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Students' ideas of contributing to sustainable development: a study of how ideas emerge, travel and expand through classroom microblogging and discussions

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ABSTRACT

This qualitative study investigates how young students expressed, explored and expanded their ideas of how they could contribute to sustainable development. We analyse a trajectory in a Norwegian 8th grade class, focusing on the students' emerging understanding through microblogging and talk in individual, group and whole class activities. The material analysed are logs from a microblogging tool and transcribed video recordings from two lessons. We examined the trajectory as a whole to understand how the topic was treated, we sorted students' microblogs thematically, and we used interaction analysis to investigate talk excerpts. The results show that the students initially tended to suggest everyday actions related to reducing consumption, and that through classroom interactions about a challenging idea their understanding broadened. The combination of microblogging activities and discussions facilitated the travelling of ideas between activities and participants, prompted the students to question, elaborate and reason, supported broad participation, and helped students create links between everyday actions and wider sustainability issues.
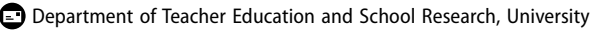
1. Introduction

Sustainable development is a core issue in education. For instance, Norway's renewed curriculum, implemented in 2020 and covering years 1–13, highlights 'sustainable development' as one of three topics to be taught across all subjects. The core curriculum (Norwegian Ministry of Education and Research 2017) explains that this topic concerns 'protecting life on earth and providing for the needs of people who live here now without destroying the possibilities for future generations to fill their needs.' This conception is in line with the Brundtland report (World Commission on Environment and Development 1987), acknowledging the complex interconnections between social, economic and environmental conditions. The curriculum text further states that through this topic, students are to develop the competence to 'make responsible choices and to act ethically and with environmental awareness,' and they 'must learn to understand that all individual activities and choices are significant' (Norwegian Ministry of Education and Research 2017).

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Previous research has found that when young people express how they see themselves able to contribute to sustainable development or protect the environment, they mostly describe individual everyday actions, such as household behaviour or reducing consumption (Connell et al. 1998; Connell et al. 1999; Kumler 2010; Sass et al. 2021; Selboe and Sæther 2018; Tayne 2022; Tayne et al. 2021). Action competence, as something more than individual behaviour, is often advocated as the aim of environmental and sustainability education (ESE; e.g. Breiting and Mogensen 1999; Hedefalk, Almquist, and Lidar 2014; Jensen and Schnack 1997; Olsson et al. 2020). In this understanding, education should strive towards unravelling conflicts to broaden students' understanding and inciting students to take action. Thus, focusing on students' everyday behaviours is not enough. Still – as indicated by the above referenced studies – this is where most people start. Moreover, developing awareness of continually choosing more environmentally friendly behaviours may lead to the desire for knowledge and wanting to take action (Sinnes 2020; Stoknes 2014). In this view, awareness of environmentally friendly behavioural choices as part of everyday life can be a vehicle for continuous sustainability thinking.

However, as sustainable development addresses complex socio-scientific issues, it is challenging to understand how one's everyday behaviours, such as recycling household waste or reducing consumption, are entangled in ecological, economic and social systems. To develop didactics of sustainability (Öhman and Sund 2021), it becomes important to investigate how initial understandings can be stretched towards acknowledging more complex connections. Further knowledge about how youngsters express and explore ideas of their opportunities to contribute to sustainable development is therefore warranted.

Over time, educational research has demonstrated that working with real and complex issues, as well as rooting teaching in students' everyday conceptions and experiences, is important for student engagement and deep learning (diSessa 2014; Furberg and Silseth 2022; Hestness, McGinnis, and Breslyn 2019; Linn and Eylon 2011; Scardamalia and Bereiter 2014). Classroom discussions are one way of eliciting students' ideas that has been found to support students in examining sustainability issues (e.g. Rudsberg, Öhman, and Östman 2013). However, classroom talk faces challenges, such as securing broad participation (e.g. Clarke 2015) and the inclusion of different perspectives and ideas (Öhman and Öhman 2013). In turn, we know that technology has the potential to support classroom dialogues. For instance, the use of social media, more specifically microblogging, has been found to engage students and create extended space for multivoicedness (Frøytlog, Rasmussen, and Ludvigsen 2022; Rasmussen and Hagen 2015; Rødnes et al. 2021). The potential of social media use in classroom settings is particularly interesting in relation to ESE, as we know that such media is an important arena for young people's discussions and standpoint formation about sustainability issues (Andersson and Öhman 2017). Still, few studies investigate educational practices involving these tools in sustainability education.

The early teen years represent a particularly interesting age group. At this age, children are transitioning into adolescence and beginning to form their own opinions, often orienting to peers more than adults (Sass et al. 2021). At the same time, this group of young people have very little power and limited opportunities to influence political decision making. Therefore, it is all the more important that they become aware of the opportunities they do have in their daily lives so that their environmental awareness is maintained, paving the way for continuing awareness about sustainability issues and action opportunities.

As noted above, we have some knowledge about what young people report that they can do to contribute to sustainable development. However, we know little about how they express their ideas in their own words in real educational settings, how they influence each other through peer talk and how they may interact to expand their understandings. To gain further insight into students' meaning making of their perceived action opportunities, we investigate a trajectory in which a Norwegian 8th grade class discussed how they, in their everyday lives, can contribute to sustainable development. The class participated in a research project focusing

on developing dialogic practices, as mediated by a microblogging tool that emulated social media platforms (e.g. Twitter) inside the classroom.

The study aims to contribute to knowledge about how students consider themselves able to contribute to sustainable development and how classroom work may affect their initial understandings of sustainable everyday actions. Three research questions guided our analysis:

1. What characterized the trajectory?
2. What ideas of contributing to sustainable development did the students initially suggest?
3. How were these ideas treated through microblogging and talk in the classroom?

2. Background

2.1. Young people's conceptions of opportunities to contribute to sustainable development

Previous research sheds light on what young people see themselves capable of to protect the environment and contribute to sustainable development. In a survey of 16–17 year olds' environmental attitudes, Connell et al. (1998) found that while most respondents acknowledged the importance of protecting the environment, only 55% of the students reported having taken action in this respect, and these actions were mostly 'household behaviour such as recycling' (p. 85). Connell et al. (1999) deepen this insight, uncovering that young people 'seem to suffer from a sense of 'action paralysis' in that they believe the only things that they can do for the environment are small things such as recycling' (p. 108). More recent studies find that students largely see their environmental action possibilities as personal behaviours, or making small 'green' choices in their daily lives (Kumler 2010; Selboe and Sæther 2018; Tayne 2022; Tayne et al. 2021). While small, these individual actions represent hope through the belief that they may be effective if many participate (Selboe and Sæther 2018; Tayne et al. 2021).

Sass et al. (2021) reveal a more collective orientation in how students aged 10–14 express their ideas of taking action, finding that they most frequently mentioned actions such as donating to the needy, promoting eco-friendly behaviour, calling for action or speaking up against injustice.

Tayne (2022) investigated students' participation in a curricular unit on socioenvironmental sustainability. She found that during their reflections after the unit, the students mostly discussed individual and collaborative actions aimed transformation of behaviour and small system like their homes and schools. However, Tayne (2002) also reports indications of more collective-oriented thinking in the students' actions and reflections, underlining that when looking for learning, we can look for 'the small ways that people are learning together towards possibilities for greater collectivity' (p. 235).

Together, these studies show that students largely consider their frames of action to be individual, daily behavioural actions. While there are indications of more collective-oriented action ideas, these are reported in studies where students were involved in projects with an explicit collective focus (Tayne 2022), or in contexts where schools over time had already emphasized private sphere actions (Sass et al. 2021).

To investigate young peoples' views, studies have used a wide array of methods, such as surveys (Connell et al. 1999), interviews (Connell et al. 1999; Selboe and Sæther 2018) and analysis of youngsters (Tayne et al. 2021). Closer to classroom practices are studies reporting on interventions or teacher-researcher collaborations in combination with tests, interviews, surveys, student products or presentations (Sass et al. 2021; Tayne 2022). We know less about how teenage students form their opinions when interacting with peers. Such knowledge is important, because – as Sass et al. (2021) point out – peers rather than parents or other adults become

role models at this age. We therefore look further into studies that investigate classroom inter-actions in relation to sustainability issues, as well as meaning making of complex issues.

2.2. Sustainability issues, classroom talk and technology

Several studies address how classroom talk can affect students' understanding of sustainability issues. One particular type of classroom talk focusing on argumentation has been found useful when students work with socio-scientific issues, such as sustainable development. Rudsberg, Öhman, and Östman (2013) note that students develop deeper insight into socio-scientific issues through argumentative talk, especially by specifying the conditions for their claims and finding new solutions. However, research has also found that students' peer discussions are often consensus-oriented (Öhman and Öhman 2013). While constructing shared understandings is valuable, the lack of questioning, confrontation and opposing views limits opportunities for pluralism, which is a prerequisite when handling complex matters without clear answers. This highlights a need to support ways of talking that allow students' questioning and exploration of complex issues (e.g. Sezen-Barrie, Miller-Rushing, and Hufnagel 2020). Classroom talk also holds potential beyond promoting understanding of subject-specific matters. Participating in classroom dialogue has been shown to foster engagement in moral and ethical dilemmas (Cheung and Lee 2010; Lesnick 2006), which is essential to a deeper understanding of complex issues. Furthermore, engaging in discussions is a way of preparing for democratic participation (see e.g. Andersson and Öhman 2017; Rudsberg, Öhman, and Östman 2013; Öhman and Öhman 2013).

On a more general note, some studies indicate that dialogic classroom practices support students' development of critical thinking skills (Kuhn 2015, 2018, 2019) and collaborative prob-lem solving (Gillies 2011, 2019; Rojas-Drummond, Mercer, and Dabrowski 2001) – skills that are constitutive to addressing complex issues. Certain features have been found to characterize educationally valuable classroom talk. Posing authentic questions without pre-specified answers is particularly important to developing genuine dialogue (Nystrand 1997). In productive talk, participants engage critically and constructively with each other's ideas, such as by elaborating, providing reasons, and questioning (Howe et al. 2019; Mercer 1996; Mercer, Wegerif, and Dawes 1999). This kind of talk, which makes reasoning visible and accountable (Mercer 1996, 2000), has been termed exploratory talk. Broad participation in such dialogues is conducive of quality talk, as when many participate, more elaborated talk that demonstrates students' reasoning is likely to occur (Sedlacek and Sedova 2017). Even so, broad participation is a persistent challenge in educational dialogues (Cazden 1988; Clarke 2015; Myhill 2006): Power relations may play out in the classroom, limiting who gets to talk and what opinions are included (see e.g. Andersson and Öhman 2017).

Interestingly, studies note that technology facilitates productive classroom dialogue in several ways (e.g. Kerawalla 2015; Kerawalla, Petrou, and Scanlon 2013; Major et al. 2018; Mercer, Hennessy, and Warwick 2019). Our focus is on microblogging, or the writing of short messages in online social networks (e.g. Twitter; Ebner et al. 2010; Mercier, Rattray, and Lavery 2015). In educational contexts, this technology works well to initiate dialogues (Gao, Luo, and Zhang 2012) and to share ideas and thinking (Looi, Chen, and Ng 2010). It has also been found to promote students' participation in learning work (Frøytlog, Rasmussen, and Ludvigsen 2022; Rasmussen and Hagen 2015). Furthermore, microblogging can serve as a tool for teachers to monitor group conversations, helping them ensure that ideas emerging within groups can become part of the wider classroom discourse (Mercier, Rattray, and Lavery 2015). Written contributions, including microblogs, provide materialized objects that can be exploited in further discussion, encouraging explicit reasoning and engagement with others' ideas (Omland, Ludvigsen, and Rødnes 2022; Pifarré 2019; Pifarré and Li 2018; Rasmussen and Hagen 2015; Rødnes et al. 2021).

Microblogging technology is well known to most teenagers, but integrating students' everyday communication methods into educational settings requires focus on the framing of the activity (Crook 2012) and how the affordances of the tool can be exploited (Mercer, Hennessy, and Warwick 2019; Warwick, Hennessy, and Mercer 2011). So, while researchers argue that young peoples' meaning making of sustainability issues on social media promotes ways of discussing that hold implications for educational practices (Andersson and Öhman 2017), there is still a need for studies on how social media technology can be integrated into classroom practices to support educational aims.

In summary, research indicates that students see their frames for contributing to sustainable development primarily as small everyday behaviours. We also know that talk and technology may support students in exploring complex issues, such as sustainability. However, we know little about how students interact with other students when trying to understand how they can contribute. It is pertinent to learn more about how classroom work can be organized to allow students the space to discuss topics with peers, while at the same time providing scaffolding to help them expand their thinking.

3. Research design

3.1. Participants and context

This study involved an 8th grade class of 29 students (13–14 years old) and their teacher, at a school on the outskirts of a large city. All participants signed consent forms. The class participated in the research project *Digitalised Dialogues Across the Curriculum (DiDiAC),* a collaboration between the University of Oslo and the University of Cambridge and schools in Norway and England. The project is registered with the Norwegian Centre for Research Data[1]. Ethical procedures were informed by the guidelines from the Norwegian Centre for Research Data and the National Committee for Research Ethics in the Social Sciences and the Humanities.

Aiming to support classroom dialogues by combining dialogic teaching with a microblogging tool called Talkwall, the project was guided by the Thinking Together programme (https://thinkingtogether.educ.cam.ac.uk/). The researchers conducted workshops for participating teachers to introduce them to Talkwall and to the dialogic principles of Thinking Together. Then, the researchers videorecorded three lessons with each teacher and their classes during spring 2017. The teachers planned the lessons, using dialogic principles and Talkwall as they saw fit.

In Talkwall, the teacher (or another person responsible) adds a task or a question, and the students post short blogs. All the contributions become visible in a shared feed, and the students or teacher can choose to pin the contributions to a wall (see Figure 1). The wall allows different ways of sorting contributions, including with hashtags. On a class display, any participant's screen can be shared with the class. The application can be used on computers, tablets or mobile phones.

3.2. Theoretical grounding, data and analytical procedures

Underpinning our investigations of classroom talk and microblogging is the key theoretical understanding that language and thinking are inextricably intertwined processes (Bakhtin 2004; Vygotsky 1986). Meaning making (Linell 1998, 2009) evolves through dialogue with others in which language is used to 'interthink' (Littleton and Mercer 2013). Methodologically this means that by studying verbal utterances among participants we can gain access to emergent understanding. Thus, to understand how students' made meaning of sustainable everyday actions, we investigated participants' talk and microblogging.
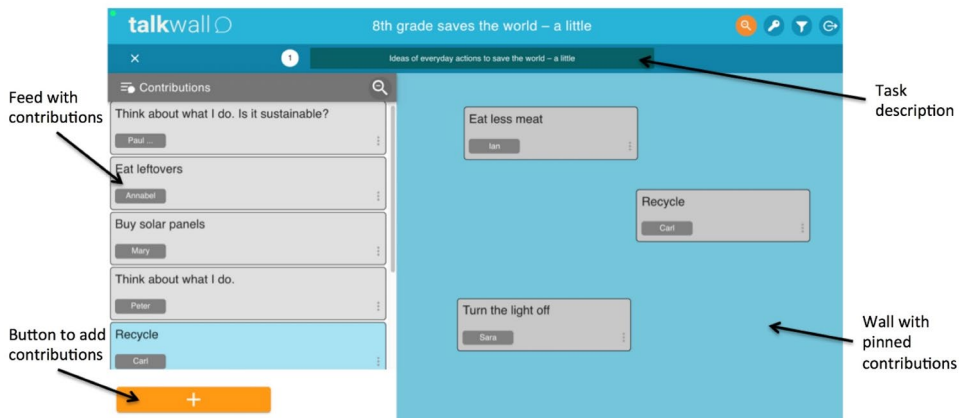
Figure 1. Illustration of Talkwall functionality.

Video recordings of the class's activities, transcripts of the talk, and logs from Talkwall provided data for analysing the trajectory as a whole, the ideas presented in Talkwall, and details of talk. When collecting the videodata, we used two cameras that were placed at the back of the classroom. One camera followed the teacher and the whole class activities, while the other followed one group. This group, subsequently termed 'focus group,' was selected for practical reasons of proximity to the camera.

We analysed our material on two levels (Mercer 2008; Rasmussen 2012): 1) how the topic of contributing to sustainability was treated through the trajectory and 2) interactions during the focus lesson. By studying details of the participants' verbal interactions through talk and microblogging, we accessed collectively constructed lines of reasoning to see how their meaning making unfolded across the lesson (Linell 1998; Rasmussen and Damşa 2017).

To investigate the trajectory, we first collected all the material (videos, Talkwall logs, lesson transcripts), then constructed an overview of *activities* and *tasks* in the trajectory (see Appendix). We pay particular attention to these elements because they provide insight into the framings of the students' meaning making work.

To maintain our focus on students' ideas of contributing to sustainability, we identified the ways in which participants expressed and responded to such ideas. Our analysis was performed in three stages. First, we investigated the individual microblogs by inductively categorizing and counting the Talkwall logs according to the main idea they presented. For instance, microblogs like 'Drive with more persons in the car' and 'Walk to sports practice' were counted as ideas related to the category 'Reduce use of fossil fuels.' Further examples are provided in section 4.2. In addition, we identified the individually posted Talkwall contributions that the focus group participants made.

Second, we studied the talk in the focus group's work. We watched the video recordings several times to identify where questioning or discussion appeared. Then, we selected an excerpt demonstrating the main discussion in the group for closer analysis.

Third, we studied the talk in the whole class discussions. Here, we selected an episode addressing the same idea that caused the most discussion in the focus group to investigate how an idea can travel across activities, and how it was treated in different contexts.

The analysis of the talk followed established procedures of analysing interactions in educational contexts (Derry et al. 2010; Hall and Stevens 2015; Jordan and Henderson 1995). To understand how the students' made meaning making about their ability to contribute to sustainability, we investigated how the participants related to each other's ideas. Building on the research presented in Section 2.2, we looked for talk moves such as *reasoning*, *elaboration* and *questioning*. These terms are used descriptively to illustrate how the talk about the students' initial ideas unfolded.

The data and the aim of the study were discussed between the authors. The analysis was written by the first author and followed up by repeated readings, checking and adjustments by the second author. The article idea, data excerpts, and versions of the emerging analysis were also discussed with members of the DiDiAC-team.

When translating from Norwegian and transcribing the material, we aimed to maintain the content of the utterances more than translating word by word. We have slightly edited the talks to improve readability, including omitting hesitations and repetitions that obscured the lines of reasoning. Such omissions are marked with []. All names have been changed to maintain participant anonymity.

A core concern in this study was to investigate emergent understanding. Focusing on trajectory is important in this regard, because it allowed us to follow how an idea was introduced and explored through different ways of working. Therefore, we present the analysis in the following section in accordance with the activities in the lesson trajectory. In the discussion, the findings are summarized per the research questions.

4. Analysis

4.1. The trajectory

The work was initiated in a lesson where the students wrote individual contributions to Talkwall with their tablets, answering the task of suggesting what they could do to 'save the world a little.' In the following lesson, the class built upon the Talkwall session. The class was divided into groups of three or four and each group was assigned a theme. The teacher instructed the students to individually hashtag and pin contributions that they found relevant to their group's theme (i.e. #Diet, #Foodwaste, #Transport, #Electricityconsumption, #Waterconsumption, #Littering, #Recycling, #Clothingconsumption or #Plasticwaste). The students then discussed all the contributions that the group members had hashtagged. They used one member's tablet to pin the most relevant contributions to a group wall. This work was followed by a whole class session in which the teacher showed each group's wall on the electronic whiteboard and had them explain why they had chosen each contribution. The trajectory is visualised in the Figure 2.

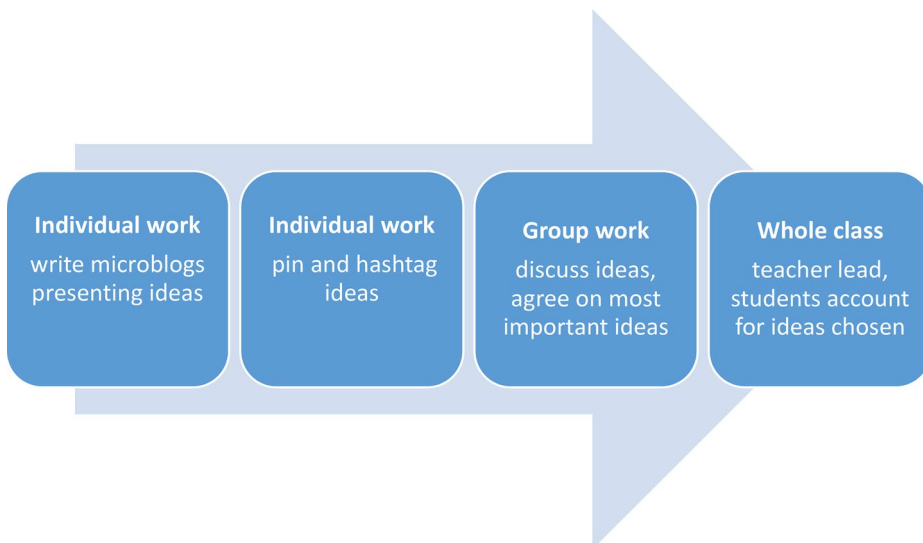| Individual work	Individual work	Group work	Whole class
write microblogs presenting ideas	pin and hashtag ideas	discuss ideas, agree on most important ideas	teacher lead, students account for ideas chosen

Figure 2. Illustration of the observed trajectory.

4.2. Students' initial ideas of contributing to sustainable development

In the first activity, the students wrote microblogs about what actions they could take to contribute to sustainable development. According to the teacher, they generated 330 contributions. Our thematic counting of the microblogs showed that the most common ideas were about reducing consumption, as detailed in Table 1. Some microblogs referenced more than one measure. Some were very general (e.g. 'throw away less,' 'don't be stupid,' 'make an effort') and were not included in the sorting.

The students' ideas mostly concerned reducing the consumption of energy, meat and water, as well as buying less and recycling more. However, some contributions dealt with personal and interpersonal awareness, such as thinking about one's own sustainable everyday actions and making others more environmentally conscious. Another idea that stood out was 'do not always choose the finest fruit in the shop.'

In the subsequent group discussion, we followed a group of three students: Ian, Sara and Joe. Their contributions were largely in line with the most common suggestions. Table 2 provides an overview of the group members' individual contributions.

Table 1. Thematic sorting of ideas for sustainable everyday actions, as presented in Talkwall.

Ideas suggested	No. of contributions
Reduce meat consumption (e.g. eat less meat, become vegetarian or vegan, eat leftovers)	62
Reduce the use of fossil fuels (e.g. use public transport, cycle to sports practice)	61
Reduce electricity use (e.g. turn off the lights when you are not in the room, unplug chargers)	47
Buy less/reuse clothes (e.g. think about what I buy, donate clothes)	42
Reduce water use (e.g. take shorter showers, do not leave the water running)	37
Recycle (e.g. recycle, waste sorting)	27
Reduce plastic use (e.g. bring own shopping bags, avoid plastic packaging)	19
Some messages did not fall into any of the above categories, such as:	16
• Think about what I am doing. Is it sustainable?	
• Get other people to be more environmentally conscious	
• Do not always choose the finest fruit in the shop, but rather pick the ones that have a small blemish	
• Buy food from Norway	
• Buy solar panels	
• Do not use cash	

Table 2. Focus group members' individual contributions.

Ian:	Sara:	Joe:
• Think a bit more about what I buy	• Walk to (sports) practice	• Drive with more people in the same car
• Stop being driven to (sports) practice	• Recycle	• Sort waste
• Eat less meat	• Eat less meat	• Buy food using my own containers that are not made of plastic
• Do not stay as long in the shower	• Turn the lights off more often	• Turn electricity off when leaving a room
• Be more conscious about what I buy that is wrapped in plastic	• Use public transport more	• Use environmentally friendly transport
• Do not leave the water running	• Spend less time in the shower	• Do not throw away food
• Use the clothes that I have and give what I don't use to Salvation Army	• Give clothes to Salvation Army	• Donate clothes you don't use or that don't fit to Salvation Army
• Do not be driven to school	• Sort waste	• Eat less meat
• Do not eat as much meat	• Do not buy as much food, use what's in the fridge	
• Unplug from the socket when I'm not using it		

4.3. How students' ideas were treated through microblogging and talk

4.3.1. Individual work

The first individual microblogging activity was characterized by a high number of microblogs produced in a short period of time. Although some students were more active than others, all students contributed with several posts. The activity allowed the students' ideas about sustainability actions to be presented on an equal level, generating a plethora of ideas.

4.3.2. Group work

As previously described, the teacher assigned groups of students to categorize contributions based on a theme. The focus group members worked with the category #Waterconsumption. As a group, they were to agree on 10 contributions to pin on the group's wall. The members easily agreed on pinning the microblogs suggesting 'use less water,' 'eat less meat,' 'become a vegetarian,' 'don't leave the water running' and 'take fewer baths.' The following excerpt (Table 3) details what happened when they encountered a more challenging idea.

Ian suggested pinning the microblog 'Do not always choose the finest fruits in the shop, but rather take the one that has a small blemish.' As shown in Table 1, only one of the 330 microblogs suggested this idea.

Sara and Joe (2, 3) both contested Ian's suggestion to include the microblog 'do not always choose the finest fruits in the shop' (1). They questioned this idea by asking what choosing a blemished fruit has to do with water consumption (5, 7). Ian defended the idea with explicit reasoning, elaborating on his idea with how fruit production requires a lot of water, so buying blemished fruit results in the production of less fruit (4, 6, 8, 10, 12, 14). Joe kept questioning this idea (11, 13), but listened to Ian's arguments (9) and eventually acknowledged it (15).

The excerpt demonstrates how questioning triggered elaboration and explicit reasoning. Because Joe and Sara doubted his suggestion, Ian had to argue for why it was related to water consumption. Ian's reasoning convinced Joe and Sara and seemed productive to the group's understanding of the problem that selecting only perfect items forces manufacturers to produce more items, which is resource-demanding.

Considering the role of Talkwall in this activity, we see that microblogs became part of the group's reasoning. Ian introduced the point about the blemished fruit to the group. However, this idea was originally posted by a student outside the focus group. This example shows how the microblogging tool allowed ideas to travel across activities and groups. Furthermore, hashtagging facilitated the connection of disparate ideas to larger topics.

Table 3. Excerpt from group talk: Water consumption.

1.	Ian:	Do not always pick the finest fruit in the shop, but rather take the one that has a small blotch.
2.	Sara:	What does that have to do with –
3.	Joe:	Yes, but what does that have to do with water consumption? [ ]
4.	Ian:	If you take the bad one, they will need to produce less water, no, less fruit and then less water. But if you take the best one, they need to produce more good fruit than if you just take the bad one.
5.	Sara:	You don't use water.
6.	Ian:	Yes, you do. Lots!
7.	Joe:	You use water doing it, yes, but I don't understand how if I
8.	Ian:	If you take the bad fruit in the fruit pile
9.	Joe:	Mhm.
10.	Ian:	Then the producers need to make less good fruit.
11.	Joe:	In what way is it like, if I take the bad one, they must make, eh
12.	Ian:	If you take the bad one, then there is more good fruit for those who will not be bothered to do it.
13.	Joe:	Yes, but if I, if, say I am one of a thousand people and take the bad one and the 999 others, they take the good one. Yes, then they will keep producing good ones.
14.	Ian:	Yes. But not as much as if you too had taken the good one.
15.	Joe:	That's true.
16.	Ian:	Exactly!

The reasoning in the above excerpt demonstrates how the group's understanding of water consumption was broadened. When asked to post microblogs about contributing to sustainable development, the group members first focused on recycling, using less water, buying less and avoiding the use of plastic and fossil fuels. These ideas are part of the public discourse on the subject and not controversial. However, when they discussed the relevance of the microblog from a peer outside the group, the group had to unpack the argument of why this post was relevant. Thus, this line of reasoning broadened their initial understanding of how they can contribute to sustainability. Through their discussion the students also expanded their understanding of the implications of a simple everyday choice: they connected their individual actions as buyers to food production, and they tapped into the tension between doing the right thing (12, 14) and resigning because one small contribution may not seem to matter (13).

4.3.3. Whole class

After each group had pinned 10 contributions related to their assigned theme on their digital group wall, the class came together for a whole class session. The teacher showed each group's wall to the whole class on the whiteboard. In the excerpt below (Table 4), the teacher addressed the group responsible for selecting microblogs related to food waste prevention. Here the idea of 'the blotched fruit' was referenced again.

The teacher invited the selected group to share any actions they found particularly important (1). One student, Amy, suggested the idea of not throwing food away just because of the expiration date (2). The teacher acknowledged that they had become good at this practice, indicating the class had previously expressed awareness of this action. Chris then suggested to 'not choose the finest fruit' (4). Again, the teacher (5) repeated the suggestion and invited Carl to provide reasons for why this contribution was important, all while elaborating on the idea herself by giving examples. Carl responded by hypothesizing that we need to pick imperfect fruit because most people will not want to (6). The teacher continued Carl's line of reasoning, explicating that a crooked carrot tastes the same as a straight carrot but that consumers still choose the best-looking produce first, leaving the poorer to be thrown away. Supporting Carl, she concluded that picking crooked vegetables is environmentally friendly (7). Her claim broadened the idea to consider both fruit and vegetables with blemishes as well as cosmetic flaws ('crooked'). As in the group excerpt, the arguments provided through reasoning and elaboration contributed to a potentially more nuanced understanding and demonstrated the characteristics of productive talk.

In this whole class episode, the microblogging tool provided access to the groups' selected contributions once the teacher displayed their walls on the class screen. Across this trajectory, the microblogging tool facilitated an idea's opportunity to seamlessly travel between individuals,

Table 4. Excerpt from class talk: Food waste.

1.	Teacher:	[ ] Which ones do you think were the most important of these actions?
2.	Amy:	Maybe to not throw away food? Because of the expiration date?
3.	Teacher:	Mhm. Not just throw away food because of the expiration date. You have become very good at that.
4.	Chris:	Or not choose the finest fruit.
5.	Teacher:	Not always choose the finest fruit. Why not? *[Carl, from Chris's group, raises his hand]* What is the point of that? Carl. Why should we not always choose the greatest, eh, banana or, eh, carrot? [ ]
6.	Carl:	If you choose one that doesn't look as good, while there are some that look a bit, that look much better, then there is a bigger chance that the one that doesn't look as good won't get picked. So if you take that one, then someone else will be guaranteed to take the finest-looking one.
7.	Teacher:	Mmm. Because it is not as if a bit crooked carrot tastes worse than, eh, a straight carrot, but we know that consumers always pick the greatest-looking first. [ ] And then the worst-looking ones are left there, and they don't get sold, and then they are thrown away. So, it is actually environmentally friendly to pick the crooked vegetables first.

groups and class. A girl entered an idea in a microblog during the initial activity. That idea then travelled to at least two groups (that she was not part of). We have shown how the focus group discussed the idea, and how the same idea entered the whole class conversation through another group. Through whole class discussion, the idea was highlighted for all students to consider. Furthermore, hashtagging allowed the idea to travel to different categories; water consumption and food waste.

Within a short period, one person's atypical idea was picked up and considered significant as it was elaborated, advocated and contested through the talk activities. It emerged as a challenging idea but represented new possibilities for sustainable everyday action. Together, the lines of reasoning observed in this class demonstrated the potential of dialogic practices to expand students' understanding of sustainable everyday actions.

5. Discussion

This study set out to gain knowledge about students' ideas of how they can contribute to sustainable development, and how classroom work may affect their understanding.

In order to investigate these issues, we followed a trajectory in an 8th grade class, exploring how students expressed their ideas about the topic and how these ideas were treated in the classroom. In the following, we discuss our findings in relation to the research questions and previous research.

5.1. The trajectory

To understand how the initial ideas emerged and how they were addressed in the classroom, we investigated the trajectory as a whole, focusing on activities and tasks. The trajectory combined individual, group and whole class work. The tasks the students addressed in these activities were open-ended (Nystrand 1997), and individual students and groups were free to provide their own views. The opportunity to express ideas individually through the microblogging tool allowed everybody to participate and present a variety of ideas. In the group task, the students were given space to discuss and explore ideas that they connected to the category they had been assigned. These discussions encouraged them to see relations between larger aims and small actions. In the whole class session the dialogic space was broadened. Ideas chosen by different groups were made the object of elaboration and explanation, allowing them to be investigated further. As they were shared on a screen in the classroom, the ideas became shared objects of talk for the whole class (Mercer, Hennessy, and Warwick 2019; Rødnes et al. 2021). Together, these activities provided ample opportunities for the students to express their own ideas and access those of others.

5.2. Students' initial ideas of contributing to sustainable development

Our analysis shows that the students initially suggested mainly individual actions related to recycling and limiting the consumption of water, food and clothes when asked how they could contribute to sustainable development. This finding is in line with those of previous studies (Connell et al. 1999; Connell et al. 1998; Kumler 2010; Selboe and Sæther 2018; Tayne 2022; Tayne et al. 2021). The suggested actions mainly concerned environmental aspects of sustainable development. This is not surprising, considering the attention issues like climate and nature crises have received among teenagers through, for instance, school strikes. It is, however, interesting that none of the students mentioned actions of this kind. The focus on reducing consumption may be understood in relation to the students' age. For many, their frames for action may seem limited, entangled as they are in their families' or parents' habits and choices. With

limited political power, as the students are years from being allowed to vote, it is not surprising that their own consumption is what they address.

While individual behaviours have clear limitations in terms of actual impact, they may have substantial value for raising awareness. Sustainable development demands change in consumption and lifestyles in rich parts of the world. Nevertheless, too much focus on private actions in ESE may create the understanding that individual changes are sufficient to prevent climate and nature crises, and hence prevent students from understanding the root causes of global environmental challenges. Even so, it is clear that 13–14-year-old students cannot be expected to fully understand their everyday actions in relation to larger systems. Therefore, developing awareness of doable actions is important, as participating is a way to keep hope that when many take part, small everyday choices may be effective (Selboe and Sæther 2018; Tayne et al. 2021). Furthermore, behavioural awareness and everyday actions may stimulate search for knowledge (Sinnes 2020).

5.3. Students' ideas treated through talk and microblogging in the classroom

5.3.1. Talk

The analysis of the group and whole class discussions demonstrated a high number of elaborations in which the participants built on, evaluated or clarified their own or others' contributions. Interestingly, Howe et al. (2019) found this particular move to be indicative of productive talk and curriculum mastery. Furthermore, we saw that both group and whole class talk were characterized by the participants actively engaging with a challenging idea, as they asked questions and provided reasons. Allowing room for students' questions may be particularly important, as they are 'about confusion and a willingness to learn more about the unknown' (Sezen-Barrie, Miller-Rushing, and Hufnagel 2020, 571). The elaborations, the questions and the willingness to engage with the ideas of others, indicate that our examples of classroom talk display similarities with exploratory talk (e.g. Littleton and Mercer 2013; Mercer 2000). This type of talk allows different perspectives to come into play and the topic to be explored. Broad participation in turn substantiates reasoning and promotes the unfolding of more nuanced and complex lines of reasoning through the meeting of more voices and perspectives (Bakhtin 2004; Sedlacek and Sedova 2017). In our case the talk provided a dialogic space that allowed the students to develop links between sustainability issues and their everyday lives, which can help them see the relevance of performing sustainable actions. This linking is important for students' engagement in sustainability issues (Hestness, McGinnis, and Breslyn 2019), as well as for their development of conceptual understanding (Furberg and Silseth, 2022; Rødnes et al. 2021).

Kuhn (2015, 2018, 2019) argues for the role of interaction and dialogue in developing critical thinking skills, which are pivotal when engaging with value-laden and complex issues. In line with Kuhn, the ways of talking practised in this class by actively engaging, elaborating, questioning and providing reasons are opportunities to practise and develop critical thinking.

5.3.2. Microblogging

The classroom interactions were highly influenced by the inclusion of a microblogging tool, Talkwall. This tool emulates social media used outside the school context, and our analysis adds to the scarce knowledge of how social media can be exploited in classroom work on environmental and sustainability issues (Andersson and Öhman 2017). In the first activity, we saw a very high number of student contributions, which demonstrates how the use of a digital tool allowed everybody the opportunity to 'talk' simultaneously. Furthermore, a tool like Talkwall provides a low threshold for participating; participants can share unpolished ideas, repeat others' ideas or provide original ideas (Frøytlog, Rasmussen, and Ludvigsen 2022; Rødnes et al. 2021). As such, the tool supports broad participation and equality in terms of who gets to talk. Such

a high level of participation is by no means a given; research demonstrates that few students participate by expressing their ideas to the whole class (Cazden 1988; Clarke 2015; Myhill 2006).

Another affordance of the microblogging tool is that it can facilitate the sharing and discussion of ideas (Kerawalla, Petrou, and Scanlon 2013; Mercer, Hennessy, and Warwick 2019). Our analysis demonstrated how the simultaneous creation of so many student contributions provides an instant – and visual – multivoicedness. In the first individual activity, students could see what others were contributing while they were writing. This visibility may give participants new ideas, as indicated by the fact that contributions following each other often expressed similar ideas. Having several utterances concerning the same ideas can contribute to robustness of ideas, underlining the actions as highly doable. Further, all the students who contributed the same idea have equal 'ownership' of it. This is relevant if the idea is picked up in subsequent group work or whole class talk. Then, even if one's contribution is not the one selected, that idea might still be included in subsequent reasoning, strengthening one's ownership in the unfolding lines of reasoning.

Having access to ideas from outside their group widened the students' space for what they can discuss, adding richness and increased multivoicedness to the group talk (Rasmussen and Hagen 2015). This promotes exposure to alternative perspectives and the evaluation of various ideas (Kerawalla 2015), thus supporting aspects of critical thinking. In line with previous studies (Mercier, Rattray, and Lavery 2015), our material demonstrated that microblogging can serve as a tool for monitoring group work, which may help teachers ensure that ideas emerging within groups become part of the wider classroom discourse. Additionally, the above analysis details how the microblogging tool allowed ideas to travel from individuals to groups and then to the whole class. This is a powerful way to provide students access to others' thoughts and ideas.

The role of hashtagging was prominent in this lesson and tightly interwoven with the assignments. The teacher's assigning one theme or category of actions to each group promoted the linking of small actions to larger systems or ideas. Again, the microblogging tool provided visual support, making visible how one idea can be hashtagged in different categories. When the same idea is linked to different systems, students can develop lines of reasoning that help them understand the complexity of everyday actions.

5.3.3. Broadening understanding

Our analysis showed that the students initially suggested individual, everyday behaviours related to reducing consumption. However, through classroom discussions, one deviant idea gained attention. The idea of choosing blemished fruit when grocery shopping was a suggestion that was not intuitively connected to the themes (hashtags) framing the subsequent group activity. To pin and hashtag this measure to a specific theme, the students needed to make justifications. Through the classroom activities, the idea was connected to water consumption and to food waste, and thus shared, explored and broadened. As Kumler (2010) notes, teachers' explicit instructions are essential to guiding students in developing their frames for action. However, by also allowing students to build on their own conceptions or ideas about authentic issues (i.e. sustainable actions), evaluating and discussing these ideas and those of others, they can build knowledge and deep understanding, as well as attitudes towards what can be done to contribute to solving problems (Linn and Eylon 2011; Scardamalia and Bereiter 2014). Thus, eliciting students' own suggestions of what they see themselves as capable of, is a way to start unpacking complex relations by anchoring in the students' own interests or ideas. When the students addressed the links between individual choices when grocery shopping, and the consequences for water consumption, they tapped into the question of one's own needs or wants against those of the global community. The connections that were developed through the talk, such as linking small actions to larger economic, social and environmental systems, may point to emerging awareness of the need for collective and system transformation (Tayne 2022). In

many ways, the core problem for acting as individuals is whether one believes that the little things we do might actually help. The space allowed for different perspectives to meet, problematize, elaborate and reason can help students expand their understanding about how they can contribute as well as see new connections between their own actions and larger systems.

The combination of varied activities, the different ways of participating verbally and the space for exploring allowed all students to participate in collective classroom reasoning. Involving students in dialogues that allow exploration, questioning and connection to everyday life is one way of fostering engagement in complex dilemmas (Cheung and Lee 2010; Lesnick 2006), such as sustainability. Engagement is a prerequisite for personal investment, which again is necessary for prioritizing sustainable actions in everyday life. Treating dilemmas through discussions in the classroom seems even more pertinent when young people report not having spoken much, or at all, to their peers about a central sustainability issue, such as climate change (Hestness, McGinnis, and Breslyn 2019, 921). A particular concern when discussing challenging issues is the social relations in the classroom. Adolescents may struggle to address disagreements (Öhman and Öhman 2013), as they are especially sensitive to the perceptions of their peer group members (Eames, Barker, and Scarff 2018; Sass et al. 2021). Therefore, there is a need to develop classroom cultures that teach students *how* to talk to each other to explore challenging and sensitive issues (e.g. Littleton and Mercer 2013; Mercer 2000; Rudsberg, Öhman, and Östman 2013), and how collaboration through talk is conducive to problem solving (e.g. Gillies 2011, 2019; Rojas-Drummond, Mercer, and Dabrowski 2001).

Participating in dialogic interactions about sustainability is important to develop an understanding of sustainability as a concept, as well as to acquire verbal resources that allow one to navigate conflicts, using language to explore both the issue itself and one's own attitudes towards it. Through such talk, students practise discussion and argumentation skills, relate to different opinions and viewpoints, ask for reasons and seek explanations. These skills are essential to developing critical thinking, and ultimately to participating in society as democratic citizens.

6. Conclusion and limitations

By investigating a classroom trajectory in which students discussed how they could contribute to sustainability, we have gained insight into the students' initial ideas, and how such ideas were expressed, explored and expanded. The study provides understanding of students' meaning making through talk and microblogging, demonstrating how this combination supports students' reasoning. The activities we studied were mobilizing, helping students to voice their ideas and develop their understanding. We argue that a better understanding of how students form their views of acting sustainably is valuable in ESE, as we need to understand the ways in which people learn together about sustainable action opportunities (Tayne 2022, 235). However, we note two limitations in our study. First, our data does not provide insight into how the awareness students demonstrate could be prompted into behavioural change or action, nor does it say anything about their will or ability to actually contribute. Second, the study does not address discussions in which conflicts of norms or interests emerge, which is often advocated as foundational in ESE (e.g. Lundegård and Wickman 2007; Ojala 2022).

Acknowledging these limitations, we suggest possible ways to build on the work done in the investigated trajectory. As social media use in ESE is scarcely researched (Andersson and Öhman 2017), we pinpoint the affordances of continuations exploiting such technology. In particular, the affordance of permanence immanent in digital tools provides the opportunity to return to the suggested actions at any later point in time. This might be exploited to incite students to actually implement their suggested actions or behaviours, as well as to incite further knowledge development. The permanence of the utterances also allows the participants to, for instance, compare their viewpoints after a period of time. What did they suggest then, and what do they know now? What actions have they actually performed? As Stoknes (2014)

indicates, comparison with – and acknowledgment among – peers is a strong driver when aiming to, for example, reduce power consumption (p. 166).

Considering the importance ascribed to conflicts and disagreements (see e.g. Öhman and Öhman 2013), we highlight the affordance of digital utterances becoming materialized objects. This objectification may facilitate focus on the utterances themselves more than the people uttering them. This may be conducive to addressing disagreements, which otherwise may be a challenge among peers (Eames, Barker, and Scarff 2018; Öhman and Öhman 2013). Finally, we wish to highlight the potential of activities like the ones studied here as stepping stones into different subject discourses. The ways of working and the content (i.e. ideas) suggested by the students can be brought into different subjects or cross-curricular projects. Thus, the mobilizing work as studied here may serve to develop knowledge, and not least to spur curiosity, paving the way for further work to take action to contribute to sustainable development.

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Appendix: Trajectory overview

Day 1

Time (minutes)	Activity description
0–40	Whole class. The teacher and students discuss what they have been doing so far. They cover topics such as eco-friendly eating; food waste; eco-friendly transport; power, water and clothing consumption; and littering and microplastic.
40–52	The class watch a short movie about sustainable living.
52–60	Individual work. The students write individual contributions in Talkwall on what they can do to contribute to sustainability.

Day 2

Time (minutes)	Activity description
0–5	The teacher informs the students of what to do.
5–19	Individual work with Talkwall. The students pin contributions that are relevant to their group's theme and hashtag them (i.e. #Diet, #Foodwaste, #Transport, #Electricityconsumption, #Waterconsumption, #Littering, #Recycling, #Clothingconsumption or #Plasticwaste).
19–27	Group work. The students discuss all the contributions that the group members hashtagged individually. They use one member's tablet to pin the most relevant contributions to their group's wall.
27–44	Whole class session. The teacher retrieves each group's wall and displays them on an electronic white board, and each group explains why they chose to pin their particular contributions.
44–52	The class watch a short film about sustainable living.
52–60	The teacher informs the students about future plans, and class is dismissed.