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Learning about climate change in, with and through art

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Abstract

Effective strategies to learn about and engage with climate change play an important role in addressing this challenge. There is a growing recognition that education needs to change in order to address climate change, yet the question remains "how?" How does one engage young people with a topic that is perceived as abstract, distant, and complex, and which at the same time is contributing to growing feelings of sadness, hopelessness, and anxiety among them? In this paper, I argue that although the important contributions that the arts and humanities can make to this challenge are widely discussed, they remain an untapped or underutilized potential. I then present a novel framework and demonstrate its use in schools. Findings from a high school in Portugal point to the central place that art can play in climate change education and engagement more general, with avenues for greater depth of learning and transformative potential. The paper provides guidance for involvement *in*, *with*, and *through* art and makes suggestions to create links between disciplines to support meaning-making, create new images, and metaphors and bring in a wider solution space for climate change. Going beyond the stereotypes of art as communication and mainstream climate change education, it offers teachers, facilitators, and researchers a wider portfolio for climate change engagement that makes use of the multiple potentials of the arts.

Keywords Sustainability education · Transformation · Arts-based methods · Youth

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1 Introduction

There is little doubt that today's children will inherit a world with complex social-environmental challenges. Limiting global warming to 1.5 °C above pre-industrial levels is a major task that involves rapid and profound changes in how societies function. Education plays a vital role in addressing this challenge and many have argued that it needs to be revised and restructured in order to provide conditions for transformative learning and meaningful climate action (Monroe et al. 2017; O'Brien et al. 2013; Sterling and Orr 2001).

At school, teaching about climate change usually takes place in the natural science disciplines and is often limited to explaining the greenhouse effect and discussing the potential consequences of rising temperatures, changing precipitation patterns, and increasing sea levels (Monroe et al. 2017; Stevenson et al. 2017). Communicating mainly messages of fear rather than showcasing real examples for active engagement, this approach has been criticized for contributing to feelings of denial, numbing, and apathy (Norgaard 2011; Stoknes 2015). Not surprisingly, research has found that pessimism and hopelessness about climate change and the future in general is growing among young people (Ojala 2012). At the same time, in 2018, Greta Thunberg sparked an initiative among school children referred to as Fridays for Future movement because she provides a fresh perspective on the urgency of the climate challenge and signals the need for positive avenues for understanding and engaging the issue.

The arts and the humanities can play a critical role in engaging young people and adults with new perspectives on climate change. At universities as well as at school, humanities classes offer environments for critical, integrative, and reflexive approaches and the arts disciplines including visual art, theater, and music can provide spaces for creative imagination, experimentation, and perspective-taking (Bentz and O'Brien 2019). Art can also attend to and transform emotions, creating hope, responsibility, care, and solidarity (Ryan 2016). Integrating arts-based methods and climate change education and engagement can thus serve as a means of expanding young people's imagination and empowering them to co-create new scenarios for transformative change.

Notwithstanding this potential, climate change is rarely integrated into the curricula of arts, music, literature, language, and philosophy (Siperstein et al. 2016). Little research has been done on how to teach about the topic in the humanities and social sciences (A. Siegner and Stapert 2019), especially in elementary, secondary, and high school. This is despite the fact that a large body of research has shown that the engagement with sustainability-related topics at younger age has a higher chance to lead to pro-environmental behaviors and attitudes (Barthel et al. 2018; Chawla and Cushing 2007). The impact of a given climate-art education project depends very much on the chosen approach and setting. Arts-based practices can be used in many different ways and will result in different depths of engagement.

In this article, I propose a framework that distinguishes three levels of arts-based engagement with climate change and their potential application to teaching. Integrating climate change *in* arts courses, expressing *with* art, and learning *through* art can prepare and empower young people to address climate change themselves and add to the current discourse in a way natural sciences alone are unable to achieve. The proposed framework, aimed towards teachers, practitioners, and researchers working with young people, draws insights from scholars of education for sustainable development, transformation, art, and critical thinking among others as well as from a case study in a Portuguese high school, which will be discussed below.

The objective of this article is not to provide an "artistic recipe" for climate change education. Rather, it intends to articulate and reflect on the potential of art and educational practices to prepare and empower young people to address complex global challenges and contribute to the broader discourse on climate change and societal transformation. There is need for further research to better understand the contributions of teaching climate change *in*, *with*, and *through* the arts and the applicability of the tentative framework in diverse school settings. Nevertheless, this study articulates some insights that can complement existing frameworks for education on sustainable development, critical thinking, and climate change.

2 Climate engagement *in*, *with*, and *through* art

Art and arts-based practices are increasingly seen as a powerful way of developing meaningful connection with climate change (Bentz and O'Brien 2019; Shrivastava et al. 2012). Artistic and creative practices and approaches can help expand our imaginaries of the future, opening up our minds to new scenarios of change. Art's potential to transform society, as well as its capacity to support agency and inspire feelings of hope, responsibility, and care, has been known for a long time (Boal 2000) and esthetic practices can contribute to deep emotional learning about sustainability. For example, artistic practices can create openness towards more-than human worlds, providing access to different sources of cognitive, emotional, and sensual experiences (Pearson et al., 2018).

Art has the capacity to raise awareness, to engage creativity for addressing complex problems, and may also support transformation to sustainability (Dieleman 2017). However, the impact and outcome of a given climate-art project depends on the very nature of it.

Here, I propose a framework for understanding and guiding arts-based practices to be used in different ways and for fostering different depths of engagement of a given target group of participants and audiences (see Table 1). In the following section, I illustrate the three depths of engagement in climate change depicted in Table 1, including *in* art, where art is used as a platform for introducing or communicating the issue; *with* art, where art serves as a medium to facilitate dialogue and express learning; and *through* art which conceptualizes art as a means of transformation. Transformation has been conceptualized as a change in societal systems, structures, and relationships, and carries with it a promise of moving the world towards equity and sustainability (O'Brien 2012).

2.1 Climate engagement *in* art

Art can be a powerful tool for communication. Within the growing field of science communication, art has been identified as an effective means of communication to raise awareness with the help of video work, documentaries, infography, illustrations, and comics about climate change impacts and adaptation strategies (Roosen et al. 2018). Many of such approaches rely on the visual engagement of art, based on the well-known saying "a picture is worth a thousand words". Here, art is supposed to enrich the narrative and extend its reach. It is used in an instrumental way to communicate climate change or project results in a more attractive, potentially less serious and more understandable way without shaping or questioning fundamental methodological approaches or systemic givens (Burke et al. 2018; Yusoff 2010). It is often the case that the predefined settings and boundaries of a research project or public event wishing to present art leave limited space for creative expression of

Table 1 Climate engagement *in, with*, and *through* art

In art	*With* art	*Through* art
Art as platform for introducing the issue/as communication	*Art as medium to facilitate dialogue and express learning*	*Art as means of transformation*
Characteristics: Aesthetic, attractive, accessible communication of climate change; goal oriented	Characteristics: Participatory, experiential, community engaging; process and goal oriented	Characteristics: Co-creational, transdisciplinary, open-ended; process oriented
Examples: Illustrating climate change with comics, infography, or documentaries	Examples: Providing creative experiences related to climate change including art-&-science labs and participatory art	Examples: Using art as a process to discover meanings of climate change, and to deepen and embody experiences e.g. through dance, storytelling, or independently creating an artwork prompted by an open-ended and personally relevant climate-related question

artists. Artists have engaged in such collaborations, using *art as a platform to introduce and communicate about climate change*.

A growing number of artists are interested in and concerned about climate change and environmental degradation (Gabrys and Yusoff 2012; Lesen et al. 2016). Emerging from the field of ecological art since the 1970s, artistic engagements with climate change have grown considerably. A common approach of many artworks has been to focus on or document the problems, risk, and impacts of environmental problems; they communicate climate change, as a topic *in* the arts. This way of using art to introduce and communicate about climate change has attracted more and more critique because it rarely leads to pro-environmental behaviors and might even have contributed to feelings of powerlessness (Moser and Dilling 2011). Another reason for artists' engagement in climate communication may be related to limited funding opportunities of more experimental, open-ended and arts-led research projects. In comparison with the natural sciences, social sciences and humanities continue to attract a much smaller amount of research funding for climate change mitigation (Overland and Sovacool 2020). Climate projects where arts play a dominant or equally important role as natural sciences are yet limited.

Artworks resulting from collaborations in which arts play a subordinate role, in the sense of communicating project outputs or predefined climate change impacts and adaptation measures, do not fully unleash the potential of arts to contribute to new ways of seeing and acting upon climate change. Nevertheless, this use of art is important to provide more aesthetic, attractive, and easily accessible ways of communicating the complexities of climate change to broad audiences.

2.2 Climate engagement *with* art

Climate engagement using creative, artistic practices has the potential to go beyond science communication and help people to overcome perceived psychological distance and develop critical thinking. Formerly limited to galleries and laboratories, art and science interactions have become commonplace within social, political, economic, and environmental contexts outside of conventional institutions (Latour, 2004). This shifted the traditional sender-receiver paradigm by, for example, engaging communities in creative-participatory processes (Hawkins

2016). Participatory art has the potential to bring together people from different sectors and contexts, supporting dialogue and the creation of networks among artists, scientists, and society. Such arts-based practices can facilitate dialogue, which can then lead to the cultivation of deeper understanding.

Creativity, inspiration, and positive stories are powerful means to explore practical solutions for addressing climate change (Veland et al. 2018). Experiential projects such as creative hands-on labs or fieldtrips can make climate change feel real and near for diverse audiences by providing sensorial experiences and emotional connection (Hawkins 2016; Hawkins and Kanngieser 2017). Art can help facilitate a creative engagement with the topic and the expression of new insights and learnings of a participatory process (Burke et al. 2018). Such processes and collaborations between artists, scientists, and the broader society are also useful for making micro-macro connections between individual lives and the larger global context. Art's ability to keep open the ambiguities, ambivalences, contradictions, and sometimes chaotic dimensions of reality, rather than leveling them into a coherent logical system, is seen as helpful when addressing the complexities of climate change (Kagan 2015).

Projects involving art and artists benefit from art's capability to capture complex processes and problems as well as its ability to mirror the unfolding nature of social life and express the learnings of an interactive process (Leavy 2015). Such projects engage people in climate change *with* art and creative processes. Processes in which art serves *as a medium to facilitate dialogue and express learning* are often appreciated due to their engaging and potentially playful nature, which can bridge and integrate opposing interests and different forms of knowledge. They are often participatory, experiential, community engaging, and process as well as goal-oriented. Examples include art-&-science labs and participatory art. Such processes that tap into the creative potential of all participants and reduce hierarchies of ways of knowing and have the potential to build community, which might be an important prerequisite for social transformation.

2.3 Climate engagement *through* art

Apart from facilitating dialogue and the expression of learning, art can operate on a profound, transformative level. It can be a process that engages people with climate change on a deep, emotional, and personal level. It has been argued that at its best, art can be emotionally and politically evocative, captivating, aesthetically powerful, and moving (Leavy 2015). For instance, a theater on the experience of a forest fire can communicate emotional aspects of life in a way that creates a deep connection with the audience, evoking compassion, empathy, as well as understanding and meaning. The creation of personal meaning usually involves more than the cognitive aspects of climate change. It requires the inclusion of ethical, affective, and aesthetic knowledges, which affect how we interpret and assign value to certain aspects of our life (Castree et al. 2014). Arts practices allow multiple meanings instead of pushing authoritative claims by implying which meanings are considered relevant or correct. In that sense, a piece of visual art, for example, can be interpreted in many different ways depending on the viewer as well as the context of viewing.

Another way of creating meaning is through stories. Storytelling and writing are fundamental parts of human life. To a certain extent, we tell stories to give meaning to our lives (Bochner and Riggs 2014). Stories can make us feel connected, open our eyes to new perspectives, stimulate self-awareness or social reflection. Through fictional writings, we can

express ourselves freely, reveal the inner lives of characters, and create believable worlds for the readers to enter (Leavy 2013).

Artistic and creative practices can also include embodied experiences. This is particularly relevant when we consider that all experiences are ultimately embodied and that it is through the senses that we come to know (Wiebe and Snowber 2011). Dance and theater, as particularly embodied practices, can incorporate words and narratives. When we understand the body as having meaning in itself, as opposed to a container where meaning is stored, we can use it as a means to pose questions, connect with emotions, and understand theoretical concepts. This way, dance and movement can challenge norms that are embodied and rendered invisible. It can be argued that it is through the body that we can see and experience differently. That being so, dance has been attributed a transcendent, transformative potential (Leavy 2015).

Using art as a tool that guides us *through* a meaning-making and embodied experience is arguably a transformative process that can enable us to see and act differently on climate change. According to Pelowski and Akiba (2011), in order to be transformative, art needs to be disruptive so that the viewer is forced to accommodate new information that does not fit his/her self-image. This leads then to a process where conceptions and worldviews are questioned and a self-change of the viewer can occur (Pelowski and Akiba 2011). Processes in which art is used as a *means of transformation* are often open-ended, co-creational, and therefore process-oriented as opposed to output oriented. Results may also differ from initial expectations. Examples for such processes could be independently creating an artwork prompted by an open-ended and personally relevant climate-related question, or co-creating a theater performance based on personal experiences.

Being hard to measure, there is limited knowledge about how to provide transformative experiences in climate change engagement processes that allow participants to question and re-evaluate their perspectives, values, and worldviews in a way to learn anew how to relate to the systems and structures that maintain the status quo. Such processes often rely on the experience of the facilitators, artists, or teachers and their notion of successful tools (Funch 1999) but also on the receptivity of the engaged participants or students. Furthermore, they are potentially time-consuming.

The outcomes of engaging in climate change *through* arts may greatly differ from those of engagement *in* or *with* art in the sense that they potentially create a deep, long-lasting impact on the participants and audiences, which can then enable transformations in the way they relate to, feel about, and act upon climate change.

3 Data and methods

The insights of this article are drawn from multiple sources of data. Between 2018 and 2019, using qualitative research and embedded in a transformative research paradigm, I engaged 70 students aged between 16 and 18 years of a public art high school in Lisbon, Portugal, in two different art and climate change projects.

(1) Within project *Art For Change*, two 11th-grade communication design classes (in 2018 and 2019) engaged in climate change by identifying one small change that could be beneficial to the environment and committing to it for 30 days. During the 30-day experiment, they reflected in group dialogues, and fish-bowl discussions, writing exercises and through making art about their particular relationship with climate change as well as social norms, values, and systems.

(2) In project *Cli-fi & Art*, students of one 11th-grade class (in 2019) engaged with climate change through Climate Fiction (cli-fi). In their English classes, they read the short stories in "Everything Change: An Anthology of Climate Fiction" (Milkoreit et al. 2016) and expressed their feelings about the stories, climate change, and the future more generally in group dialogues. Within the communication design classes, they developed an art project about their particular interaction with the topic.

Both projects were designed as reflexive, experiential, and open-ended learning processes. Over a period of 4–5 months, within each class, students reflected individually and in groups on climate change by connecting behavioral changes and practical actions with larger systems and structures, as well as by examining individual and shared beliefs, values, and worldviews. In two interactive lessons for each class, students learned about observed and future climate change impacts as well as what kind of responses existed and could be imagined. They discussed how these would affect them and how they could influence them. In group dialogues and fish-bowl discussions, students could share their thoughts and feelings along the learning process as well as new insights about themselves and about climate change. They further discussed similarities and differences in their experiences. Parallel to the reflection and learning process, students started sketching and conceptualizing their individual art project. Each student developed an artwork related his or her personal subject of interest, point of view, new insight, or individual process of reflection related to climate change. The process of making the artworks (silk print, stencil, drawing, aquarelle painting, digital image edition using Illustrator and Photoshop) was led by the art teachers of the school, yet the teachers' guidance was of technical nature related to the realization of the artworks and did not influence the ideas of the students' artworks. The resulting 63 artworks and 33 written artist statements were exhibited in a local sustainability festival in Telheiras, Lisbon (2018 edition, Art For Change), and at the European Climate Change Adaptation conference in Lisbon (2019 edition).

As a methodological approach, I used participant observation, took notes, and facilitated group dialogues and fish-bowl discussions. The group dialogues and discussions were recorded. Recordings were transcribed, and transcripts, notes, and students' written reflections and artist statements were then coded. Coding is a heuristic and exploratory problem-solving technique that can encompass a diverse range of qualitative data including transcripts of discussions, field notes, and visual data (Saldaña 2016). A code book was developed to define the meaning of each code and create categories of codes. Specific codes were assigned to the data using NVivo (version 12).

Analytic memos were written to reflect on code choices and their operational aspects. These data were used to identify emergent patterns and possible networks among the codes and categories. The artworks were analyzed using a holistic interpretive lens guided by intuitive inquiry and in connection with the artist statements. The intuitive impressions and holistic interpretations of the images were documented in analytic memos. Then, the credibility of the visual reading was assessed through supporting details from the artworks—evidence that affirmed or disconfirmed the personal assertions. Codes were then derived based on the interpretative essence of the image, a method suggested by Saldaña (2016).

Through this process, I noted how climate change seems to be a challenging topic in education settings. Despite enormous amount of information on the changing climate, effective teaching strategies are still limited, especially ones that empower young people (Monroe et al. 2017). While carrying out this study on art and climate, I realized that there was more than one way to make the links between climate and art, and that different ways of involvement had an impact on how the students engaged with climate change. Moving between my data collection

and the artworks in a preliminary analysis, I began to note the categories of how art was being used in climate change education and with what effect. Based on this abductive inquiry, carried out in relation to the scholarship on this topic and in consideration of the data generated by this study, I present a newly developed framework for using art in climate change engagement and education (Tables 1 and 2). My research suggests that researchers and teachers may be able to make use of this framework on the potential of art to engage more deeply with climate change in order to provide conditions for meaningful learning and climate action.

4 Learning about climate change *in*, *with*, and *through* art

In most countries, climate change is part of the natural sciences curricula, which commonly approaches the topic from a positivist science point of view, presenting climate change as an environmental problem related to increasing levels of greenhouse gases in the atmosphere as a result of human activities (Hess and Collins 2018; Schreiner et al. 2005). It has been argued that this discourse fails to address some of the elements that reinforce the status quo. Nor does it consider the possibility of individual and collective agency to dramatically change current systems, patterns of consumption, and resource use (Kirby and O'Mahony 2018; Leichenko and O'Brien 2019; Verlie and CCR 15 2018).

The students in this research engaged with climate change within arts and humanities disciplines. The projects were conceived as arts-led, transformative learning experiences that invited students to a reflexive, experiential, and open-ended learning process. Most of the students were receptive to embark on this experiment and were interested in climate change. Yet the results show that there are different depths of engagement in climate change. This may depend on a number of factors including the chosen arts-based approach—whether climate change is merely dealt with *in* arts disciplines, *with* creative-participatory practices, or learned or guided *through* an art process (Table 2). Drawing from the tentative framework of the depths of artful climate involvement (Table 1), the following discussion, I portray these depths of engagement through art in the context of climate change education, illustrated with data from two different climate-art-education projects. I also provide suggestions for how to apply them to a school setting. Whereas the above described characteristics and modes to engage with climate change (and Table 1) can occur in a variety of fields of practices, the following discussion applies specifically to an education context.

Table 2 Learning about climate change *in*, *with*, and *through* art

In arts and humanities	*With* art	*Through* art
Art as platform for introducing the issue/as communication	*Art as medium to facilitate dialogue and express learning*	*Art as means of transformation*
Approach: Climate change used as a topic in arts and humanities courses: e.g., drawing, painting, illustrating climate change impacts or recommendations for sustainable lifestyles or reading about/watching documentaries on climate change	Approach: Climate change is approached with the help of creative tools as a medium to explore and reflect on the broader social, political, economic and ecological context, e.g., art-&-science labs, group discussions, by using art to express experiences and learnings	Approach: Climate change is explored through arts practices as an interrelated, complex, personal and collective challenge, e.g. by using art as a way to discover meanings of climate change, and to deepen and embody experiences. Practices may be co-creational, transdisciplinary and/or open-ended

4.1 Learning about climate change *in* arts and humanities classes

More and more arts and humanities educators explore climate change as a topic within their classes (Monroe et al. 2017; A. B. Siegner 2018; A. Siegner and Stapert 2019). Usually, they rely on teachings from the natural science disciplines and the biophysical discourse, for example, by reading informative texts about climate change, watching documentaries, applying learning games or by using climate change as a theme for illustrations, paintings, or drawings (Climate Generation 2019; Cooper and Nisbet 2017; Dieleman and Huisingh 2006; Vethanayagam and Hemalatha 2010). Resulting artworks are often descriptive works, illustrative climate communication, and lack a critical or personal reflection and interaction with the theme, as in Fig. 1 a and b. The students of this research were introduced to the topic of climate change through an interactive lesson. Due to limited time provided by the school, the focus of this lesson was climate change impacts as well as possible solutions which runs the risk to paint a rather dark picture of the future. In the group dialogues and fish-bowl discussions, the focus was more on individual and collective action and on opportunities to act, yet some students maintained an unattached, technical perspective on the subject matter. This is also illustrated by their associated statements that show that these students used (stencil) art to depict the problems of climate change (Fig. 1a) and a technical, arguably simplified solution (Fig. 1b):

> My work was inspired by cartoons, and represents a light bulb. My goal is to alert people of the need for energy saving.
> Student F, artist statement, Art For Change project 2019

> The representation of the world with a label with the expiration date of 12 years is the period of time in which we can still make difference and improve the critical situation of the planet. With adapted symbols, I wanted to mention that the causes are human. The QR code will lead the viewer to a site that explains climate change, its causes, and consequences. With this work I intend to convey that if there is no change in our actions in these 12 years, the world can face an irreversible destruction, and it is our responsibility to change our attitude towards this problem.
> Student M, artist statement, Cli-Fi & Art project 2019

The students' artworks and statements show that their perception of climate change is disconnected from themselves. Although they are aware of the problem, their statements relate to the perspective of the biophysical discourse that frames climate change as an environmental problem of greenhouse gas emissions. This more technical way of conceptualizing climate change runs the risk of disempowering students because of a limited consideration of individual and collective agency to change systems within this discourse (Leichenko and O'Brien 2019). The results suggest that when the goal of a learning experience is to create more than climate awareness (e.g., empowerment), it might not be enough to teach climate change *in* the arts with the same approaches that are commonly applied in the natural science disciplines and use art as a platform of providing easily accessible information or communicating the problem. Rather, more (co)creative approaches are needed, some which hail from different discourses in order to build a young generation that is capable of addressing climate change.

Fig. 1 Artwork of projects Art For Change and Cli-fi & Art 2019

For example, teaching climate change *in* the arts and humanities courses can be done more holistically, by drawing on the integrative discourse. An integrative discourse sees climate change as interconnected with multiple processes of environmental, economic, political, and cultural change and closely linked to individual and shared norms, beliefs, values, and worldviews (Leichenko and O'Brien 2020). Integrating multiple perspectives, the integrative discourse approaches climate change as a transformative process involving the environment as well as communities and our relationship to nature and each other. By suggesting the metaphor of a living system as opposed to a mechanistic way of seeing the world, a postmodern and ecologic worldview emphasizes relationships, participation, empowerment, and self-organization (Sterling and Orr 2001; Verlie and CCR 15 2018). It recognizes also that questioning paradigms and patterns of thought can create space for new ways of exploring the complexities of climate change.

Within an integrative discourse, humans are viewed as a reflexive part of the climate system that is able to create as well as change patterns. This perception introduces the fundamental possibility to change the relationship that creates climate risk and vulnerability (Leichenko and O'Brien 2019). This discourse is also in line with growing recognition within the climate change

research community that societal transformations are inevitable in order address the climate challenge (Leichenko and O'Brien 2020; O'Brien 2015; Pelling 2011; Pelling et al. 2015).

Teaching climate change *in* arts disciplines using an integrative discourse is an approach that is already being applied in schools in Finland. The Finnish climate guide (Sipari 2016) contains tips and tools for multidisciplinary climate education as early as in the primary level. With an emphasis on critical and cultural competence, teachers are encouraged to approach climate change in visual arts courses, music, foreign language courses, and literature (among other disciplines) (Sipari 2016), for example, through the lens of the ecological handprint that focuses on the positive impacts humans have on the planet as opposed to the ecological footprint that is more problem-centered (Kühnen et al. 2017). While this kind of approach does not require a change in teaching methodologies, it consists rather of a *different content* of information and more holistic lens to approach climate change *in* arts and humanities courses.

4.2 Learning about climate change *with* art

There is a growing recognition that the current dominant model of transmissive education is insufficient to meet today's challenges (Blake et al. 2013; O'Brien et al. 2013; Sterling and Orr 2001). Many advocate for a shift from the transmissive, instructive notion of education which relies on the transfer of information to a more creative and engaging, transformative learning where meaning is constructed in a participative way (Reid et al. 2008; Rickinson et al. 2010; Sterling and Orr 2001).

Seeing with critical eyes or critical thinking is a key ingredient in such learning processes. Daniel Willingham (2008) describes critical thinking as "seeing both sides of an issue, being open to new evidence that disconfirms young ideas […]." The basic assumption is that we need to "see" differently if we are to know and act differently. Art can help us to see and integrate different perspectives and complexities, which then can lead to development of critical thinking. In this research, students adopted a sustainability-related change for 30 days and approached climate change through a personal experience with change. Along the 30 days, they reflected on the various (personal and systemic) facets of change. This in addition with the group discussions and the artistic expression constituted a student-centered, learning-by-doing approach. Learning *with* the help of creative and experiential approaches has shown to help students to discover new insights about themselves and facilitate new relationships with resources and the topic climate change in general (Bentz and O'Brien 2019). For example, it enabled one student to discover her "own consumerist interior" (student T, written reflection, 2018) during the project. Creative forms of engaging in climate change can help students to see things from new perspectives and question their frames of reference. The following quote and artwork from a student (Fig. 1c) shows a critical reflection with the capitalist way of life, with which she interacts.

> I created this image as a form of criticism of consumerism, materialism and the greed of mankind, who tries to possess and give monetary value to everything, even to their own planet.
> Student R, artist statement, Art For Change project 2019

Promoting learning in which students critically examine the structures in which they are embedded is crucial for understanding the causes and impacts of climate change, and yet is underemphasized in mainstream education (Stevenson et al. 2017). Artistic and humanities

disciplines at school have the capacity to promote critical thinking due to art's power to enhance perspective-taking capacities. Instead of focusing on knowledge provision, teaching can involve experiential methods such as participatory art projects, hands-on labs, field trips, and group dialogues, which engage more than the cognitive domains of learning. The importance of active participation and learning-by-doing is highlighted by the "head, hands and heart" approach to learning, which incorporates transdisciplinary study (head), practical skill sharing and development (hands), and translation of passion and values into behavior (heart) (Sipos et al. 2008). Such approaches allow students to see that the shape of knowledge can always change and invite them share their ideas in an open manner.

According to bell hooks (2010), critical thinking is an interactive process, a way of approaching ideas with the aim to understand underlying truths. Engaging students through interactive approaches can be considered a prerequisite of good education and a principle of success in environmental education (Monroe et al. 2017). Experiential forms of learning are known for their potential to enable a process of questioning and reorienting existing values, knowledge, and concerns (Liefländer et al. 2013). As such, engaging students in deliberative discussions and forms of creative expression can contribute to the deconstruction of students' taken-for-granted frames of reference because it is through the interaction with others that students are exposed to different perspectives and opinions (Mezirow 2000; Monroe et al. 2017). Combining group dialogues with creative and artistic expression of learnings and experiences with a changing climate, such as in this research, can enable students to see climate change differently as well as their own role in addressing it. The following quote from a group dialogue shows a sense of responsibility despite discouraging comments from friends and family about the student's decision to eat vegetarian.

> People always say things like "that doesn't do anything" and maybe I don't see the results. My whole family eats meat and it's always a topic at the dinner table because I don't eat the chicken. Sometimes I need to eat another soup or so. I don't see the difference I am making but you just have to look at it from another perspective. You can fix things. It's a fact, if we all just stopped eating meat, the meat industry wouldn't exist. So I'm stopping eating meat and a lot of people do too […]. It's changing! It does something.
> Student N, group dialogue, Art For Change project, 2019

The experiential part in this research, which meant adopting a change for 30 days in combination with artistic expression, may have contributed to a deeper self-reflection and to the creation of a sense of responsibility. Freire (2013, p. 13) emphasizes that "responsibility cannot be acquired intellectually, but only through experience." This highlights the importance of the participatory and learning-by-doing components in climate change education. Many artistic methods and practices are inherently experiential. Therefore, they have a great yet seemingly overlooked potential for engagement in and teaching about climate change. Teaching *with* art uses *different forms* of teaching. It may involve interdisciplinary projects at school where students reflect on climate change and express the acquired learnings within the different disciplines.

4.3 Learning about climate change *through* art

Compared with teaching *in* and *with* art, teaching climate change *through* art follows a more radical idea. Where teaching *with* art can be considered participatory and experiential learning

that uses art to provide engaging and fun activities, and teaching *through* art implies letting go of predefined ideas of content as well as of one-way directed knowledge provision and engage in an arts-led learning process, both for students and teachers. Where teaching *with* art can be described as an interdisciplinary process in which "art meets science," teaching *through* art follows a transdisciplinary agenda whereby different ways of knowing (scientific, artistic and others) are engaged on eye level (Kagan 2015).

In practice, this means a whole *different approach* to teaching climate change; one that aims to meet students where they are at in terms of interests, concerns, and meanings by co-creating the learning process with them and addressing climate change through a topic or lens that is relevant for them. The fact that climate change means different things to different people depending on age, experience, and context supports the idea of making room for exploring those meanings and the associated value systems. Accordingly, research on climate change meaning-making suggests to connect with the frames and values people hold and fill out meaning from there (Hochachka 2019). Applying this to a classroom context means for a teacher to translate climate change into something tangible for the students in order to anchor it in their meaning-making. Approaches for meaningful climate change education for young people might need to differ greatly, depending on the specific meaning-making stages of a given classroom, the social context, and value systems.

In this research, students were engaged in storytelling and collective reading of a climate-fiction story (Milkoreit et al. 2016), in which the main character is a teenager named Flea, helped to bring climate change near and create meaning, as the quote below illustrates.

> After pushing myself through it and finished reading the story I was very happy with the ending (I think that's my favorite part of the story). Not because it was a happy ending, it wasn't. But it wasn't a sad ending either. It was reality. I know it's a cli-fi story but the ending got me identifying with the topic. It was when I started understanding the realness of the story. […] It was at the ending that I understood Flea like I understand myself, not very well but well enough.
> Student L, written reflection, Cli-fi & Art project 2019

The learning process was guided through the storytelling, fiction reading, and the students' personal connections with the subject matter. In connection to that, the students developed an artwork related to a personally relevant topic. A personal connection to the topic can tap into students' emotions and senses helping them to see and think differently. The potential to connect to emotions and senses makes art a profound source for learning (Leavy 2015) and a tool for deepening and embodying experiences. Learning through the body, for example, through movement, dance, or theater work (which was not the case in this research), is another way to connect to emotions and understand theoretical concepts through the senses (Leavy 2015; Wiebe and Snowber 2011). These techniques can enhance the awareness for different ways of knowing and increase the degrees of freedom in young people's imagination (Heras and Tàbara 2014). Student-centered arts-led processes can thus guide through a meaning-making and embodied experience, which can be a transformative process that enables to see and act differently on climate change. The freedom of artistic practices can help students to explore dimensions and future imaginaries that are not accessible through standard teaching approaches helping them to co-create new scenarios of transformative change. The fiction reading in this research created avenues for creative imaginaries of the future. The artwork 1d expresses the potentiality of scenarios that we usually do not consider. The question "what

if the world turns on us," creatively illustrated with a T upside down, opens up imaginations of an inverted world in which non-human agency gains power (Fig. 1d).

Exploring alternative, positive imaginaries of the future can be empowering for young people to co-create scenarios of change such as the artwork entitled "be the drop the world needs" (Fig. 1e). This is relevant as climate change is increasingly emerging as a depressing force affecting social lives of young people (Ojala 2012). The the artwork 1f illustrates the student's helplessness and powerlessness by depicting a person falling into a hole (Fig. 1f).

Acknowledging this trend of psychological stress seems relevant when teaching climate change. Within this project, the group dialogues and creative expression offered students spaces for disclosure and helped them transmuting feelings of powerlessness, hopelessness, anger, and apathy. As important it is to acknowledge the growing sadness, anxiety, and anger when teaching climate, it is equally important to emphasize solutions and opportunities to get engaged. Experimenting with concrete solutions for climate resilience and social transformation through role plays, theater work, or giving actual opportunities for engagement (e.g., local initiatives) can help build a sense of empowerment and hope. Providing possibilities for direct experience in democratic processes, such as through participation in community projects, are examples that enable young people to come to their own decisions based on the information they gather and discussions they share (Chawla and Cushing 2007; Hess and Collins 2018). When contextualized in a broader integrative discourse, small behavior changes or school projects can be empowering too, as they can serve as entry points for larger changes on the political and systemic realm (Bentz and O'Brien 2019). Within this research, the integration of a 30-day behavioral change in a learning-through-art approach helped students to realize that their individual choices have an impact globally as well as on others (e.g., family and friends). This realization of one's own power to influence change can give hope and a sense of empowerment.

There is limited research about how to provide transformative experiences in climate change education *through* art (Pelowski and Akiba 2011; Roosen et al. 2018). The success depends very much on the experience of facilitating artists and teachers as well as on the students to embark on a different kind of learning journey without a predefined destination. The preceding examples show that within two project approaches, three levels of engagement can occur. Some students kept their engagement to a more descriptive, shallower one (e.g., Fig. 1a and b), whereas others permitted deeper, more reflexive levels of engagement where they showed themselves more vulnerable and gained new insights about themselves and about climate change (Fig. 1c, d, e, and f). It must be noted that not all school settings will allow working with open-ended, co-creational, potentially time-consuming processes and the perspective that final results may differ from initial expectations. However, the outcomes of teaching climate change *through* arts may greatly differ from those of engagement *in* or *with* art in the sense that they potentially create a deeper impact on the students, educating them to be empowered, critical and climate active citizens.

5 Conclusions

In this paper, I have shown how the arts and humanities can offer important contributions to the challenge of engaging and learning about climate change. Art has multiple potentials that can be harnessed for climate change education, among them its capacity to engage emotions and to expand imaginaries of the future to create hope, responsibility and care, as well as

healing. Art is also a powerful form of communication; it can integrate diverse knowledges through experiential learning and it can engage young people in deeper, embodied, and potentially transformative ways with the subject (Bentz and O'Brien 2019; Dieleman 2017).

This article aims to offer teachers, facilitators, and researchers a portfolio for engaging with climate change that makes use of the multiple potentials within the arts and humanities. It provides guidance for the students' involvement *in*, *with*, and *through* art and makes suggestions to create links between disciplines to support meaning-making, create new images and metaphors, and bring in the wider solution space for climate change. The three categories of using art in an educational context differ in the way they use art. Teaching climate change *in* arts courses makes use of art's potential to communicate better but also offers the opportunity to address climate change from a different angle, providing a *different content* of information (e.g., by focusing on positive examples and ways to influence change). Teaching climate change *with* art uses of art's experiential potential and invites *different forms* of teaching and learning as well as a *different content*. Learning *through* art suggests a *different approach* to learning itself guided through art (together with a *different form* of teaching and a *different content*) that relies on reciprocity, openness, and co-creation. The stepwise increasing weight of art in the different learning processes can then lead to increasing depths of the students' engagement with the subject matter.

With the framework provided in this article, the depths of engagement and desired outputs of a given learning process may be better targeted and addressed. The engagement may range from an increase of climate awareness, to critical articulation, and sense of empowerment to climate agency and trauma healing. Acknowledging that the boundaries between the categories are blurry, this framework aims to provide a clearer image of the spectrum of art's potentialities for learning and engaging in climate change. This may assist teachers, facilitators, and practitioners to better shape their strategies and adapt them to a given context. It should be noted that the framework is not conceived as a recipe for artful approaches and different levels of engagement may occur within the same group of students or participants, as shown in the results.

The above examples of learning about climate change *in*, *with*, and *through* art have certain key aspects in common. Each includes the use of narrative and metaphors to help visualize climate change. They support reflection and deeper meaning-making, and seek to include the emotional aspects of climate change. They integrate what scholars have seen as the role of schools and the role of art namely to create spaces of possibilities or laboratories of the future where (young) people engage in creative and experiential ways with questions connecting socio-ecological change to the everyday and to their own experience and shaping not only individual but also shared desires for potential futures (Dieleman 2012; Fehrmann 2019; Kagan 2015; Roosen et al. 2018; Verlie and CCR 15 2018). They also relate to an education praxis which accounts for the importance of personal experience in generating agency by creatively identifying problems and solutions through reflection, which in turn produces an appropriate course of action (Camnitzer et al. 2014).

In conclusion, I have presented a novel framework for using art in climate change engagement and demonstrated its use in schools. The findings point to the central place that art has in climate change education, with avenues for greater depth of learning and transformative potential depending on whether one brings art *in* to the climate change curriculum, whether art is taught *with* other climate science concepts in participatory ways, or whether one teaches *through* the very topic to the heart of transformation itself.

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