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Transformative climate change education and the school caretaker: a more-than-human analysis with young people

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ABSTRACT

Schools are central to climate change education and climate-friendly transformations both as places which actually produce CO_2 emissions and, above all, as educational institutions. Following a new materialist, transdisciplinary approach, we research here some of the entanglements that constitute schools as whole institutions. As part of the research-education-cooperation *k.i.d.Z.21_aCtiOn2 (*Austrian Climate Research Program*),* our innovative approach meant that the situational analyses were conducted both by young people and collaborating researchers. The experiences and accounts were captured in situational maps that illustrate the entangled agencies of people, discussions, places and matter relevant to CO_2 reductions and transformation attempts. The analysis of those maps led to new perspectives on the intra-actions between the material and the discursive in schools. In particular, the caretakers' entanglements with areas relevant to climate-friendly transformations are revealed as critical to transformative climate change education. We conclude with an outlook on schools becoming transformative, climate-friendly places by building on these kinds of entanglements and explicitly incorporating non-pedagogical aspects as part of a whole-school approach.

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Situational analysis; climate-friendly schools; whole-school approach; intra-actions; new materialism

Introduction

Preventing the most dramatic consequences of climate change by decisive transformative steps requires the involvement of and collaboration with today's young people (IPCC 2022). Only through an intergenerational effort will a rapid reduction of CO_2 emissions and associated socio-ecological transformations be achievable. Climate change education (CCE), at schools in particular, should strengthen the necessary competencies (Rieckmann 2018), and build the bridges and foundations for 'a more just and sustainable world' (UNESCO 2020, 14). Various forms of participatory and collaborative research methods have been developed or adopted with young people, acknowledging their crucial role in this process (e.g. Deisenrieder et al.

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2020; Keller et al. 2022; Lynch and Mannion 2021; Monroe et al. 2019; Rousell and Cutter-Mackenzie-Knowles 2020; Schrot et al. 2019; Trott 2020). Nevertheless, there are many open questions regarding the possibilities of transformative CCE contributing to the climate-friendly transformation of schools as both CO_2 emitters and educational institutions. While those transformations may take place independently, we[1] will argue for the importance of establishing transformational processes that take into account young people, teaching staff, non-teaching staff, the fabric of the school, the social and material practices that intertwine them and the wider spheres of eco-social processes (Kubisch et al. 2021, 2022).

The research-education-cooperation *k.i.d.Z.21_aCtiOn2* provides a new perspective to these debates by collaborating with high school students on the climate-friendly transformation of their schools, thus connecting quality education (SDG4) with climate action (SDG13) (United Nations 2015). Supported by interdisciplinary researchers, the students involved in this project assessed and tried to reduce their schools' CO_2 emissions. We sought to work 'in genuinely collaborative, imaginative and creative ways' (Rousell and Cutter-Mackenzie-Knowles 2020, 203). This included involving the young people in directing aspects of the analysis, providing insights into their perceptions and their experiences of the processes of change in their schools. Through the collaborative research, students' entanglements with the more-than-human led them to know an already familiar place in many new ways. Their existing mature pre-concepts formed the starting point for the development of transformative measures in *k.i.d.Z.21_aCtiOn2*. Hence, building on 'personal relevance and student engagement' (Monroe et al. 2019, 806), the researchers sought to support an action-oriented learning environment.

Striving for climate-friendly transformations in the partner schools, 'action for reducing climate change in every aspect of school life' (Gibb 2016, 3) was included in a whole-school approach in *k.i.d.Z.21_aCtiOn2*. Schools were approached 'as learning communities that involve everyone and every aspect of schooling' (Bosevska and Kriewaldt 2020, 70). Reaching far beyond classrooms, we included the 'socio-physical environment of learning [as] critical for coherent sustainability learning' (Holst 2023). Accordingly, not only students and teachers but other actors like administration and support staff were explicitly involved (Ferreira, Ryan, and Tilbury 2006).[2]

The transformations sought can be understood as 'transition towards doing better things differently' (Lotz-Sisitka et al. 2015, 73), thus both improving and renewing practices. In line with a non-instrumental understanding of education, there were no predefined goals and no expectations of changes spilling over into other areas (Van Poeck, Östman, and Block 2020). Without the problematic 'prescription of particular lifestyles or (codes of) behaviour' (Wals 2011), the young people created projects based on their interests in which they explored concrete measures to reduce the schools' emissions. Through harnessing young people's agency, belonging, and competencies into transformation processes (Mitra 2004), we aimed to build a viable base for long-term change.

A more-than-human approach to whole-school climate-friendly transformations

Building on Barad's new materialist work, we consider the more-than-human as an ontological perspective decentring the human and focusing on the intra-actions of materiality and discursivity which 'may or may not involve humans' (Barad 2007, 171). In the context of schools, the more-than-human may include all kinds of objects and matter in the classroom (Taylor 2013), but also beyond that, as will be shown. The recognition of the agency of matter is expressed in its configuration as processual '*intra-active becoming*' (Barad 2007, 151 emphasis in original). Thereby rejecting definitions of matter as fixed objects, the 'active capacity of matter to make a difference in the world' (Jukes and Reeves 2020, 1298) guides new materialist studies. As the relations with the more-than-human are at the heart of new materialist research, it contributes

to a renewed understanding of the entangled world (St. Pierre, Jackson, and Mazzei 2016). Challenging anthropocentrism, more-than-human approaches are adopted in critical analyses of the Anthropocene as well as environmental education research (see Gough 2016; Ulmer 2017). In this study, we take an approach that empirically addresses our socio-material entanglements to explore the co-constitutive becoming of adolescents and adults alongside the agencies of the more-than-human as they attempt to transform (Mannion 2020).

Despite decades of calls for whole-school (i.e. whole-institution) approaches as 'the most effective approach to Learning for Sustainability' (Ferreira, Ryan, and Tilbury 2006, 16), empirical studies on the material functioning of the school as a 'whole-school' are missing. Our approach meant we were open to material aspects, the role of staff apart from teachers, and the possibilities of collaboration, but also of entanglements with places in the school as the basis for the schools' potential transformations. We exemplify how the intra-actions of the material and the discursive were crucial to climate-friendly transformations in school and can even unfold as diametrically opposed to CCE. In the long run, this contributes to the question of how whole-schools can effectively become more climate-friendly institutions.

In this project, the transformational processes of learners and their actions, but also of schools and related more-than-human elements, were explored through the collaborative assessment of CO_2 emissions and the identification of climate-friendly measures with the *k.i.d.Z.21_aCtiOn2* research team. In our analysis, we looked for the open-ended but connected becomings of people/students and places/schools (Mannion 2020). Those becomings have to be addressed together as individual and organisational change processes are strongly interrelated (Boström et al. 2018). In other words, the possibility of transformation is tied to the recognition of the dialectical relationship between inner and outer learning journeys (Selby 2009). Hence, the students' learning and possible transformation of their actions are connected to the learning and transformation processes of the whole-school. Together, they shape 'transformational education towards a more sustainable world' (Mochizuki and Bryan 2015, 5).

In taking a more-than-human approach, creating a climate-friendly school was framed as relational, embodied and affective (Verlie 2021). The students' relating to the more-than-human elements of climate-friendly transformation enabled a learning '*with* (rather than *about*) the world' (McPhie and Clarke 2015 emphasis in original). We explored the schools as assemblages of responsive elements that act as a 'live wire, a tangle of nerve pathways, touching and being touched by the bodies that congregate in it' (Niccolini and Pindyck 2015). This takes account of how 'we are entangled through a mutual (re)configuring with the world' (Riley and White 2019, 261). Since places, materials and people were engaged in transformation, the ensuing entanglements allowed us to explore how participants' learning emerged (see Lynch and Mannion 2021). As we will show, the intra-actions of the material and the discursive in schools are in and of themselves educative – potentially leading to empowered young people or to young people who become as stuck and rigid as their schools. By attending to those intra-actions, we enable a recognition of the connected responsibilities for our world, and necessary climate-friendly transformations (Barad 2010; St. Pierre, Jackson, and Mazzei 2016).

With *k.i.d.Z.21_aCtiOn2*, we explored what counted as climate-friendly habits and processes in the schools as a form of 'response-making processes through […] actions with the world' (Lynch and Mannion 2021, 873). By this view, the attunement of the students and the material would arise out of responding to each other, and the place, during the project. The project's aim to reduce CO_2 emissions with young people created the necessary opening for the students to relate in new ways to materials and places in their schools and to build new relations. With a strong belief in the students' being better at identifying possible measures and transformation paths, particularly in a setting which they know much better than the researchers, the ideas for transformative change can be seen as arising from young people's perspectives and out of our shared entanglement with situated, more-than-human elements, such as buses, food, drinks, bins, electronic devices, heaters and many more.

Situational analyses of whole-schools in transformation

To capture the more-than-human entanglements in the transformational processes in the schools, Situational Analysis (Clarke 2004, 2005) was chosen as a research method accompanying and evaluating the project. Clarke developed Situational Analysis as one form of second generation Grounded Theory against the background of interactionist theory, clarifying and extending Glaser and particularly Strauss' work by putting the situation at the core of her method (Clarke 2004, 2009). Situated characteristics are not considered as mere context but as constitutive of the respective situation (Clarke 2009). Accordingly, they are the focus of the different types of maps that belong to Situational Analysis: (messy and ordered) situational maps, social worlds/arenas maps and positional maps (Clarke 2005). Together, they create an understanding of the whole situation with all its social and relational aspects (Clarke, Friese, and Washburn 2018). Rejecting anthropocentric approaches, more-than-human elements[3] are analysed as developing agency through intra-acting of the material and the discursive (Barad 2007; Clarke 2009). Thus, they are shaping conditions to the 'interactions within the situation through their specific material properties and requirements and through our engagements with them' (Clarke, Friese, and Washburn 2018, 91).

Approaching and visualising more-than-human entanglements through Situational Analysis is not free of tensions as the mapping might lead to more categorising than is compatible with more-than-human approaches, but it also enables researchers to identify key features and develop a sense of complex relations (Ruck and Mannion 2020). Furthermore, mapping everyday spaces, their elements and intra-actions, has been proposed as one way to understand entanglements in assemblages (Pacini-Ketchabaw, Nxumalo, and Rowan 2014). Analysing the co-constitution of the human and more-than-human in their situatedness while resisting the common gradual imposition of order (Fox and Alldred 2015), we sought to rethink students, places and materials in schools in their entanglements. School grounds, school governance, pedagogical approaches, and resource consumption are all considered in whole-school approaches (Henderson and Tilbury 2004). Material aspects, like school buildings, were included in the Situational Analyses in this study as they bear the potential of generating learning for sustainability (Christie et al. 2019; One Planet Schools Working Group 2012). Information on the schools' organisation were also factored in as influencing the implementation of education for sustainable development (ESD) (Mogren, Gericke, and Scherp 2019). Overall, the Situational Analyses scrutinised schools as places which are in and of themselves educative and influence all kinds of educational processes.

The participating students had a special position in the analyses as both conducting their own research and at the same time being studied. Through our special interest in young people's perception of climate change, related experiences and aspects they deem important when trying to create more climate-friendly schools, the situational mapping captures elements of young people's own interpretation of the situation. The analysts, both students and researchers, built on their existing knowledge of the situation for the collaborative mapping (Clarke 2009). In addition to its common use as a research method, we introduced it into the project *k.i.d.Z.21_aCtiOn2* as an educational tool for the students to visualise and better understand relevant aspects to the assessment and reduction of CO_2 emissions in their schools. Their inputs and leadership in mapping were crucial to the collaboration as it determined the people, places, discussions, practices and CO_2 emissions we decided to look at together. The situation in which we started to collaborate with the students was characterised as follows: *The school wants to create a CO_2 balance account and reduce its CO_2 emissions*. Since this situation includes the possibility and wish for change, the situational maps illustrated not only an analysis of elements of the present, but also of retrospective perspectives and hoped-for future scenarios. This option of acknowledging and working with complexities could be of decisive importance in achieving climate-friendly transformations.

Context of this study

In this study, we focus on the (messy and ordered) situational maps that were created in the course of *k.i.d.Z.21_aCtiOn2*.[4] The messy situational maps capture all situational aspects in an unstructured manner and were either created directly by the students (first school year) or based on their reports (second school year). There are only few other examples of collaborative situational mapping with respondents: shared situational mapping with rural nurses on mentoring experiences (Mills, Francis, and Bonner 2008); messy map interviews with parents on vaccination decisions (Nordtug 2020); participatory situational analysis of women's and gender issues of geographically dispersed participants (Fletcher et al. 2021). To the authors' knowledge, this study is, however, the first to collaboratively conduct situational mapping with adolescents on the topic of climate-friendly transformations.

In this research, we involved young people in creating messy situational maps assessing their schools' attempts to reduce emissions. Students in the three schools participating in the first year of the project were asked to co-create these maps in the digital collaboration platform Conceptboard. Digital participatory situational mapping has been shown to be particularly challenging in terms of communication and exchanging ideas (Fletcher et al. 2021). Whilst we also faced these difficulties, the resulting maps delivered a unique view on the students' perception of their schools. Conducted online, during Covid restrictions, the students reflected on important persons, sources of CO_2 emissions, discussions etc. in their schools without being distracted by other students. Based on the students' messy situational maps, we derived meta-analyses, combining and organising the different schools' results, without adding anything.

The so-called 'messy' situational maps in the second project year built on walking tours through the schools with the students and were then further developed during the collaboration. Those tours took from around 30 min up to one hour and were audio-recorded by the participating young people. On the tours, the students presented their school through the intra-actions of encountered material and discursive aspects and answered questions on the schools' emissions, possibilities of change, etc. Along these walking interviews, the more-than-human in the schools was used as a stimulus for conversation and interaction as we sought to apprehend to young people's continuous place-making (Lynch and Mannion 2016). Together, we analysed the entangled relationships of people and more-than human elements in their schools. The students were very motivated to present their schools and talk about their concerns, however, some of them at first were uncertain about what they could or should show us. As part of the co-creation process, the researchers asked about specific places in these moments. Hence, the researchers' interests and preconceptions partly influenced those maps, although the students' experiences and knowledge guided the tours, talking about the areas most important to them. Inviting students on these transdisciplinary tours allowed us to interact with the fleeting, contingent aspects of climate-friendly transformation that are difficult to grasp by other means. By connecting the resulting messy situational maps of the participating schools, we created further ordered meta-analyses.

The study included 171 young people (between 15 and 18) whose self-assessed preparedness regarding climate change and its consequences has already increased by participating in the preceding project *k.i.d.21* (Keller et al. 2019). They were grouped in ten school classes and attended four different schools in Austria and two different schools in Germany. The schools differ in terms of student numbers, year of participation, size of the locality, school type etc. (see Table 1). The inquiry covered two school years: 2020/21 and 2021/22. The students had the task of creating projects in which they calculated the schools' CO_2 emissions and searched for possibilities to reduce them. They were supported in workshops by the researchers as well as in their regular lessons by their teachers. All in all, the collaboration with each class took several months.

Table 1. Participating schools in the project *k.i.d.Z.21_aCtiOn2*, their contexts, commonalities and differences.

	School (1)	School (2)	School (3)	School (4)	School (5)	School (6)
Inhabitants of locality of the schools	14,000	20,000	130,000	19,000	860	207,000
Country	Germany	Austria	Austria	Germany	Austria	Austria
Students of the schools	750	760	900	580	250	520
Participating students	28 (1st year) 20 (2nd year)	39	16	18	22	29
Year(s) of participation in *k.i.d.Z.21_ aCtiOn2*	2020/21 2021/22	2020/21	2020/21	2021/22	2021/22	2021/22
Messy situational maps created by	Students (1st year) Researchers (2nd year)	Students	Students	Researchers	Researchers	Researchers
School type	academic high schools				Higher Federal Teaching & Research Institute	secondary school for economic professions
Commonalities	• have been part of *k.i.d.Z.21* for several years • have decided to participate in *k.i.d.Z.21_aCtiOn2* and develop CO_2 balance accounts • have a school garden (partly with animals)					

More-than-human analyses of whole-school transformations

Sources of CO_2 emissions

The students' messy situational maps provided an overview of their perception of the more-than-human in the climate-friendly transformations of their schools. The following messy and ordered situational maps combine their results, visualising frequencies and searching for recurring and missing aspects. First of all, the messy map of sources of CO_2 emissions depicts more-than-human elements that contribute in one way or another to the schools' CO_2 emissions (Figure 1). The young people noted a broad array of entangled materials, events and infrastructures, ranging

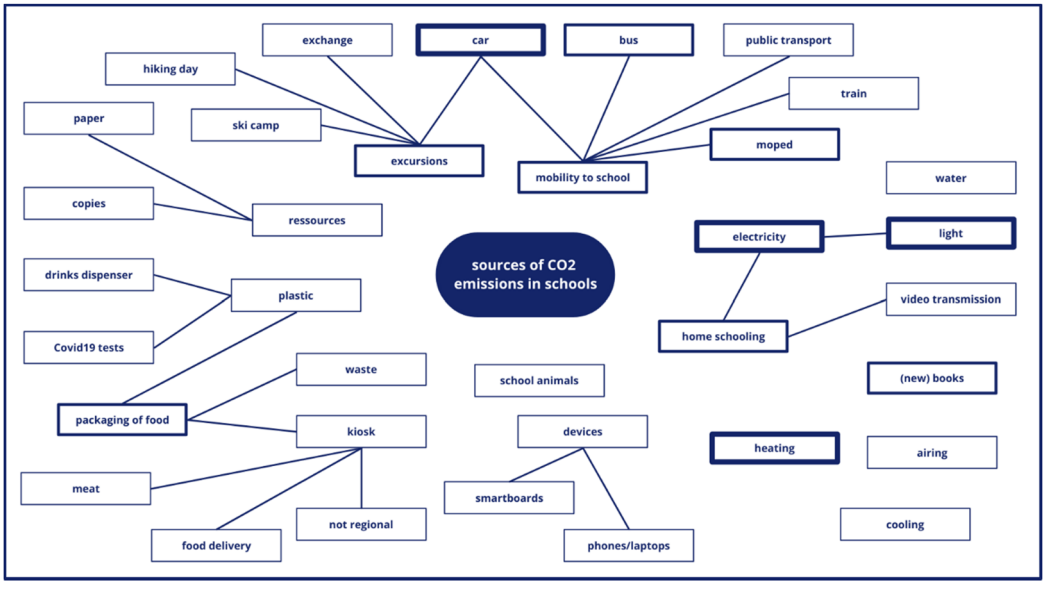

Figure 1. Messy situational map of sources of CO_2 emissions in schools based on the high school students' mapping (the increased depth of the borders represents the frequency at which they were mentioned; connections were included where the students explicitly connected these sources) (schools no. 1, 2 and 3).

from drinks dispensers and devices to excursions, lighting and books. While those sources vary regarding their influences on the schools' overall CO_2 balance accounts, all captured more-than-human elements are in some way part of the intra-actions that constitute the base for whole-school climate-friendly transformations. Without being explicitly asked, the students tried to indicate the ways in which elements mapped related to others through the use of connective lines. This leads to ways of seeing how CO_2 emissions, and the more-than-human elements-in-between connected the sources and students in complex and reciprocal ways.

Important places in schools

On the walking tours through the schools described above, the students started to actively engage with the places they are part of in their everyday life (Figure 2). They recognized their entanglement and their ability to actively respond to and interact with those places and the related CO_2 emissions. In many cases, the students provided 'storied understandings of places' (Jukes and Reeves 2020, 1296), developing an assessment of the places that included not only the analysis of emissions but connected stories and emotions (Oberauer et al. 2023). A purely factual assessment of the emissions would not have been possible on the tours through the schools as the young people answered our questions from within their entangled position with

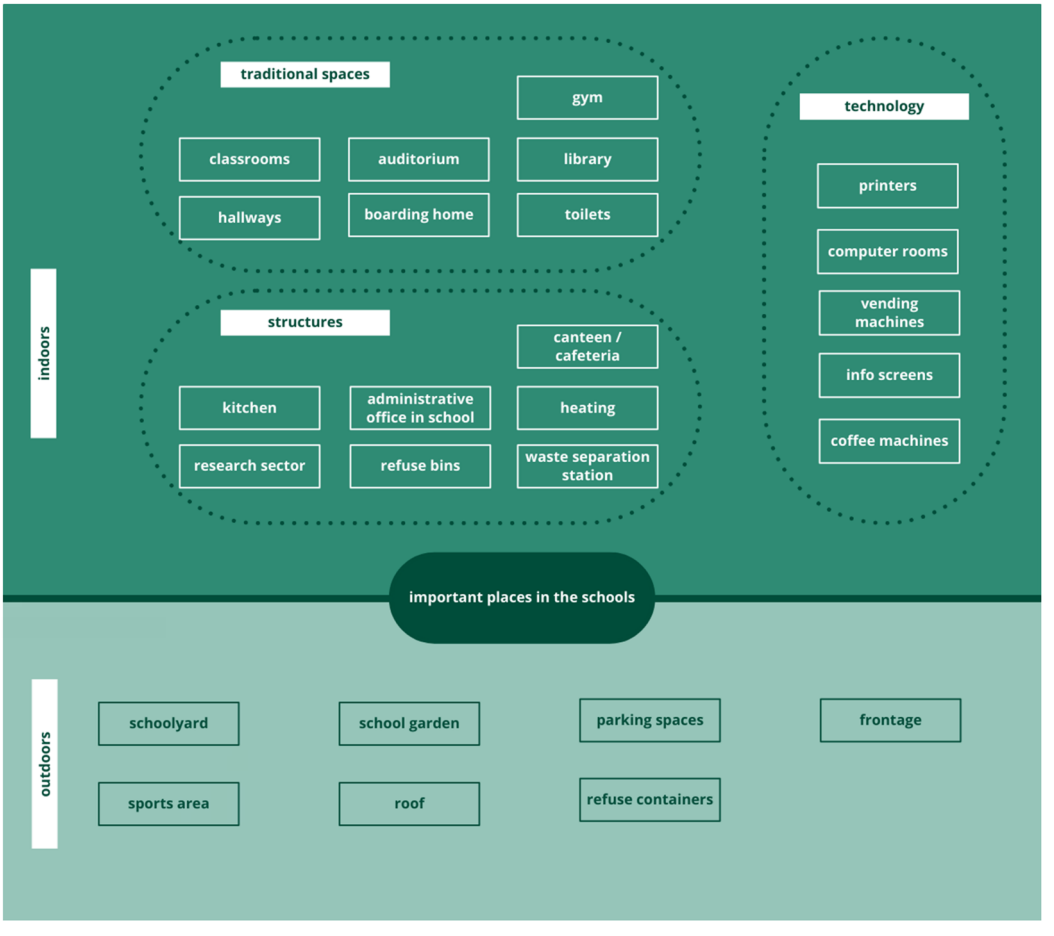

Figure 2. Ordered situational map of places important to the assessment and reduction of CO_2 emissions in schools (schools no. 4, 5 and 6).

the visited places, using and co-creating them but also depending and relying on them every day. A cafeteria is much more to them than a place where more or less emissions are produced – it is a place where they meet, eat and chat, a place of human and more-than-human interaction. Assessing CO_2 emissions was not just a collection of data and calculation of numbers but a response-making process with places that have personal meaning. In contrast, during the first school year, in the online setting, the participating students were less open and talkative when we asked similar questions. We attribute this difference to the walking tours facilitating the interaction with the more-than-human.

Starting from the rooms where we conducted the workshops, often their classrooms, we co-created an understanding of important places together with the students (Figure 2). Many of the identified CO_2 sources were technical equipment or other more-than-human elements that the students used on a regular basis. In the classrooms, they usually named heating, electricity, technical equipment as well as refuse bins. Walking along the hallways, they told us about their perception of how light and heating are regulated. One of the next stops was then often connected to food or drinking. The young people expressed both their dissatisfaction with food options in terms of taste and prices but also explained in great detail why and in what way the food at their schools is not sustainable or climate-friendly. In three of the four schools, the students also showed us the outdoor area of their schools. In many cases, the young people told us how they or others in the school community use the visited places. Connected to this, they made assessments of the places regarding how usable and how enjoyable they perceived them. Apart from that, we also visited places like the roof or the heating room which were completely new to them, too. There might be more of those places the students do not usually use which might therefore also be missing in the analysis, e.g. rooms which are only used by teachers like teachers' rooms or copy rooms.

The further we explored the schools, the more the students seemed to draw new connections to CO_2 emissions, hinting at more and more things that might be important. In school number 4, the students walked by the elevator at the beginning of our tour without mentioning it. At the end of the tour, one student enthusiastically remarked that elevators are also connected to CO_2 emissions. Through these tours, the students went through significant perspective shifts (Trott 2022), getting to know this already very familiar place in a new way. As place-based education approaches emphasise the importance of emotional connections to the places in which environmental education is organised (Iversen and Jónsdóttir 2019), we experienced the importance of the students knowing and feeling connected to their schools on several occasions.

While the young people explored how CO_2 emissions are created in different areas, they repeatedly remarked that things could or should be different and they partly could not understand or explain why certain things are not organised in a more climate-friendly way already. For example, the intensively used heating in the gym, missing refuse bins and non-sustainable food options were criticised. On several occasions, our conversations dealt with climate-friendly ideas and other visions for the future at the same time. Not only in relation to the recurring topic of food but also when reflecting on parking spaces, frontages or school yards, the young people emphasised the need for a holistic transformation. School yards should not only be climate-friendly but also provide shade and integrate gardens. Parking spaces were considered a necessity for some, but other students envisioned green areas in those spaces. In conjunction with the collaborative project work, they seemed to be hoping for an opportunity to have their wishes for a better school heard and respected more fully.

The caretakers' entanglements

Through the analysis of the students' mapping of emissions and important places, it became quickly obvious across all schools that the caretakers' entangled position makes them particularly important in climate-friendly transformations. Although headteachers, caretakers and students

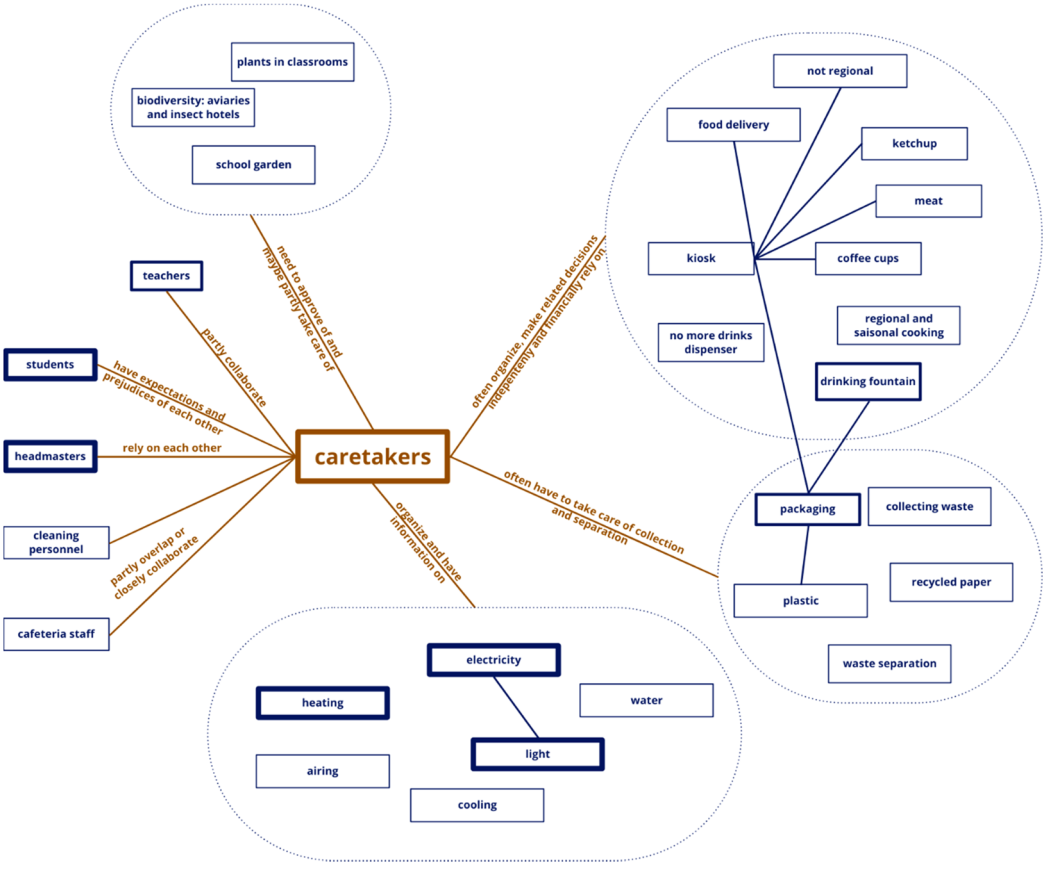

Figure 3. Relational analysis of the caretakers' role in the assessment and reduction of CO_2 emissions in schools (schools no. 1, 2 and 3).

have been mentioned equally often in the students' mapping, we decided to focus on the caretakers, based on relational mapping (Clarke 2009) which revealed their special position in the intra-actions of the discursive and the material in the schools (Figure 3).

The caretakers provided important information on heating and electricity (usage, sources of energy, mechanics, for example), on the food sold by the cafeteria, but also on waste separation (Figure 3) – all of which are necessary for creating CO_2 balance accounts. In addition, the caretakers were also tasked with all kinds of repairs to the school estate, and with questions concerning technology, lighting, waste bins, equipment like snow ploughs and lawn mowers, configuration of digital boards, orders of items such as toilet paper and food from a catering service. The caretakers' relations to many of the depicted elements were, however, not unilinear. They operated from an entangled position that is shaped by material conditions and diverse demands. They physically interact with much of the matter that is connected to CO_2 emissions at the schools.

Through their entanglements with many other people and their discourses, as well as the more-than-human (places and sources of emissions) (Figure 3), caretakers had a lot of scope to strongly influence transformations in related areas. Overall, the caretakers' entanglements enabled them to change the food choice as well as the regulation and automation of heating and electricity quite independently of other human actors. For some more fundamental changes like selecting a climate-friendly electricity provider or installing solar panels, the caretakers needed to collaborate with other groups like headteachers or administrative district

offices. But even in those cases, the caretakers' motivation to make the schools a more climate-friendly place was crucial.

In most schools, the caretakers' attitude and the manner of their response to requests led to most of the students being intimidated by them. For example, in one school (no. 4) the students tried to hide and were afraid of asking questions when we asked them if we could meet the caretaker. In another school, the caretakers refused to talk to the students about their products in the kiosk. These refusals to enter the conversation with each other rendered dialogue difficult or impossible, in some cases foreclosing the possibility of dialogic interaction as a fundamental part of transformative processes (Wals and Schwarzin 2012).

The caretakers' own positions and challenges became clearer in the analysis of the second phase of the project. In some schools (no. 5 and no. 6), they expressed their frustration in relation to transformation attempts. They did not believe in the possibility of motivating students over the long term to correctly separate waste, to buy climate-friendly food, or to turn off or turn down the heating when it is not needed. The caretakers in school number 5 were comparatively most open to the collaboration, they proudly showed us the heating and cooling systems, and were open to answering questions as well as interested in the students' results. In terms of challenges and limitations to their influence, the caretaker of school number 4 emphasised how difficult it was to order food that is not too expensive and that the students liked in order to stay competitive with the supermarket next to the school.

All in all, the caretakers had to align their interests with all kinds of conflicting expectations of students, teachers, parents, headteachers and others. The material conditions in the different areas of the school affect the caretakers in their everyday work and any transformations would do so, too. Climate-friendly transformations in this case tended to be perceived as additional baggage, work and responsibility.

Discussion

Climate-friendly transformations of schools and the caretakers' entanglements

Addressing various social and cultural relations (Shallcross et al. 2006), whole-school approaches should include all kinds of organisational and non-pedagogical staff who shape the school by their daily practices and decisions. Nevertheless, non-pedagogical staff and their entanglements are often not considered in CCE projects. Cooperation and collective engagement for more climate-friendly schools could not only accelerate the necessary transformation but contribute to the staff's wellbeing. As successful trainings of caretakers in managing food allergies in schools indicate (Polloni et al. 2020), specific educational programs with caretakers could be helpful to strengthen their motivation and capacities to becoming the schools' climate change agents.

While school leadership and the role of headteachers in whole-school approaches to sustainable development has been emphasised in other studies (e.g. Forssten Seiser et al. 2023; Forssten Seiser and Blossing 2020), our collaboration on climate-friendly transformations revealed that headteachers are only one group of agents among many other human and more-than-human agents that act and decide together. In many cases, connected to practical, technical or daily needed resources, caretakers strongly influence these decisions out of their embeddedness in the described entanglements. Few studies look to explain the specific role of caretakers. Their role, tasks and the ways in which they interact with the students and other persons and materials in the schools puts the caretakers in a central position. The presented maps on the sources of CO_2 emissions and places revealed the caretakers' diverse connections as well as the variety of their tasks. These entanglements render them indispensable when aiming for more climate-friendly schools. By supporting students in their ideas while also confronting them with

real-world challenges, caretakers could contribute to effective learning settings that deal with the complexities, challenges and possibilities of climate-friendly transformations. However, if caretakers are not open to changes, as was often the case during the project *k.i.d.Z.21_aCtiOn2,* students have to face major barriers in attempting to change their school.

Entanglements of students, places and discussions

The collaboration in *k.i.d.Z.21_aCtiOn2* revealed possibilities of creating successful CCE settings by drawing attention to the intra-actions of the material and the discursive. In our experience, students were aware of various transformation challenges in the context of everyday issues and could describe them to great detail. For example, they offered rich descriptions of paper cups being scattered all over in school number 5. The cups were left in every corner of the school, often still half full or even spilled. When put in the waste bins, those might overflow, often creating messy places. Although the paper cups do not significantly influence the schools' CO_2 balance accounts, they provided a situated problem which the students wanted to develop solutions for, and one that they would need the support of the caretakers for effective action. This example illustrates how the intra-actions of the material, such as the paper cups, and the discursive, in this case the students' debates, bear great potential for effective, more-than-human CCE.

Hence, CCE should build on educative places and entanglements of students and more-than-human elements in their schools. Educational programmes focusing on everyday contexts and actions can be 'a way to empower children and youth, increase their understanding and engagement, and avoid the despondency and helplessness that climate change can foster' (Jorgenson, Stephens, and White 2019, 165). Learning about climate change might be more effective next to waste stations, in cafeterias and next to drinks dispensers – building on and expanding situated knowledge and experiences. In this way, learners get to realise complexities 'in the small resistances, common negotiations and perspective changes that occur on a daily basis in our schools' (Larsson and Dahlin 2012, 12). CCE should use this potential also by exploring ways of better attuning students with the more-than-human. Thereby, the entanglements of the young people with the infrastructures they use and depend on can become apparent, creating the basis for change.

Conclusion

Assessing and reducing the CO_2 emissions with students in Austrian and German schools with *k.i.d.Z.21_aCtiOn2* provided new and original perspectives on the intra-actions between materiality and discursivity from which climate-friendly transformations can develop. Overall, the direct, practical experience of environmental issues in the organisation of the whole-school was shown to be an underestimated part of learning about climate change. CCE building on the entanglements and challenges alongside the climate-friendly transformation of schools could render climate change and related complexities much more tangible and actionable for learners. Young people's intra-action in the situational mapping supports the goal of assessing and reducing CO_2 emissions while also advancing their agency in research as itself a form of assemblage (Mannion 2020). Situational analysis, conducted in this participatory manner, has been shown to be a well-suited method for revealing the material and the discursive which have to be transformed concurrently.

Prerequisites to the climate-friendly transformations of students and schools addressed in this paper are the inclusion of all relevant persons and the intentional interaction with place. In particular, people and places not usually connected to pedagogy are crucial. Hence, future

CCE should not solely focus on lessons but actively engage with the entanglement of students, the school community and the schools. In this way, the whole school can actually be recognized as an educational place in which students can learn through their daily interactions with other persons as well as the more-than-human. This kind of whole-school approach lays the foundation for situated learning in changing institutions that benefit from the students' experiences and prepares them for living in a world shaped by climate change.

Utilising the situational mapping approach with young people has shown that involving them in the exploration of their whole-school institutions and identifying the areas of importance to them has the potential to increase their agency both in research and towards the goal of transformative CCE.

Further research

Taking a situated and map-based approach has enabled us to focus on the students' experiences, ideas and wishes. The result here was to notice how caretakers and their motivations aided the transformation processes in schools. In further research, co-creating situational maps with stakeholders and learners of all kinds, could provide interesting further insights in climate change and climate justice education. Indeed, in other settings, other human and non-human actors would undoubtedly come to the fore. The participatory approach taken here could be applied more widely in environmental and sustainability education, for example in biodiversity loss education, in place-based and place-responsive education, and in other studies sensitive to eco-social processes and practices.

Notes

1. Nina Liebhaber and Melanie Frick collaborated with the students and organised the data generation. All authors contributed with their knowledge and perspectives for this article which is based on the initial analysis and discussion by Nina Liebhaber. Henceforth, "we" refers to all authors.
2. The Board of Ethical Questions of the University of Innsbruck has certified the project's correspondence with all requirements of the ethical principles and the guidelines of good scientific practice of the University of Innsbruck.
3. Please note that Clarke uses the term 'nonhuman actants' here, instead of 'more-than-human'. However, we consider her reflections on the assessment of 'the nonhuman' in line with the presented approach to the more-than-human. For reasons of coherence, we stick to 'more-than-human' here.
4. Due to space limitations, the created social worlds/arena maps were not analysed in this paper, but they will be the focus of another future publication.

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