, the concept of socioscientific reasoning includes seeing the complexity of the issues, looking at issues from different perspectives, gaining an insight that research is ongoing, learning to have a sceptical attitude (Sadler et al., 2007) and identifying risk, uncertainty and values (Simonneaux & Simonneaux, 2009b).

Teaching SSIs to facilitate democratic participation is expected to result in students looking at SSIs from different viewpoints and seeing the complexity within an issue. Important to this is providing students with a broader understanding of the SSI they are discussing (Sadler, 2004; Sadler & Zeidler, 2005). However, the process is not easy or straight forward, as shown in studies where students have been seen to construct
one harmonious perspective without attention to conflicts between social, ecological and economical perspectives when, for example, planning sustainable cities (M. Öhman & Öhman, 2012). In another example, students adopted one single comprehensive discourse, rather than pursue several lines of reasoning involving different perspectives, when working on climate change in the classroom (J. Öhman & Öhman, 2012). So, even though students are introduced to complex SSIs with multiple perspectives it does not necessarily mean that the students see the complexity and different perspectives.

Socioscientific reasoning is also affected by how emotionally related the SSI is to the students’ identity (Aikenhead, 2006; Simonneaux, 2014). For example, Simonneaux and Simonneaux (2009a) report that agronomy students’ socioscientific reasoning was shown to be based on farmers’ narratives more than scientific reports. Students also use different discourses, determined by how they construct their identity (Ideland & Malmberg, 2012). Drawing on the idea that students’ core beliefs are those that are so strong that they are seen as facts, Zeidler et al. (2011) show that students can show a higher level of reasoning when not inhibited by strong core beliefs, for example regarding food additives. However, students do not develop a higher level of reasoning when discussion, for example, links religion and science, which can involve strong core beliefs. Zeidler et al. (2011) argue that this shows how core beliefs affect students’ evaluation of scientific evidence. In a more recent publication, Zeidler (2014) points out that students sometimes end up in fallacious reasoning about some SSIs, reasoning that leads to conclusions that are not relevant. He gives several examples, such as arguments that appeal to popularity and false dilemmas, validity concerns and the effect of core beliefs on argumentation (Zeidler, 2014). It seems that students find it difficult to embrace scientific results that appear to contradict their own values and that reasoning based on socio-scientific issues is highly context-dependent. Simonneaux and Simonneaux (2009b) suggest that when the SSI is contrary to a student’s value system, it can inhibit critical reasoning and there is a tendency to reproduce the group’s hegemonic discourse, i.e. their dominant way of thinking and talking.

According to Lundegård and Caiman (2019), students learn democratic participation through participating in democratic processes when they, for example, engage in issues that are authentic to them. Those issues are likely to be highly emotive, and close to a student’s identity and can include core beliefs that may challenge students’ use of science. Nielsen (2013) asks for a focus on how students articulate evidence versus other factors in socioscientific reasoning, instead of just focusing on students’ abilities to cite evidence. Similarly, Zeidler et al. (2019) ask for future research about how SSIs that are embedded in a sociocultural view of education with prevailing norms can inform pedagogy. More research is required to understand the processes behind these challenges with socioscientific reasoning; further knowledge can be used in education to increase teachers’, and thus students’, awareness about how values and emotions impact on critical reasoning and how fallacious reasoning evolves. The aim is to enrich our understanding of students’ ability to deal with complex socioscientific issues.

**The function and use of science**

Socioscientific reasoning relies on science to clarify issues, scrutinise information, identify positions and consequences of different actions, which can lead to critical thinking
(Levinson, 2010; Rudsberg & Öhman, 2015; Simonneaux, 2014). But science can also be given the function of ‘cooling down’ socioscientific issues by creating trust in science and technology, thereby avoiding conflicts of interests and the political aspect of the SSI (Levinson, 2010; Simonneaux, 2014), and has a normative function where scientific knowledge indicates a clear course of action (Östman & Almqvist, 2011; Rudsberg & Öhman, 2015). Some people might take the view that the main function of science is to find the ‘right answer’ through establishing a degree of certainty, but science can also be used to determine the consequences of different decisions and courses of action. In this way, science can be part of an activist approach where students view the issues from a social-political perspective and see themselves as decision-making citizens, using science to help make informed, ethical decisions. Drawing on science to make these kinds of decisions (i.e. with a focus on values and consequences) means that science strengthens them in acting for the society they want (Levinson, 2010; Simonneaux, 2014).

Even given these noble aims, there is no clear answer from research about how students use science when discussing SSIs. Some studies show that students gain more scientific knowledge after activities when discussing SSIs (e.g. Grace, 2009; Rudsberg et al., 2013). Other studies suggest there is a risk that scientific knowledge disappears when discussing SSIs (e.g. Christenson et al., 2012; Nielsen, 2012b). However, small-scale studies have shown that students: (a) use science when they want to clarify their position and see the need to establish a knowledge-base that will support their position on the issue (Nielsen, 2012b; Orlander Arvola & Lundegård, 2012), (b) combine science with other rationales such as morals, values, personal experience and feelings (Lindahl & Lundin, 2016; Nielsen, 2012a), (c) convince an opponent (Nielsen, 2013) and (d) implicitly use scientific knowledge (Nielsen, 2013). Nielsen (2013) noticed that students expressed arguments that build on scientific knowledge without explicitly expressing the science behind the argument. Thus students do not necessarily use specific science concepts in their talk and their reasoning may seem unscientific.

Students who are not experienced in the science disciplines, such as those who are the focus of this study, can find it difficult to use scientific knowledge in their discussion of SSIs (Sadler & Zeidler, 2005; Tsai & Liu, 2005). Students need knowledge in science and about science to take a position on various issues, to argue their cause and critically review the arguments of others.

The aim of this study is to understand which functions these particular students give to science in their discussions and how they construct democratic participation. Teaching about SSIs in science education is widely argued to promote democratic participation among students, e.g. Sadler et al. (2007). Like Feinstein (2011), we think that much of the literature that refers to learning democratic participation is based on other learning processes such as argumentation, empirical studies that focus specifically on demonstration participation are not as common. We therefore hope to address a gap in the literature by generating empirical data to explore students’ use of science in their discussions and the consequences for democratic participation.

For an earlier publication Ottander (2015) of this study, written mainly in Swedish, an initial analysis of the same empirical data identified ways in which students used science in their discussions, which included (i) to make the issue more understandable and raise questions, (ii) to evaluate, decide and act, (iii) to give authority to arguments and (iv) to make reference to scientists solving problems. For this article we have undertaken a more
detailed analysis of the same data, using the methodological approach outlined below, to gain further insights into the ways in which students used science in their discussions.

**Theoretical perspective**

In this study, we have adopted an approach from discursive psychology that provides a theoretical perspective for understanding students’ discussions in SSI tasks. The approach takes the language used as its focus of interest by investigating how people talk about different objects, events and actions (Edley, 2001; Potter & Wetherell, 1987). A theoretical starting point in discursive psychology is that people's talk has multiple functions and different consequences for how objects, events, actions, the self and others are produced (Potter & Wetherell, 1987). Language is seen as a tool for different actions and as an inseparable part of human thought processes (Potter & Wetherell, 1987). Discursive psychology is interested in how people construct meaning, the meaning of a word as it is used in language, and how discourses are reproduced, reconstructed and changed in social interaction. The social construction of knowledge and truth has social consequences by making certain forms of actions self-evident, while other actions are relevant to specific times and cultures (Billig, 2001; Edley, 2001; Wetherell & Potter, 1992). For example, in the past we would have thought of fertilisers as necessary for food production, with little heed to the consequences, whereas now we are more aware of the consequences of over-using fertilisers. Moreover, how we think about the use of fertilisers would vary according to prosperity, human need and culture. The dominant way of speaking in a particular situation can be interpreted as based on fact, or taken for granted that it is a true description of the object, event or action (Edley, 2001; Wetherell et al., 2001; Wetherell & Potter, 1992). Learning is therefore historically and culturally situated. In an educational situation, it becomes important to know what the students and the teacher are both talking and not talking about, and also how they talk. If SSIs are discussed in terms of certain facts as truths, for example, it is best to travel with electric cars to save carbon emissions, with no alternative ways of thinking, such as travel less, use other alternative fuels and means of transport, then meaning making in the discussion is built on the strength of a single well-meaning but arguably under-informed solution.

Taken from discursive psychology, we have used the concepts of interpretative repertoires, ideological dilemmas and subject positions to understand students’ democratic participation, meaning-making and their use of science. Interpretative repertoires are relatively similar ways of talking about objects, events, and actions (Edley, 2001; Potter & Wetherell, 1987; Reynolds & Wetherell, 2003; Wiggins & Potter, 2008). They consist of a limited number of similar terms and expressions used to describe, value, and give meaning to objects, events and actions. These terms and expressions are used and repeated when talking about a specific object, event or action, thus forming a pattern in the use of language. For example, when students talk about energy usage, phrases such as ‘save, do not waste, turn off lights, and turn off standby’ are used and repeated, and form a pattern in language, which is the basis of an interpretative repertoire. Reynolds and Wetherell (2003) describe interpretative repertoires as ‘what everyone knows’ about a subject. The collective common consensus behind an interpretative
repertoire becomes established, taken for granted, and thus in a discussion only fragments in an argumentation chain (or repertoire) may be needed to enable participants to recognise and understand what is meant (Reynolds & Wetherell, 2003).

One issue that is discussed in discursive psychology is the distinction between the concepts of discourse and interpretative repertoires (Edley, 2001; Winther Jørgensen & Phillips, 2000). Interpretative repertoires are identified in students’ talk and are concepts derived analytically from the data, however they draw on different societal discourses (e.g. in media or different institutions) that influence students’ thinking. Student discussions, for example, may include the idea that people must save and not waste resources (an interpretative repertoire). This interpretative repertoire draws on an ecological discourse that exists in society about limited resources on earth, so to live sustainably you must be within this limitation.

Different interpretative repertoires bring different conceptions about parts of the world into student discussions in science. Sometimes the conception of one interpretative repertoire coincides and strengthens the conception from another interpretative repertoire. At other times, the conceptions become contradictory and ideological dilemmas (Billig et al., 1988) arise. Ideology is understood here as lived ideologies: ‘Lived ideologies were said to be composed of the beliefs, values and practices of a given society or culture. [...] its common sense, [...] characterised by inconsistency, fragmentation and contradictions’ (Edley, 2001, p. 203). Thus, different ideologies about ‘the world’ construct different versions of what is ‘right’ to think, say and act, which oppose each other and hence create ideological dilemmas (Billig, 2001).

Subject positions are defined as locations within a conversation, for ‘I’ or other subjects, that are made relevant through specific ways of speaking (Edley, 2001). Davies and Harré (1990) suggest that a subject position includes both a concept repertoire and a location within the structure of the speech. The speech in everyday discussions provides a position to talk from and we can thus position ourselves and others as characters with different roles (Reynolds & Wetherell, 2003). In discursive psychology, the subject is seen as an active user of discourses which means that people have a position to talk from which enables them to position themselves or others in specific ways (Reynolds & Wetherell, 2003). So, the interpretative repertoires students use in their discussions position individuals or groups in relation to democratic participation, e.g. who has the power. Two subject positions that we bring into focus in this study are ‘troubled and untroubled subject positions’; how different subjects in interpretative repertoires collaborate or counteract each other (Reynolds & Wetherell, 2003). For example, it becomes troublesome when two interpretative repertoires tell you to act differently and each depends on the specific situation. An example of such a dilemma, exemplified later in our analysis section, concerns energy consumption, which can be perceived as either right to increase or decrease according to the interpretative repertoire. Here, we study how different interpretative repertoires position students in troubled and untroubled subject positions in the particular group discussion.

The theoretical perspective of our research methodology, discursive psychology, offers an approach to analyse conversations and focuses primarily on how subjects use discourse. Thereby it helps us to explore how subjects use their own knowledge and meaning in their meaning-making. Discursive psychology is not often found in science education research, but has been used in the analysis of students’ meaning-making of various SSIs, for example in discussions about sustainability issues (Byrne
et al., 2014; Zeyer & Roth, 2009, 2013), health issues (Ideland & Malmberg, 2012; Lundström et al., 2012) and students’ feelings of inclusion in, or exclusion from, science education (Ideland & Malmberg, 2012).

**Aim and research questions**

Knowledge about how students undergo meaning-making in SSIs can create tensions for teachers. On the one hand students learn about SSIs, develop scientific knowledge and experience democratic processes. On the other hand, there seems to be a risk that instead of creating a scientifically informed understanding of the different perspectives on a SSI and/or the different needs of various stakeholders in the meaning-making process, students can create one over-arching discourse and can have difficulty embracing scientific knowledge. We need to understand more about the processes involved as students create meaning and how one or more discourses develop during students’ meaning-making processes, thus how democratic participation is constructed. From this knowledge science educators can develop different strategies to meet these challenges when teaching about SSIs.

The aim of the study, therefore, is to contribute to our understanding of how democratic participation is constructed by upper secondary school students’ when discussing SSIs and the function of science in their meaning-making process about the SSIs. We use a theoretical approach, discursive psychology, which focuses on how people use language to create meaning and allows us to understand students’ talk and their use of science. The starting point is social science students’ discussion of two school tasks on sustainability in their science civic education.

Our research questions are:

1. What are the interpretative repertoires that upper secondary school students use when they discuss sustainability issues?
2. How do students use these interpretative repertoires in their discussions?
3. What are the underlying ideological dilemmas in tension within students’ discussions?
4. What function does science have in their discussions (how they use scientific knowledge, or make reference to wider scientific discourses)?
5. What are the subject positions, in relation to democratic participation, that are created in the discussions?

**Method**

Discursive psychology argues for research on real life events because it situates the research in the ‘messy reality’ that these events naturally occur in (Wiggins & Potter, 2008). Therefore classroom studies were conducted, with audio-recorded small-group discussions, in three different social science classes, focusing on small-group discussions about two different issues.

**Participants**

The research focuses on how students in science civic education constructed democratic participation when discussing SSIs. We conducted a targeted selection (Creswell, 2005) of
students from one upper secondary school in a small town in northern Sweden, who were attending the course, science studies (Swedish National Agency for Education, 2011), in the social science programme. The profile of students in the study was representative of the school population, predominantly white Swedish, with a minority of different immigrant ethnicities. Likewise, the socio-economic status of students in the study was mixed; specific SES data on individual students was not collected. Three out of four of the science studies teachers and their classes agreed to participate in the study. The students were in their first year in upper secondary school (aged 16 years). In the three classes, there were a total of 86 students, 56 girls and 30 boys.

**Data set**

It was considered to be important to have audio-recorded small-group discussions from different classes because different teaching approaches and class characteristics could lead to variation in how students responded to the tasks and engaged in discussion. We listened to all the group discussions and realised that the talk within each class was similar in the different groups, but that there was variation across the three classes in how engaged the students were in discussion. To keep the amount of transcription and analysis manageable within the scope of the study we decided to transcribe verbatim every second group in each of the three classes, in total 22 groups. This decision meant that 45 students were involved in providing the data set for the study, 29 girls and 16 boys. The same groups of four students were recorded discussing the two issues in the different lessons. The data were analysed in the discursive psychological tradition using a simplified form of Gail Jefferson’s transcription system (Potter & Wetherell, 1987; Wetherell & Potter, 1992). For transcription of audio recordings, the text was marked for short and long pauses, accentuations and when several people were talking at the same time in the discussions. The analysis was undertaken using the transcripts in Swedish and the excerpts presented here have been translated into English.

**Socioscientific tasks**

The main purpose of the two tasks was to get students to talk and discuss sustainability issues and thus feel competent to engage in societal discussions that involve science. The design of the tasks was such that all students would feel that they could contribute to the discussions, something that Bencze and Carter (2011) advocate. One aim was that sustainability issues should be presented from different perspectives, which is an important goal in a pluralistic teaching tradition (as defined previously). The students should use the science they found relevant to create meaning about the socioscientific issue they discussed. The use of science was not specified in the tasks or by the teachers.

The tasks were: ‘Earth at Night’, focusing on the world’s energy supply, and ‘Do we have enough food?’ focusing on the world’s food supply (Appendix 1). The tasks were anthropocentric, and had both global and local dimensions. The issues within the tasks contained potential ideological dilemmas, for example between social justice, limited resources and environmental aspects, and had the aim of engaging students in deliberative conversations and critical reflection (Lundegård & Caiman, 2019). Whether issues about the world’s energy and food supply are authentic to the students
Lundegård & Caiman, 2019) was difficult to predict, but these issues are often discussed in the media. The task ‘Do we have enough food?’ has a question where students are asked to take a stance regarding a proposed introduction of more vegetarian food in school meals (school meals being under the jurisdiction of municipal policy).

‘Earth at Night’ was taken from the national assessment (Swedish National Agency for Education, 1998) where it was used in group interviews and rearranged to suit group discussions. The whole task was based on a satellite picture taken over the ‘Earth at Night’, where different places were visible in different colours. Based on the satellite picture, students discussed what the satellite image said about the world’s energy use. The task was then to find arguments for two different future scenarios, as Berland and McNeill (2010) showed that students’ discussions become more complex when the starting point is based on two alternatives. One scenario was that a satellite image taken in the future would be brighter than the satellite image presented in the task; the second scenario was that the future satellite image would be darker. The groups thus had the opportunity to discuss energy use of the future.

The task ‘Do we have enough food?’ was developed from an earlier study where students discussed, in an interesting way, whether it matters what we eat. The design was influenced by Kolstø’s (2001a, 2001b) earlier work on scrutinising knowledge claims and consensus. Tasks where students are asked to agree upon a standpoint create discussions where conflicts of interests are visible and different standpoints are negotiated (Kolstø, 2001a). A consensus task would appear to be in contrast to pluralistic teaching where conflicts of interests and different perspectives on SSI are the core, but should be understood as an educational idea to encourage students to highlight social issues from different perspectives.

The teachers used the tasks in their ordinary teaching, when it was appropriate in the curriculum. For each task one lesson (50–70 min) was allocated. The teachers introduced the issue and the task, organised the group discussions, and summarised the discussions together with the students at the end of the lesson. The duration of the audio-recorded discussions varied between 10–15 min for ‘Earth at Night’ and 15–20 min for ‘Do we have enough food?’. The students were encouraged to express their thoughts, standpoints and knowledge, and discuss the socioscientific issue from different perspectives. The teachers told the students that it was the reasoning and exchange of thoughts that was important, rather than finding easy answers to the socioscientific issues.

Analysis

The analysis involved reading the transcripts whilst focusing on patterns of consistency, contradictions, fragmentation of speech and variations (Potter & Wetherell, 1987). Iterative reading of the material was critical to gain views on which interpretative repertoires were identified (Edley, 2001). In this research, we used the concepts of interpretative repertoires, ideological dilemmas and subject positions as analytical tools. The first step in the analytical process involved identifying interpretative repertoires in the material, then posing analytical questions ‘what ideological dilemmas occur in the student discussions?’ and ‘which subject positions are constructed by the interpretative repertoire?’. However, the process was not as linear as this suggests. As Reynolds and Wetherell (2003) describe, various analytical tools work together, for example, in the
process of analysing interpretative repertoires, subject positions appeared. It became clear that sometimes the subjects were ‘man’ and ‘they’, in other parts of the speech the subjects were ‘we’. Similarly, where ideological dilemmas were visible in the students’ discussions, interpretative repertoires also clearly emerged. In this way, the three analytical foci were used simultaneously in the analysis.

It was important to have knowledge about the character of the group discussions to understand the analysis. The students’ meaning-making processes in the audio-recorded group discussions were similar across the different groups in relation to the SSI discussed. Though students in different classes had different levels of discussion, the same interpretative repertoires were identified in the different classes and groups. Group discussions were, of course, structured according to the design of the tasks and the questions within them, but the students did not simply discuss one question, come to a conclusion and then start to discuss the next question. It was common to return to a question already discussed, look at it from a new perspective and come to another conclusion. Thus the discussions were not consistent, rather the students exchanged perspectives and positions back and forth during the conversation. It was unusual for a student to argue for one standpoint consistently. Rather, the same student expressed different standpoints in different situations in the discussion and thus alternated between different interpretative repertoires in the speech. In our analysis, we were not interested in utterances of individual students and whether an individual student expressed a certain opinion. Our focus was instead on which interpretative repertoires were in use in the students’ group discussions. The analytical tool of interpretative repertories describes social and collective patterns in people’s speech and we were interested in the patterns that could be expressed in these teaching situations. The results should therefore be understood as collective talk that can come up in these situations in a class. This does not necessarily mean that all students were involved in all interpretative repertoires. In this analysis, there were a limited number of identifiable interpretative repertoires that related to each SSI, and the precise numbers of students involved in each discussion was less important than what the meaning-making process revealed about democratic participation.

The analysis was initially undertaken by the first author, but extracts of the empirical data were shared with three other researchers to discuss ongoing interpretation of interpretative repertoires in order to establish intersubjective agreement. This process was repeated on several occasions until agreement of interpretation was reached, and the same patterns which formed the different interpretative repertoires were identified by other researchers. The analysis included all talk that related to the socioscientific issue discussed but excluded private talk and other discussions irrelevant to the task at hand.

**Interpretative repertoires**

According to Potter and Wetherell (1987), interpretative repertoires are analysed by studying patterns in the discussions; variations in what is expressed, consistency in what is expressed and whether there are exceptions in what is said. We examined how the students talked about societies, then how they talked about others and finally how they talked about nature / the environment. To describe the analytical process, we explain here how the interpretative repertoire *They will catch up* was identified through the analysis of the task ‘Earth at Night’. Patterns and consistency discerned in the student discussions were found when the students talked about the distribution of
light. When students discussed the present, the light was unevenly distributed, while when they discussed the future, the light was envisaged as more evenly distributed. The students often said that satellite images in the future will be brighter. Sometimes they gave explanations for this, e.g. because more people get electricity or that countries get richer. There were exceptions in students’ talk that made the interpretative repertoire appear sharper. For example, one utterance made in just two groups was that it would not be brighter in Africa and that it would be brighter in richer countries. In addition, one group said that it will be lighter in the future where it is dark on today’s satellite image and be darker on the satellite images of the future where it is bright on today’s satellite images. Another pattern in the student discussions was that students searched for words and used words that were different when talking about Africa, e.g. catch up, after, upgrade. Other patterns included statements about equality, statements that arose only if justice and equality were self-evident, and expressions that suggested all people should have a good life. We identified the interpretative repertoires in the students’ discussions in respective tasks; these are shown and exemplified in the results section (Tables 1 and 2). We wanted to stay close to the students’ talk, therefore we named the interpretative repertoires according to how the students expressed themselves.

**Ideological dilemmas**

Ideological dilemmas were analysed through actively searching for situations in the student discussions where the conceptions within one interpretative repertoire collided with conceptions within another interpretative repertoire. The collisions represented ideological dilemmas in the student’ discussions, that is, the students ended up in situations where it became problematic to meet the different expectations involved in the different interpretative repertoires. For example, equality is ‘right’ to advocate (according to one interpretative repertoire) as well as being restrained with limited resources (another interpretative repertoire), but these ideas were seen to be in tension if equality is achieved by poorer people using more resources. In these situations, we analysed what conceptions were set against each other. The transcript below from one of the students’ discussions illustrates the analysis. The extract has been shortened, and the translation and transcription made readable.

Jane: [reads the assignment] When other students are asked about what the satellite picture will look like in 100 years, the following two scenarios have been presented, it may be brighter than what this picture shows or it may be darker than what this picture shows. Try to find arguments or reasons for what can lead to both of these scenarios, based on what you know about human energy use and its development. Then try to agree on which of these scenarios you think is most reasonable.

Jane: I mean … that it might get darker is that you should save electricity (mmm) i.e. environmental reasons.

Ella: It gets brighter, … if we were to use more.

Jane: What else can make it brighter then?

Fanny: If it[light/electricity] spreads to other countries, that … like Africa and all that, start using it [light/electricity].

Ella: They do not now [or]?
Jane: So, you like upgrade Africa.

Ella: They are a pretty poor country … Africa, so if they get richer, they will surely start to use more. Electronics.

Fanny: It can be both positive and negative that the satellite picture becomes brighter.

Jane immediately said that it might get darker if you save electricity for environmental reasons. So, here the interpretative repertoires Save – don’t waste and Help the environment were interwoven, that is, it is good for the environment if we limit our electricity use. In the discussion, the students also said that the satellite picture could be brighter in Africa. According to the students, this leads to increased equality, hence the interpretative repertoire They will catch up. Because these two conceptions are in tension they provide an example of an ideological dilemma.

**Subject positions**

Based on the interpretative repertoires, we also noted that subjects were positioned and constructed in different ways in different interpretative repertoires. Since people’s talk has multiple functions and different consequences for how the self and others are conceptualised in discussions, we posed an analytical question of the empirical material: what functions and consequences does the interpretative repertoire have in the discussion? We used the concepts untroubled and troubled subject positions (Reynolds & Wetherell, 2003) as a thinking tool in the analysis. We identified that in some interpretative repertoires the individual did not need to act to fulfil the expectations of the interpretative repertoire, thus they were defined as having an untroubled subject position. However, the individual could also end up in situations where he/she would need to act in a certain way to fulfil the expectations of the interpretative repertoire or would be forced to choose between expectations of what is right within the various repertoires, thus they were defined as having a troubled subject position. Through this analysis we identified strategies the subjects used to avoid a troubled subject position. We also asked the analytical question: what consequence does an interpretative repertoire have for how individuals are expected to act in relation to the SSI? We decided to name the subject positions as ‘can act responsibly’ when the interpretative repertoire implies action from the individual, and ‘no need to act’ when the repertoire does not require action by the individual, as ‘others’ are seen to have responsibility for action.

**The function and use of science in students’ discussions**

The first step in the analytical process was to highlight statements and conversation sequences that could be related to science and a science discourse. Since human speech has several functions and has different consequences for how objects are presented (Potter & Wetherell, 1987) we asked the following questions regarding science in the discussion: What function does science have in the discussion? What consequences does science have in the discussion? A similar analysis is made by Rudsberg and Öhman (2015), who analysed what function knowledge had in students’ discussions about sustainability issues. In our analysis, the focus was to determine how students used their knowledge in and about science during the discussions, that is, whether their talk
made reference to scientific knowledge, or to wider discourses about science. The overall functions of science were identified as (i) to make the issue more understandable and raise questions, (ii) to evaluate, decide and act, (iii) to give authority to arguments and (iv) to make reference to scientists solving problems. These functions are exemplified in the results section below. By expressing trust in science when making reference to scientists solving problems, students turned a troubled subject position to an untroubled subject position and thereby solved the ideological dilemmas they encountered when discussing the SSI. Moreover, we also identified in which interpretative repertoires students made reference to scientific knowledge or wider science discourses, and how they used science in these interpretative repertoires. The role of science in the interpretative repertoires refers to the role that students ascribed to science, scientists, or scientific processes. If the students gave science no role to play in a specific interpretative repertoire we defined this as no science – even though, as an outside observer, you might see science that is relevant to the interpretative repertoire. For example, in the interpretative repertoires *There will be more* and *They will catch up*, it could be argued that science about economic growth and development of lower SES countries is involved. But in the student discussions the students did not relate to this. Likewise in the interpretative repertoire *Not many vegetarians* there could be a huge amount of science involved but in the student discussions the students’ talk was only based on their own relationship to vegetarians. In this analysis we wanted to stay close to students’ talk, rather than add additional layers of meaning from our own understanding of science and add links to science that the students themselves did not include. This analysis serves to further our understanding of the highly context-dependent use of scientific knowledge and science discourses in SSIs with strong emotions and/or values, as discussed by Simonneaux and Simonneaux (2009b).

**Results**

**Interpretative repertoires identified in students’ discussions**

To understand how democratic participation was constructed when students were working with these tasks it was important to determine the meaning-making process through their use of interpretative repertoires. For each of the two tasks, five interpretative repertoires were identified from students’ talk in the discussions (see Tables 1 and 2, first two columns). The students used interpretative repertoires that carried different conceptions of the world to create meaning. The analytical process for developing these interpretative repertoires has been outlined in the analysis section above. In the results presented here we provide more exemplar material from the data in the tables to show how interpretative repertoires related to student talk and how science was used (third column).

**Experiencing democratic participation through ideological dilemmas**

As students discussed the issues in each task, ideological dilemmas arose. This happened when two or more interpretative repertoires collided and revealed different conceptions, or ‘truths’ that contradicted each other. Dilemmas caused the students to critically reflect over prevailing discourses around the specific SSI and engaged them in deliberative
Table 1. Interpretative repertoires, conceptions and the function and use of science within students’ discussions on the task ‘Earth at Night’. Both with excerpts from the student’ discussions.

| Interpretative repertoires | Conception in the students’ talk, with examples | The function and use of science in the interpretative repertoire |
|----------------------------|-------------------------------------------------|---------------------------------------------------------------|
| There will be more         | The idea of a world in growth and development.  | No science used by students in the repertoire                |
|                            | Ann: Maybe more countries that have more industries. |                                                              |
|                            | Boris: There will be … like the countries become more populated … so they will be much lighter, I think. |                                                              |
| They will find something out| The notion of scientific progress, technological development and trust in science and technology. | Scientists solving problems                                    |
|                            | My: I don’t think it will become darker … because they will find something out, like several new ways to get energy … | By expressing faith in science and technology and handing over the societal issue for scientists and technicians to solve. |
| Helping the environment    | People should show care and responsibility for the environment and help nature. | Evaluate, decide and act                                       |
|                            | Siv: But there is a thing, you see more and more of those things … that will help the climate. | By evaluating actions and individuals.                        |
|                            | Make the issue more understandable and raise questions | Make the issue more understandable and raise questions | |
|                            | Evaluate, decide and act |  By evaluating consequences. | |
|                            | Martina: We must save (yes) we have to save as well. |  By evaluating consequences. | |
| Save – don’t waste         | People have to change their lifestyle to live within the Earth’s limited resources. | Make the issue more understandable and raise questions | |
|                            | Soft: I think the most reasonable thing [about the future] is that, […] maybe it’s running out of energy. | By clarifying conditions, identifying consequences, searching for explanations and scrutinising information. |
|                            | […] | Evaluate, decide and act |                  |
|                            | Sigrid: Solar energy … may not be enough. | By evaluating consequences. |                  |
|                            | Soft: We must save (yes) we have to save as well. | By evaluating consequences. |                  |
| They will catch up         | Increased equity in the future due to the ‘Others’ catching up to western society and lifestyle. | Make the issue more understandable and raise questions | |
|                            | Rebecka: I think Africa and they will catch up a little too. | By clarifying conditions, identifying consequences, searching for explanations and scrutinising information. |
|                            | Robert: Let’s hope for that. | Evaluate, decide and act |                  |

discussions around the issue (Lundegård & Caiman, 2019). For example, in the task ‘Earth at Night’, four of the interpretative repertoires created three ideological dilemmas in students’ discussions and hence tension in the discussion. The conflicting interpretative repertoires that created such dilemmas were: There will be more vs Save – don’t waste; There will be more vs Help the environment; Help the environment vs They will catch up. One example of an ideological dilemma between There will be more vs Save – don’t waste is presented below:
Vanja: Is what we found as the most likely scenario a desirable scenario? [that it gets lighter].

Yrsa: NO!

Vanja: no, it’s not … or?
Yrsa: Ehh, You want the development to move forward but not that you … use as much energy as now

Yrsa expressed a wish for the development to move forward while at the same time stated that you should not use as much energy as you do now. The students realised that it might be problematic to envisage how the Earth’s resources would be sufficient for continued growth and development.

Similarly, some interpretative repertoires coincided and strengthened each other’s conceptions. The repertoires Save – don’t waste and Help the environment strengthened each other, because if we live within the Earth’s limits the environment will not be harmed. Likewise, There will be more and They will catch up supported each other because the conception was that a world in growth and development would lead to equality. It became an ideological dilemma in the discussion when the fact that a world in growth and development would lead to more equality was in tension with the perception that humans should live within the Earth’s limits and thereby not harm the environment. This dilemma was exemplified in the analysis section, where Jane first talked about saving energy because of environmental reasons (Save – don’t waste and Help the environment), then Jane and Fanny went on to talk about Africa catching up and the satellite picture getting lighter (They will catch up and There will be more). In the end Fanny pointed out the ideological dilemma.

In the task ‘Do we have enough food?’ the interpretative repertoires Save the environment and Enough for everyone could be mutually reinforcing if people were to move away from eating so much meat. Animal breeding causes loss of resources (energy and protein) and requires larger land areas than would be required if humans just ate the cereals grown. This scenario can lead to the conclusion that there may not be enough food for everyone if we continue to eat as much meat as we do. However, these two interpretative repertoires created an ideological dilemma with I want – I decide, in which the view was expressed that the individual has the right to decide what to eat. That is, no-one can tell another person what to eat or not eat.

These contradictory ‘truths’ in the ideological dilemma revealed different societal discourses surrounding the SSI, which provided the students with an opportunity to reflect on the SSI and how it is discussed in society. Ideological dilemmas show the need for a deeper understanding of the issue that the students discussed and the associated discourses in society. However, these ideological dilemmas also put the students in a troubled subject position when they wanted to fulfil both conceptions in the interpretative repertoires.

**Solving ideological dilemmas through talk**

Within both tasks students experienced or were positioned in untroubled and troubled subject positions. In an untroubled subject position, there is no need for the individual to act; the prevailing order is sustained. The interpretative repertoire They will find something out worked this way, as shown in the excerpt below. Scientific and technological developments absolve the common person from responsibility by handing over the problem to scientist and technicians.

My: I don’t think it’s going to get darker.

Mona: No, I don’t think so either … it would be …
My: So, one will come up [...], with so many new ways to use, to get energy, so therefore I do not think the energy will end, on the other hand, the oil can, because it is, well, because it is probably the red [light in the satellite image].

Mona: Yeah, so there are still other ways to get ... energy.

Lotta: Yeah.

The interpretative repertoires There will be more and They will catch up worked similarly in ‘Earth at Night’. Too many animals created an untroubled subject position in ‘Do we have enough food?’ as Martina expressed: ‘It would not work if everyone was a vegetarian ... then all animals would become more and more.’ Likewise, I want – I decide and Not many vegetarians also allowed for an untroubled subject position for the individual because these repertoires position the discussion in a Swedish context where there is always food and there is an individual choice to be a vegetarian. These repertoires avoid the global dimension of the issue.

A troubled subject position arose if students wanted to agree with opposite conceptions in contradictory interpretative repertoires. The interpretative repertoires Save – don’t waste, Helping the environment, Save the environment and Enough for everyone all lead to troubled subject positions, because the repertoires suggest that an individual has to act in some way to fulfil all the interpretative repertoires’ conceptions. For example, in the task ‘Do we have enough food?’ the interpretative repertoires Save the environment and Enough for everyone demand that you, as an individual, must take action by reducing meat consumption to minimise the environmental impact whilst also promoting equality between people. Sometimes ideological dilemmas and troubled subject positions persisted in the discussions, but often the students’ talk avoided the troubled subject position rather than focussing on ways to address the problem. Such avoidance was accomplished in different ways, which include:

• ‘Magic bullet’ that makes the dilemma resolves itself. The interpretative repertoire They will find something out solves the dilemma by believing in scientific and technical solutions to sustainability problems
• Making the dilemma invisible. The interpretative repertoires Not many vegetarians and Too many animals have these consequences because Not many vegetarians places the discussion in a Swedish context and avoids global aspects. Too many animals hold the conception that humans are meat-eaters and thereby the amount of animals is regulated.
• Create compromises between interpretative repertoires that make the dilemma dissolve. For example, the responsible ‘meat eater’ is a compromise between Save the environment, Enough for everyone and I want – I decide.
• One interpretative repertoire takes over. The conception of the interpretative repertoire Helping the environment is often seen as most important.

Subject positions in relation to democratic participation

The interpretative repertoires also offer subject positions that relate to democratic participation by including a subject where individuals can either act responsibly or where
there is no need for them to act (Table 3). One example is the interpretative repertoire
There will be more – in this repertoire the individual does not need to act because societal
development just happens. The interpretative repertoire I want – I decide, on the other
hand, creates a subject who has to decide for herself – the individual can either choose
to act responsibly or to not act at all. Other interpretative repertoires like Save – don’t waste include a subject who can act responsibly. In Table 3, the subject positions for
each interpretative repertoire have been labelled as ‘can act responsibly’ or ‘no need to act’.

**The function and use of science in students’ discussions**

In six out of the ten interpretative repertoires, one or more functions of science were identified in the students’ discussions. How students used science ranged from directly applying scientific knowledge to making less specific reference to ideas that had a scientific basis, to using no science as students made clarifications and searched for explanations. Science was used in the students’ meaning-making process to explore understanding about the specific SSI, also, when ideological dilemmas revealed insecurities about students’ knowledge-base, they asked for more knowledge in and about science (Tables 1 and 2).

Students used science to ‘Make the issue more understandable and raise questions’ in both tasks, in a total of four of the repertoires (Figure 1). Students also used science to ‘Evaluate, decide and act’ in the same four interpretative repertoires (Figure 1). For example, students identified consequences and compared, assessed and evaluated them.

![Figure 1. Students use of science in their group discussions. Marked in grey are interpretative repertoires that turn a troubled subject position into a untroubled subject position and marked with bold demarcation is the repertoire with fallacious reasoning.](image-url)
They also scrutinised information (Tables 1 and 2). In the task ‘Do we have enough food?’ the students used science to ‘Give authority to arguments’ in two interpretative repertoires (Figure 1). In the repertoire Enough for everyone students’ scientific knowledge about limited resources was used as an argument for allocating resources to all people by eating more vegetarian food (Table 2). In the repertoire Too many animals the students used their scientific knowledge in population dynamics to express the need for humans to eat meat, otherwise there would be too many animals on earth because of less predation (Table 2). This reasoning is in line with reasoning about how top predators, for example wolves, affect other species populations, for example roe deer. However, students’ knowledge was applied in a context, food production, where the process is more likely to reduce animal breeding than in a scenario where cows, sheep etc. are freely breeding in a natural environment. We therefore identified this as fallacious reasoning. In this repertoire, the function of ‘Give authority to arguments’ also had the function of putting the student in an untroubled subject position. The interpretative repertoire holds the conception that according to science humans are meat-eaters and predation is an important factor in population dynamics (Figure 1). ‘Scientists solving problems’ was only used in the task ‘Earth at Night’, with reference to the notion of scientific progress and technological development (Table 1). By expressing faith in science and technology the societal issue is handed over for scientists and technicians to solve, thus a troubled subject position is avoided. In both tasks there was at least one interpretative repertoire that had the function of turning a troubled subject position into an untroubled subject position.

Overall our results show that the students’ use of science was extended during the discussions, e.g. as arguments or explanations were developed using scientific knowledge, or with reference to science discourses. The students thereby experienced different functions of science. We also identified that on occasions when students were put in a troubled subject position, they sometimes used science to turn the troubled subject position into an untroubled position.

**Discussion and conclusion**

According to Sadler et al. (2007), teaching based on SSIs in science education has the potential for promoting democratic participation for students. In this study, we chose to analyse how democratic participation was constructed for individuals using two SSI tasks within a value-inclusive science education. From the results, we can conclude that the students experienced democratic processes through deliberative conversations and critical reflection of the SSIs, which Lundegård and Caiman (2019) suggest is important in learning democratic participation.

The two value-inclusive SSI tasks provided the students with several learning opportunities in relation to democratic participation. The tasks were designed to create ideological dilemmas, which reveal different conceptions of sustainability that exist in society and thereby have the potential to uncover norms and values in relation to the SSIs discussed. Experiencing ideological dilemmas led the students to ask questions about these conceptions and identify their need for scientific knowledge to further their ability to evaluate and scrutinise information about the SSI, thus taking one step forward in critical thinking (Levinson, 2010; Rudsberg & Öhman, 2015; Simmonaux, 2014). We conclude that tasks built around ideological dilemmas can create learning opportunities about
democratic participation by creating awareness about discourses, ideological dilemmas and subject positions that inform SSI discussions.

According to discursive psychology (Davies & Harré, 1990), people adapt to the discourses available and create positions that make themselves and their actions acceptable. In these discussions, the students often converted a troubled subject position to an untroubled position and thereby avoided the ideological dilemma within the SSI. The consequence was that the discussion did not always address the problem and find solutions to the SSI. M. Öhman and Öhman (2012) identified that when students were discussing sustainable cities, their conclusions focused only on benefits of sustainable cities, without conflicts between social, ecological and economical perspectives. It seems that democratic participation was constructed similarly in those discussions by avoiding troubled subject positions. Within the discussions in this study, there were instances when democratic participation was constructed as ‘someone else will deal with these issues’, which was exemplified in relation to energy and food-consumption. Avoiding troubled subject positions in this way can disempower the students’ feeling of democratic participation. On other occasions, the students created compromises between interpretative repertoires that made the dilemma dissolve (the responsible ‘meat eater’) or valued one interpretative repertoire as the most important, or created subject positions where the individual can act responsibly, which led to more empowering aspects of democratic participation.

The results show that knowledge in and about science was used in a multifaceted way by the students. For example, they clarified conditions and identified and evaluated consequences of different actions by using their existing knowledge in and about science. The students did not encounter ‘new’ scientific facts whilst discussing these issues, instead they applied their knowledge to the SSIs and explored different functions science can have when discussing SSIs. By engaging in such discussions and sharing scientific knowledge as they developed understanding and arguments, the students had the opportunity to extend their experience about what knowledge in and about science can be used for.

The students also used knowledge in and about science to ‘cool down’ the SSIs (Simonneaux, 2014), and thus avoid any ideological dilemmas, as exemplified in the repertoires They will find something out and Too many animals. In the interpretative repertoire, They will find something out students expressed trust that science and technology would solve the ideological dilemma, a function earlier described by Levinson (2010) and Simonneaux (2014). The interpretative repertoire Too many animals has a normative function that tells us how to act according to science (eating meat), a function suggested earlier by Östman and Almqvist (2011) and Rudberg and Öhman (2015), which absolves the individual from making his/her own choices and actions.

This study also shows that students sometimes end up in scientific fallacious reasoning, reasoning that leads to conclusions that are not relevant (Zeidler, 2014), as shown in the interpretative repertoire Too many animals. In this repertoire, students turned a troubled subject position to an untroubled subject position as this SSI was emotionally charged and close to the students’ identity as meat-eaters.

Learning for democratic participation is complex. On the one hand, from these results, we can conclude that value-inclusive tasks enhanced learning for democratic participation through deliberative discussions, critical reflection, uncovering of values and a multifaceted use of scientific knowledge. On the other hand, these results show disempowering notions of democratic participation, such as ignoring ideological dilemmas
through converting a troubled subject position to an untroubled position and fallacious reasoning. In other words, without empowering students to actually change or take actions that can make a difference. So, what do we learn from this study than can inform practice and future research?

Encouraging students to become aware of conceptions about sustainability can be the first step towards a science education for social change (e.g. Bencze & Carter, 2011; Hodson, 2003). Teaching about SSIs can put students in a position where his/her way of life is questioned; a troubled subject position. In these situations, students – through language, can explore other options and become empowered to consider new solutions. They can learn to see that turning a troubled subject position into an untroubled one can be unintendedly disempowering; a way of avoiding their personal democratic responsibilities and power to change their world for the better by making the entire situation ‘someone else’s job’. These are occasions where teachers can pay extra attention in SSI teaching, such as how knowledge in and about science is used and how democratic participation is constructed. Zeidler et al. (2011) argue that teachers should avoid issues that lead to fallacious reasoning, however, when we know more about how fallacious reasoning evolves such issues can be used in teaching to increase student’s awareness about how they might fall into fallacious reasoning. For example, if the teacher asks the students to scrutinise the interpretative repertoire Too many animals, the students will have the opportunity to identify the fallacious reasoning themselves. Such awareness is an important competence for scientific literacy of today.

Our results are based on two short (10–20 min) group discussions, each took place in one lesson. How teachers choose to use these discussions in the lesson is important for learning about how democratic participation is constructed. Instead of asking the students for their answers to the different questions within the tasks we think a meta-discussion about the meaning-making process can create learning about ideological dilemmas, strategies for how to avoid troubled subject positions and conceptions held in discourses surrounding the SSI. It would be interesting to know how students would respond if teachers encouraged them to reflect on the task by asking questions like ‘Based on your discussion, who is in control of what actions that shall be done/not done?’ or ‘What expectations exist in society about how you as an individual shall act in the SSI?’ or ‘Is scientific knowledge helpful in this SSI? How?’ This approach can lead to discussions about empowering and disempowering notions of democratic participation. A more extended inclusion of such tasks in a social science programme could have the potential to raise students’ awareness and confidence in engaging in SSI debates. Furthermore, tasks built around ideological dilemmas can be used as ‘starters’ for a new teaching topic in science, for example biodiversity or energy production, since these issues are shown in our results to raise students’ questions. Students’ questions can then be used to further investigate the SSI. An interesting question is what students learn from these discussions, do they learn about dilemmas and the complexity within these issues or is it the interpretative repertoire that solves the dilemma that will remain prominent? More research is needed to answer this question.

The results of this study were obtained through only two tasks with a limited number of students. Though the detailed analysis of their interpretative repertoires has revealed much about how they construct democratic participation, caution is needed to make wider claims for how other students and tasks might impact on students’ democratic
participation. For example, sudden changes in society such as a pandemic or the ‘Greta-effect’ may rapidly change how certain SSIs are discussed. The study provides evidence that student led discussions can help students become aware of the tactics needed to face and productively resolve ideological dilemmas and hence be a first step towards equipping them with the scientific knowledge and skills needed to contribute to societal discussions about socioscientific issues. By focusing on sustainability issues, such as the world’s energy consumption and food production of this study, school students can engage in activities that address issues of global concern, where they have to address scientific, ethical, and social dimensions. In doing so it is believed that all students will grow to feel that they can effectively contribute to socioscientific discussions, and are thereby empowered to engage in democratic discussions of science in society.

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References

Aikenhead, G. (2006). Science education for everyday life: Evidence-based practice. Teachers College Press.
Bencze, L., & Carter, L. (2011). Globalizing students acting for the common good. Journal of Research in Science Teaching, 48(6), 648–669. https://doi.org/10.1002/tea.20419
Berland, L. K., & McNeill, K. L. (2010). A learning progression for scientific argumentation: Understanding student work and designing supportive instructional contexts. Science Education, 94(5), 765–793. https://doi.org/10.1002/sce.20402
Billig, M. (2001). Discursive, rhetorical and ideological messages. In M. Wetherell, S. Taylor, & S. J. Yates (Eds.), Discourse theory and practice: A reader (pp. 210–221). Sage Publications.
Billig, M., Condor, S., Edwards, D., Gane, M., Middleton, D., & Radley, A. (1988). Ideological dilemmas: A social psychology of everyday thinking. Sage Publication Ltd.
Borg, C., Gericke, N., Höglund, H.-O., & Bergman, E. (2012). The barriers encounter by teachers implementing education for sustainable development: Discipline bound differences and teaching traditions. Research in Science & Technological Education, 30(2), 23. https://doi.org/10.1080/0265143.2012.699891
Byrne, J., Ideland, M., Malmberg, C., & Grace, M. (2014). Climate change and everyday life: Repertoires children use to negotiate a socio-scientific issue. International Journal of Science Education, 36(9), 1491–1509. https://doi.org/10.1080/09500693.2014.891159
Christenson, N., Rundgren, S.-N., & Höglund, H.-O. (2012). Using the SEE-SEP model to analyze upper secondary students’ use of supporting reasons in arguing socioscientific issues. Journal of Science Education and Technology, 21(3), 342–352. https://doi.org/10.1007/s10956-011-9328-x
Creswell, J. W. (2005). Educational research: Planning, conducting, and evaluating quantitative and qualitative research. Pearson Education, Inc.
Davies, B., & Harré, R. (1990). Positioning: The discursive production of selves. *Journal of Theory for Social Behavior, 20*(1), 43–65. https://doi.org/10.1111/j.1468-5914.1990.tb00174.x

Edley, N. (2001). Analysing masculinity: Interpretative repertoires, ideological dilemmas and subject positions. In M. Wetherell, S. Taylor, & S. Yates (Eds.), *Discourse as data: A guide for analysis* (pp. 109–128). The Open University.

Feinstein, N. (2001). Analysing masculinity: Interpretative repertoires, ideological dilemmas and subject positions. In M. Wetherell, S. Taylor, & S. Yates (Eds.), *Discourse as data: A guide for analysis* (pp. 109–228). The Open University.

Grace, M. (2009). Developing high quality decision-making discussions about biological conservation in a normal classroom setting. *International Journal of Science Education, 31*(4), 551–570. https://doi.org/10.1080/09500690802076800

Haglund, J., & Hultén, M. (2017). Tension between visions of science education: The case of energy quality in Swedish secondary science curricula. *Science and Education, 26*(3-4), 323–344. https://doi.org/10.1007/s11191-017-9895-1

Hasslöf, H. (2015). *The educational challenge in ‘education for sustainable development’: Qualification, social change and the political*. [Doctoral dissertation, Malmö University]. Malmö Universitet.

Hodson, D. (2003). Time for action: Science education for an alternative future. *International Journal of Science Education, 25*(6), 645–670. https://doi.org/10.1080/09500690305021

Ideland, M., & Malmberg, C. (2012). Body talk: Students’ identity construction while discussing a socioscientific issue. *Cultural Studies of Science Education, 7*(2), 279–305. https://doi.org/10.1007/s11422-012-9381-7

Jickling, B., & Wals, A. E. J. (2008). Globalization and environmental education: Looking beyond sustainable development. *Journal of Curriculum Studies, 40*(1), 1–21. https://doi.org/10.1080/00220270701684667

Kidman, G., & Fensham, P. (2020). Intended, achieved and unachieved values of science education: A historical review. In D. Corrigan, C. Buntting, A. Fitzgerald, & A. Jones (Eds.), *Values in science education: The shifting sands* (pp. 173–190). Springer Nature.

Kolstø, S. D. (2001a). Scientific literacy for citizenship: Tools for dealing with the science dimension of controversial socioscientific issues. *Science Education, 85*(3), 291–310. https://doi.org/10.1002/sce.1011

Kolstø, S. D. (2001b). ‘To trust or not to trust – pupils’ ways of judging information encountered in a socio-scientific issue. *International Journal of Science Education, 23*(9), 877–901. https://doi.org/10.1080/09500690010016102

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.

Levinson, R. (2010). Science education and democratic participation: An uneasy congruence? *Studies in Science Education, 46*(1), 69–119. https://doi.org/10.1080/03057260903562433

Lindahl, M., & Lundin, M. (2016). How do 15-16 year old students use scientific knowledge to justify their reasoning about human sexuality and relationships? *Teaching and Teacher Education, 60*, 121–130. https://doi.org/10.1016/j.tate.2016.08.009

Lundegård, I., & Caiman, C. (2019). Didaktik för naturvetenskap och hållbar utveckling: Fem former av demokratiskt deltagande [Education for science and sustainable development: Four forms of democratic participation]. *NordiNa, 15*(1), 38–53. https://doi.org/10.5617/nordina.4822

Lundegård, I., & Wickman, P.-O. (2007). Conflicts of interest: An indispensable element of education for sustainable development. *Environmental Education Research, 13*(1), 1–15. https://doi.org/10.1080/13504620601122566

Lundström, M., Ekborg, M., & Ideland, M. (2012). To vaccinate or not to vaccinate: How teenagers justified their decision. *Cultural Studies of Science Education, 7*(1), 193–221. https://doi.org/10.1007/s11422-012-9384-4
Mogensen, F. (1997). Critical thinking: A central element in developing action competence in health and environmental education. *Health Education Research Theory & Practice, 12*(4), 429–436. https://doi.org/10.1093/her/12.4.429

Mogensen, F., & Schnack, K. (2010). The action competence approach and the “new” discourses of education for sustainable development: Competence and quality criteria. *Environmental Education Research, 16*(1), 59–74. https://doi.org/10.1080/13504620903504032

Nielsen, J. A. (2012a). Co-opting science: A preliminary study of how students invoke science in value-laden discussions. *International Journal of Science Education, 34*(2), 275–299. https://doi.org/10.1080/09500693.2011.572305

Nielsen, J. A. (2012b). Science in discussions: An analysis of the use of science content in socioscientific discussions. *Science Education, 96*(3), 428–456. https://doi.org/10.1002/sce.21001

Nielsen, J. A. (2013). Delusions about evidence: On why scientific evidence should not be the main concern in socioscientific decision making. *Canadian Journal of Science, Mathematics and Technology Education, 34*(2), 275–299. https://doi.org/10.1080/09500693.2011.572305

Öhman, J. (2006). Pluralism and criticism in environmental education and education for sustainable development: A practical understanding. *Environmental Education Research, 12*(2), 149–163. https://doi.org/10.1080/13504620600688856

Öhman, J., & Öhman, M. (2012). Participatory approach in practice: An analysis of student discussions about climate change. *Environmental Education Research, 19*(3), 324–341. https://doi.org/10.1080/13504622.2012.695012

Öhman, M., & Öhman, J. (2012). Harmoni eller konflikt?: En fallstudie av meningsinnehållet i utbildning för hållbar utveckling [Harmony or conflict?: A case study of the conceptual meaning of education for sustainable development]. *NorDiNa, 8*(1), 59–72.

Orlander Arvola, A., & Lundegård, I. (2012). ‘It’s her body’: When students’ argumentation shows displacement of content in a science classroom. *Research in Science Education, 42*(6), 1121–1145. https://doi.org/10.1007/s11165-011-9237-2

Osborne, J., & Dillon, J. (2008). *Science education in Europe: Critical reflections. A report to the nuffield foundation.* King’s College London.

Östman, L. (1995). *Socialisation och mening: No-utbildning som politiskt och miljömoraliskt problem* [Socialization and meaning: Science education as a political and environmental moral problem]. [Doctoral dissertation, Uppsala university]. Uppsala Universitet.

Östman, L., & Almqvist, J. (2011). What do values and norms have to do with scientific literacy. In C. Linder, L. Östman, D. A. Roberts, P.-O. Wickman, G. Erickson, & A. MacKinnon (Eds.), *Exploring the landscape of scientific literacy* (pp. 160–175). Routledge.

Ottander, K. (2015). *Gymnasieelevers diskussioner utifrån hållbar utveckling* [Upper secondary school students’ discussions arising from sustainability issues]. [Doctoral dissertation, Umeå university]. Umeå universitet, Umeå.

Potter, J., & Wetherell, M. (1987). *Discourse and social psychology: Beyond attitudes and behavior.* Sage Publications.

Ratcliffe, M., & Grace, M. (2003). *Science education for citizenship: Teaching socio-scientific issues.* Open University.

Reynolds, J., & Wetherell, M. (2003). The discursive climate of singleness: The consequences for women’s negotiation of a single identity. *Feminism & Psychology, 13*(4), 489–510. https://doi.org/10.1177/09593535030134014

Roberts, A. D. (2007). Scientific literacy/science literacy. In S. K. Abell, & N. G. Lederman (Eds.), *Handbook of research on science education* (pp. 729–780). Lawrence Erlbaum Associates.

Roberts, D. A., & Bybee, R. W. (2014). Scientific literacy, science literacy, and science education. In N. G. Lederman, & S. K. Abell (Eds.), *Handbook of research on science education* (Vol. 2 (pp. 545–558). Routledge, Taylor & Francis.

Roth, W.-M., & McGinn, M. (1997). Deinstitutionalising school science: Implications of a strong view of situated cognition. *Research in Science Education, 27*(4), 497–513. https://doi.org/10.1007/BF02461477
Rudsberg, K., & Öhman, J. (2010). Pluralism in practice – experiences from Swedish evaluation, school development and research. Environmental Education Research, 16(1), 95–111. https://doi.org/10.1080/13504620903504073

Rudsberg, K., & Öhman, J. (2015). The role of knowledge in participatory and pluralistic approaches to ESE. Environmental Education Research, 21(7), 955–974. https://doi.org/10.1080/13504622.2014.971717

Rudsberg, K., Öhman, J., & Östman, L. (2013). Analyzing students’ learning in classroom discussions about socioscientific issues. Science Education, 97(4), 594–620. https://doi.org/10.1002/sce.21065

Sadler, T. D. (2004). Informal reasoning regarding socioscientific issues: A critical review of research. Journal of Research in Science Teaching, 41(5), 513–536. https://doi.org/10.1002/tea.20009

Sadler, T. D. (2009). Situated learning in science education: Socio-scientific issues as contexts for practice. Studies in Science Education, 45(1), 1–42. https://doi.org/10.1080/03057260802681839

Sadler, T. D. (2011). Situating socio-scientific issues in classrooms as a means of achieving goals of science education. In T. D. Sadler (Ed.), Socio-scientific issues in the classroom: Teaching, learning and research (pp. 1–11). Springer.

Sadler, T. D., Barab, S. A., & Scott, B. (2007). What do students gain by engaging in socioscientific inquiry? Research in Science Education, 37(4), 371–391. https://doi.org/10.1007/s11165-006-9030-9

Sadler, T. D., & Zeidler, D. L. (2005). Patterns of informal reasoning in the context of socioscientific decision making. Research in Science Education, 42(1), 112–138. https://doi.org/10.1002/tea.20042

Santos, W. L. (2014). Debate on global warming as a socio-scientific issue: Science teaching towards political literacy. Cultural Studies of Science Education, 9(3), 663–674. https://doi.org/10.1007/s11422-014-9596-x

Scott, W., & Gough, S. (2003). Sustainable development and learning: Framing the issues. RoutledgeFalmer.

Simonneaux, L. (2014). From promoting the techno-sciences to activism: A variety of objectives involved in their teaching of SSIs. In L. Benze, & S. Alsop (Eds.), Activist science and technology education (pp. 99–111). Springer.

Simonneaux, L., & Simonneaux, L. (2012). Educational configurations for teaching environmental socioscientific issues within the perspective of sustainability. Research in Science Education, 42(1), 75–94. https://doi.org/10.1007/s11165-011-9257-y

Simonneaux, L., & Simonneaux, J. (2009a). Socio-scientific reasoning influenced by identities. Cultural Studies of Science Education, 4(3), 705–711. https://doi.org/10.1007/s11422-008-9145-6

Simonneaux, L., & Simonneaux, J. (2009b). Students’ socio-scientific reasoning on controversies from the viewpoint of education for sustainable development. Cultural Studies of Science Education, 4(3), 657–687. https://doi.org/10.1007/s11422-008-9141-x

Skolverket. (2011). Curriculum for the compulsory school, preschool class and the recreational centre 2011.

Svanfeldt, K., & Svensson, M. (2000). Naturkunskap.: Kurs A, Medan jorden snurrar. Natur och kultur.

Swedish National Agency for Education. (1998). Tema tillståndet i världen [State of the world]. Skolverket.

Swedish National Agency for Education. (2011). Kursplaner Naturkunskap [Syllabus science studies]. https://www.skolverket.se/undervisning/gymnasieskolan/laroplan-program-och-amnen-i-gymnasieskolan/gymnasieprogrammen/amnenurol/syllabus?subject=1530314731%2FsyllabusSwedish&subject=12.5dfe44715d35a5cdaf92a3#anchor_NAKNAK01a1

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Tsai, C.-C., & Liu, S.-Y. (2005). Developing a postdimensional instrument for assessing students’ epistemological views towards science. *International Journal of Science Education, 27*(13), 1621–1638. https://doi.org/10.1080/09500690500206432

Van Poeck, K., & Vandenabeele, J. (2012). Learning from sustainable development: Education in the light of public issues. *Environmental Education Research, 18*(4), 541–552. https://doi.org/10.1080/13504622.2011.633162

Wetherell, M., & Potter, J. (1992). *Mapping the language of racism; Discourse and the legitimation of exploitation*. Harvester Wheatsheaf.

Wetherell, M., Taylor, S., & Yates, S. J. (2001). Introduction. In M. Wetherell, S. Taylor, & S. J. Yates (Eds.), *Discourse theory and practice, a reader* (pp. 1–8). SAGE Publications Ltd.

Wiggins, S., & Potter, J. (2008). Discursive psychology. In C. Willig, & W. Stainton-Rogers (Eds.), *The SAGE handbook of qualitative research in psychology* (pp. 73–90). SAGE Publications Ltd.

Winther Jørgensen, M., & Phillips, L. (2000). *Diskursanalys som teori och metod*. Studentlitteratur.

Zeidler, D. L. (2014). Socioscientific issues as a curriculum emphases: Theory, research and practice. In N. G. Lederman, & S. K. Abell (Eds.), *Handbook of research on science education* (Vol. II (pp. 697–726). Taylor & Francis.

Zeidler, D. L., Applebaum, S. M., & Sadler, T. D. (2011). Enacting a socioscientific issues classroom: Transformative transformations. In T. Sadler (Ed.), *Socio-scientific issues in science classrooms: Teaching, learning and research* (pp. 277–306). Springer.

Zeidler, D. L., Herman, B. C., & Sadler, T. D. (2019). New directions in socioscientific issues research. *Disciplinary and Interdisciplinary Science Education Research* 11(11).

Zeyer, A., & Roth, W.-M. (2009). A mirror of society: A discourse analytic study of 15- to 16-year-old Swiss students’ talk about environment and environmental protection. *Cultural Studies of Science Education, 4*(4), 961–998. https://doi.org/10.1007/s11422-009-9217-2

Zeyer, A., & Roth, W.-M. (2013). Post-ecological discourse in the making. *Public Understanding of Science, 22*(1), 33–48. https://doi.org/10.1177/0963662510394949
Appendix 1

The students’ task Do we have enough food?. Can the Earth feed us? – Do we have enough food?

Can the Earth feed us? – Do we have enough food?

In 1948 the American ecologist William Vogt wrote the book: *Can the earth feed us?* The author was concerned that the global population was so big that they were right next to the border to have an adequate food supply. He argued that we need to stem population growth, otherwise there would be a disaster.

It is 72 years ago, William Vogt wrote this. At that time the world’s population was about 2 billion. We are now 6.48 billion.

The question of human’s food supply is still under discussion. In the textbook, Medan Jorden Snurrar, for Natural Science A is a chapter called: Enough food? When the textbook was written, the number of people on earth has passed 6 billion. Below is quoted a paragraph from the chapter.

Meat or vegetables

Most people in the world are vegetarians. The main crops are wheat, rice, corn and potatoes. Eating meat is one of the rich Western diets, and this is questionable from an environmental perspective. Cattle herds in the world use larger and larger land areas, more water and energy. An increasing proportion of the world’s cereal production is used to feed animals. But the animals have a low efficiency. When the grain is passing pets, is 96% of the calories lost and only 10% of the protein from the grain remains in the animal. Conclusion: the more animal products mankind eats, the less people can be satisfied. (Medan Jorden Snurrar, 2000, p. 77 by Svanefeldt and Svensson 2000)
1. Discuss the paragraph, meat or vegetables together and try to understand what the authors mean.
2. The authors state that it is questionable from an environmental point to eat meat. Discuss if/why it is questionable from an environmental perspective, based on your knowledge in for example ecology and environment.
3. Is the conclusion coherent: "The more animal products mankind eats; the less people can be satisfied!"? Discuss.
4. Imagine that a political party in the Town has suggested that it should be served more vegetarian food in the Towns schools, for environmental reasons.

You are now a participant in the Towns city council and shall decide in the issue. First consider what you as an individual think. Then have a discussion / debate on the issue to finally come up with a decision.