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Gesturing in plain sight: dialogical enactments of sustainable futures as being and doing in the world

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Abstract

Addressing the critical question posed by Gudrun Jonsdottir and Anne Kristine Byhring who are asking what place for a common future in the science classroom, this paper focuses on and expands on the construct of *dialogical space*. Not simply as an abstract concept to describe the presence of divergent ideas or the exchange of idioms, but a space filled with metaphors and material artefacts that exist *in the world*. On this basis, science education takes seriously the affordances of sensorial perception in space, as physical and material *doings*, arising from and deeply concerned with the lived experiences of people. By making visible the material relations that give life to human experience, and by giving life to different imaginations, science education can thus become profoundly dialogical: turning away from the expectation of sameness, it houses in itself the invitation of taking authorship and to give form, that being a narrative, a personal journey, or a different way of looking at the world. This is what I call gesturing in plain sight, a science education that critically engages with material artefacts and their relations; one that inhabits the realm of the symbolic and the experiential, and one that speaks to sustainable futures in general, repurposing and reconceiving the work of science education in particular.

Keywords Futures · Gestures · Drama · Dialogical space · Sustainability

Education on the global stage

With the claim “leaving no one behind”, the United Nations 2030 Agenda for Sustainable Development—launched in 2015—set its ambitious action plan for people, planet and prosperity. The declaration is clear: “to build peaceful, just and inclusive societies; to protect human rights and promote gender equality and the empowerment of women and girls; and to ensure the lasting protection of the planet and its natural resources” (p. 4). With 17

This review essay addresses issues raised in Gudrun Jonsdottir and Anne Kristine Byhring’s paper entitled: When a common future for all enters the science classroom (doi: <https://doi.org/10.1007/s11422-022-10143-2>).

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Sustainable Development Goals (SDGs), each one comprising between 8 and 12 targets—education is Goal 4 on the list. With a characteristically dual purpose, education is tasked to guarantee quality education for all citizens, and to ‘close the gap’, supporting economic growth on the global stage (West 2012).

It is in this context that the paper by Gudrun Jonsdottir and Anne Kristine Byhring raises some important questions. First of all, should a science education lead to a future that is the same and inherently good for everyone? And to this I would add; to what extent is this ambition even achievable, without a serious discussion of difference, and the radically different ways in which different groups access, dwell in, and value the environment they share and on which they all depend? This is not a simple task, and one which calls for significant rethinking about the ways in which science education is both conceived of and practiced. Countless dividing lines can be traced over its different and intersecting purposes: the extent to which it provides ‘powerful knowledge’ to grow the economy as in the provision of skills in short supply (Smith 2019), or its capacity to ‘put matters on the table’ and to make them visible, for students and teachers to address collectively, through the exercise of ethical judgement (Herranen, Yavuzkaya, and Sjöström 2021).

Outline of the argument

In response to the challenges that Gudrun Jonsdottir and Anne Kristine Byhring have set for us, I will expand on the construct of *dialogical space* as a focal point for critical and collective appraisal of science and technology, and their contribution to sustainability. Drawing on literature in science and technology studies, I will first focus on science and technology not as bodies of knowledge, but as material artefacts *in the world*, thus inviting the reader to pay attention to the materiality of space, the affordance of sensorial perceptions and the lived experiences of people. From this, I will bring together recent accounts of embodied cognition, and the earlier insights of John Dewey (1934), to show that in their being artefacts, science and technology can act—in fact—as powerful *gestures*, influencing culture and arising in the context of human relationships with the environment. Taking the lead from the fields of sculpture, theatre and drama, a gesture is a movement of the body that conveys the actions and states of mind of a character in relation with other characters and with an audience. Differently from an idiom, a gesture is connected to movement in space; it is a form of visual signing which can have emotional and cognitive impact, both on the actor and on the viewer’s understanding of a situation or ideas being presented: “The physical process develops imagination, while imagination is conceived in terms of concrete material (Dewey 1934, p. 78)”. Thinking of scientific and technological artefacts *as* gestures is thus inviting the reader to think in dynamic and spatial terms, as living performances, unfolding in ways that are different and often with unexpected consequences for different groups.

Finally, shifting emphasis from content to sensorial perception in science education, I will argue for the power of a dialogical space that is filled with gestures, showing what matters for different people in the classroom. At the same time, it is also a space that creates the possibility for gesture, by making visible the relations that give life to human experience, and by giving life to different imaginations. This is what I call *gesturing in plain sight*, a science education that is profoundly dialogical because it engages with material artefacts and their relations; it inhabits the realm of the symbolic and the experiential, and in so doing, it speaks to sustainable futures in general by repurposing and reconceiving the

work of science education in particular. In the second part of the paper, I will provide some examples from my experience and practice, first to illustrate gesturing as a material feature of being and doing in the world; and secondly, to illustrate how we can engage with gesturing as an educational process in science education.

Sustainability indicators and the multiple purposes of education

With the SDGs acquiring a central focus in Government policies, notable examples are found amongst the Scandinavian countries, ranking highest in global performance indicators (Sustainable Development Report 2021 (sdgindex.org)). Such is Norway, which provides the context for Gudrun Jonsdottir and Anne Kristine Byhring's article. With high levels of economic prosperity and a strong social-democratic infrastructure, Norway is well on track to achieve the SDG's tripartite aim. Yet, as reported by Sinnes and Eriksen (2016), when looking at education, there appear tensions between different systems of global governance, such as PISA—focussed on achievement on numeracy and literacy and science—and the OECD, concerned with educational curricula and structures. The authors lament the confusion this causes about the relevance of Education for Sustainable Development (ESD) in school curricula, assessment practices and the lives of teachers and pupils in school. As the authors speculate: “because PISA also tests knowledge about sustainable development issues, it is possible (at least in theory) that PISA-driven educational reforms could contribute to the integration of ESD into educational practices” (p50). And indeed PISA has attempted to explore students' understandings of sustainability issues since 2006: both retrospectively with the report ‘Green at Fifteen?’ (2009) and then directly in 2018 and in 2022. However, while performance on international student achievement tests has been considered a valid prediction of economic productivity and social welfare (Wiseman 2010), it is also widely recognised that more knowledge and higher test scores do not necessarily lead to action for sustainability.

This is an area where complex problems demand the ability to weigh up conflicting evidence, explore differing values and alternative possibilities, together with others (Sinnes and Eriksen 2016). Furthermore, while the rationality of sustainable indicators strive to meet specific issues and targets, there is in fact no one single education for sustainable development that would help achieve those goals. As Gudrun Jonsdottir and Anne Kristine Byhring correctly stated in the context of ESD—there are indeed many ‘educations’ for sustainable development, as there are many alternative conceptions of sustainability itself, bringing different agendas and purposes.

This recognition is a clean departure from equating sustainability and its associated educational work to a measure of product on increasingly narrow targets. This approach emphasises what education may be *for and set out to achieve* within the realm of universal parameters. Instead, starting from a position of difference, I wish to probe the more difficult question of *what education is* and what it may actually *mean* in the lived experiences of time and space of different people. Arguably, in a world where education has become the major socio-economic stratifier—and growth in education has been concentrated in the middle and upper classes (UIS 2018)—the challenge for educators and researchers is not simply concerned with how education *gets done*, but it pushes at the edges of how we can begin to describe the nature of *being educated* and how such an educational experience is articulated within a changing and conflicted world.

The structuring of cognition and experience through metaphors and cultural artefacts

In seeking to address these questions, Gudrun Jonsdottir and Anne Kristine Byhring ask in their paper what different experiences each pupil may bring to school. The authors speak of ‘lived experiences’ concerned with personal relationships, memories of place and children’s own personal values, which may all, and at the same time, both align and collide with existing social norms. Arguing against the vertical structure of formal curricula, the authors concern themselves with the notion of ‘space’, whereby a plurality of voices and experiences in dialogue “*can contribute to a more dynamic and open learning environment in ESD*” (Jonsdottir and Byhring, in this issue). I would like to further explore this notion of ‘dialogical space’ as a catalyst for a different way of thinking in science education.

In the first instance, space can be a physical entity, more or less defined by area or volume and a boundary line. In this sense, thinking through space in education is both visually and discursively powerful, as it brings up patterns of social organisation, for example, as they may be defined by the arrangement of furniture in a classroom, mirroring social norms and reinforcing social hierarchies. Arguably, space is always dialogical, if we take dialogue to be the interplay of power forces, not simply the possibility to speak one’s mind. This brings us to a second interpretation of space, which is associated with the flow of experience, for space is never empty, but it is made perceptible in its qualities by a dynamic set of physical-relational configurations (Timeto 2011). In this other sense, a space can be narrow or wide, relaxed or tense. A space can be both described and experienced by the invisible and yet tangible lines of power and of co-presence with others, both humans and other than humans.

So, going back to the idea of a ‘dialogic space’ in the classroom, an experiential account of space goes beyond the simple exchange of idioms or information for the purpose of transferring one’s knowledge, as a rationalist-cognitive model of communication would have it. Instead, dialogue will include both what is being said and the ‘what if’, as we endeavour to imagine what the situation at hand might be like from the position of somebody else in the relational space. This is important because while in classicist/cognitivist views of the mind, symbols are generally seen as *encoded* that is—univocal, pre-existing and representational, recent accounts of cognition derived from philosophy, linguistics, neurosciences and science and technology studies, point to our ability to understand and make meaning of the world as fundamentally embodied and emplaced. As discussed by Nathan (2021),

“This sense of embodiment comes about from our experiences with a body that has form and movement as well as specific perceptual capacities. From form comes axes of symmetry (e.g. left-right), alignment (e.g., up-down), and mass. From movement comes direction (front, back), speed and acceleration (and notions of linearity and nonlinearity), pathway, dynamics and so on. Perception from the senses offers the experiences of depth, balance, contrast, sweet and bitter, smoothness, harmony, and so on” (p. 84).

Movement, body form and perception are tightly integrated processes, with body-axis and body-based processes structuring experience in space, and giving rise to metaphorical configurations and linguistic imagery which are socially and culturally transferred (Lakoff and Johnson 1980). For example, the English language is rich in spatial terms that are used to make sense of the experience of time. Time is described as moving

forward, the past is *back* then, while the future lies *ahead*. Contrarily, in Mandarin time is described along vertical axis, with the future being up and the past being down. While this is not evidence of linguistic determinism, as Boroditsky (2001) maintained, it is however evidence of the pregnancy of space and the embodied manifestations therein, rich as it were, of the cultural experiences of human groups that are traced in language.

This understanding is of particular importance for an education that engages with matters of the ‘not yet’ and ‘the might be’, as actions of different groups projected into the future. In fact, many of such metaphors are uttered and used without awareness of their origins as the link with former experience may be invisible, unknown and unnoticed. Well-known examples are detailed in the history and philosophy of science, as discussed by Brown (2004): ‘acquired’ metaphors such as the double helix, ladder of evolution, life-cycle are so well-established and used so literally in language to even lose the inverted commas.

And so metaphors travel across times and domains of experience. Turbayne (1962) defines the power of metaphor as “the presentation of the facts of one category in the idioms appropriate to another”, mediating the crossings amongst categories, nautical, metallurgical, architectural or geometrical ideas, drawn from different and distinct areas of knowledge and experience. Observing as Turbayne (1962) describes the ‘sort-crossing’ power of metaphorical thinking, we see how the embodied conception of language is wider than verbal idioms, so as to comprise artefacts and material constructions: we can physically see the twisting of the (nautical) rope of the double helix, as we can see the ladder climbed by the “more or less adapted” or the ‘more or less evolved’ (Colucci-Gray and Camino 2014).

Such metaphorical expressions are thus both linguistic expressions as well as physical and material artefacts, with the power of defining and altering the field of perception, ‘drawing’ lines in space. In the form of a gesture, they articulate, define and sign, thus literally ‘gesturing’ in plain sight. Going further along this path, we are thus invited to see that the dialogical space filled with metaphorical power is of particular importance in science education; first of all, it calls for a serious critique of knowledge mastery to make room for multiple and creative interpretations. But in the second instance, this recognition also contains a more subtle invitation to cultivate awareness and sensitivity to the metaphorical as a kind of freedom, opening the door to different imaginations and even, to the perception of the divine.

This recognition is important for science education and for ESD in particular. As Gudrun Jonsdottir and Anne Kristine Byhring reminded us in their paper, when an economic framing of education prevails, sustainability remains largely confined to environmental mitigation, under the mantle of scientific research and technological applications. Conversely, an experiential and dialogical framing would emphasise a cultural transformation that demands attention to linguistic assumptions and ways of being. This is the realm of dialogical inquiry within a space that as we have seen, is neither neutral nor empty, but filled with meanings, metaphors and symbols embedded in material structures. This recognition moves education out of the classroom as traditionally conceived and into the liminal spaces where different modes of sensing, being and doing co-exist. This reconfiguration of the educational space is what I will call a ‘gesturing in plain sight’, a living performance that could be witnessed as well as enacted in a multiplicity of ways, grappling with the complex questions of sustainability and the future. To illustrate what this may mean in practice, I will proceed with an example. The bridge over the Forth: a living performance gesturing in plain sight.

Box 1 Extract from the Unesco (2015) declaration of World Heritage Site for the Forth Bridge as reported in the BBC news on 5th July 2015

NOW A WORLD HERITAGE SITE, THE UNESCO WRITES:

“Innovative in style, materials and scale, the Forth Bridge marks an important milestone in bridge design and construction during the period when railways came to dominate long-distance land travel.”

Work on the superstructure got under way in 1886 and the growing structure became a site of wonder as it grew out from the piers, growing first upwards as the towers were completed, and then outwards as the cantilevers stretched out to meet one another, seemingly defying gravity as they did so. The Construction of the Forth Railway Bridge, a 19th Century Engineering Marvel—Flashback
Historians estimate that the project claimed the lives of 63 workers

- overall length: 8,095 feet
- height: 361 feet above the high water level
- mass: 53,000 tonnes of steel were used to construct the bridge (a new material at the time for bridge construction)



Fig. 1 The Firth of Forth railway bridge—Edinburgh, Scotland. Courtesy of Donald Gray

To illustrate the power of ‘gesturing in plain sight’ I invite the reader to take a view over the railway bridge that connects Edinburgh with the North East of Scotland (Aberdeen and Dundee). Box 1 provides the historical background to its construction. The practical purpose of enabling transport and trade between the East and the West of Scotland was reflected in the ambitious size while its very size was a gesture in itself, that of ‘defying gravity’, through the combination of steel and design.

From an educational perspective, if we look at the picture of the bridge (Fig. 1) in terms of its relevance for the science curriculum, we recognise some immediate basic concepts: the physics of balancing forces, marine webs, chemistry of seawater. If we hold a dynamic, process-based view, perhaps we can also see the exchanges of carbon dioxide between water and atmosphere and weather patterns. But another way to look at the same picture, is to look at the bridge as a physical gesture, as in the manner of theatre. In this mode, we are not trying to describe and identify the ‘what’ of the picture, but how the lines on the picture foreground and background that which we can see; how the landscape is divided into shapes because of the size, shape and design of the bridge itself, its material construction made of metal, and most importantly, its purpose and functionality.

So this bridge is more than just the sum of scientific concepts, and more than the sum of its component parts. Its gesturing has changed both the history and the culture of the country, fundamentally shifting the economy and society from a view from the sea, with its wide horizons, the changing weathers and rhythms of the tides, to a view from the

land, with its lines and confines, and the speed of motorised vehicles moving in linear fashion from origin to destination.

The bridge: a cultural, symbolic artefact in the dialogical space

When we talk about the bridge not simply as a metal construction, but as part of a dialogical space filled with gesturing, we are thus referring to an important change that has occurred in science and technology. As I wrote elsewhere (see Colucci-Gray, 2017; Colucci-Gray and Camino, 2014), this is the shift from science to technoscience. In technoscience, science and technology are interrelated; one does not precede the other. Actually, technology put to the service of social innovation brings new objects and new artefacts into the world and so it generates new realities and new problems, as well as new tools, for the attention and use of scientific research. As the philosopher Francis Bacon reported, purpose-driven technoscience has the power to influence the organisation of society, its language and also, what such language makes visible, *its values*. In this sense, to say that technoscientific developments have an ‘applied’ dimension does not simply mean that they derive from the application of scientific knowledge, but that such developments are consequential and ‘culture-forming’. They play with the structure of human experience of being and living in the world.

In this regard, De Sousa Santos (2014) insightfully remarked that the sustainability crisis is not just a problem ‘in the world’, to be solved with science and technology, but it is indeed the result of a particular set of world-making practices which have appropriated for themselves the right to *be* ‘the world’, subjecting all other worlds to their own terms. Such intentional re-worlding may actually go against a relational awareness of the other, which may become opaque to our perception, different, distant or non-existent. As in the example of the bridge, gesturing as a form of signing connects the signifier with the signified, materially directing attention in particular ways, by modifying the space of the visible. For example, the creatures from the sea are opaque to the view from the bridge and so is the fishing community with the little houses on the shores underneath. So if ‘gesturing in plain sight’ is concerned with the experience of multiplicity, how can we enter the dialogical space and allow others to enter as well? How can we keep our relational awareness and our relational understanding open?

Cultural artefacts as metaphors and models ‘to think-with’

Returning to the discussion on metaphors, Myers (2015) brings attention to three-dimensional models as material artefacts, that is, manifestations of embodied experience. Not as descriptions of reality, but more like gestures that give life to our thoughts, they act as ‘*objects-to-think-with*’: they are recursively made and remade to give shape and sense to the experience of a changing phenomenon. For example, embodied processes drive children’s development of cognition and language; with a particular emphasis on play, manipulation and gesturing to support the transition from experiential to abstract and symbolic thinking in the early years, through counting on one’s fingers, pointing, and using gestures (Nathan 2021). Such models are far more than conventional, flat inscriptions but they embed the physical and material manifestation of a thinking process and cannot be ‘reduced’ to textual practices of reading and writing (Myers, p.17). Instead, such ‘reading’ is of a different, interpretative nature requiring an account and a history of the ‘gestural knowledge’ which

shaped the way in which models were made and how they circulate, including the variety of means and modes of making, experiencing and using them.

Natasha Myers talks about artefacts as part of a choreography of practices, a performance of bodies emerging in tangled, sensorial experiences. And such is the experience of the bridge over the Firth of Forth: not simply a construction that historians can study by piecing together its corroded parts, but as a cultural artefact, it is a model that speaks about the crafting of an experience in time and space. As an artefact, it both affected and affecting human lives in the present; and as an artefact, it can be put to work educationally to support collective ‘thinking-with’ about matters of the future, as a gesture in ‘plain sight’.

This recognition generates significant questions of purpose for education. If facts and values are no longer distinct, but are integrated within gestures that are embodied and emplaced, who is responsible for making decisions on their significance, their value and impacts? According to whose values and whose interests?

Taking a hint from Science-Technology-Studies and specifically the contributions of Barad (2007), queering the experimental work of Niels Bohr, any model or methodological artefact does not stand separate from its field of study; but in fact, it is integral to its epistemic status and indeed it serves to identify, define and create the object of its investigation. Hence, the problem does not precede the method, but it arises from the realm of experience, and it manifests itself by means of the methodology being adopted. If we apply this insight to the question of technoscientific artefacts, which are part objects and part culturally performative symbols shaping the flow of human experience, we can think quite differently about technoscientific innovation: from activities occurring ‘from without’, to activities stemming from within, such that they do not exclude or transcend the body but are fully enmeshed with the materiality of *knowing through experience*.

From this perspective, language is both material and metaphorical, and it acts as one of the most powerful technologies for ‘world-making’. Through language, we can shift attention from abstract concepts to embodied perspectives and vice versa: in one mode, we can attend to the world by fixing our attention on objects, categories and classes; and in another mode, we can experience the world in flux, a net of interdependencies, in continuous formation with each other: “these are not different *way of thinking* about the world. They are different *ways of being* in the world” (Gilchrist, 2009, p. 31).

This focus paves the way for a fertile exploration of pedagogical research, whereby pedagogy may be construed in the dialogical space as the elicitation and interrogation of students’ individual and intersubjective experiences, extended across mind, body and environment. Drawing on the insights of John Dewey, I will progress by delving deeper into some questions and possibilities that arise for pedagogical practice.

Thinking with the materiality of experience... in Science Education

As culture-forming artefacts, the enactments of science and technology in the world are prime objects of educational work. It was John Dewey, who first suggested that the person, with their physical actions and movements, and the world in which they come to be as unique subjects of cognition, are deeply interconnected. As he writes:

... our desires, emotions, and affections are but various ways in which our doings are tied up with the doings of things and persons about us. Instead of marking off a purely personal or subjective realm, separated from the objective and impersonal, they indicate the non-existence of such a separate world [...]. Interest, concern, mean

that self and world are engaged with each other in a developing situation. (1997, pp. 125–126)

Dewey's position is significant in discussing gesturing in the dialogical space. It signals a departure from the 'what' of content that might be pre-existing the students' own interests and experiences, to cast light on the student as a person, who is entering into direct, physical contact with the world. In so doing, the educational work is concerned with extending and deepening their interest in the world. But such interest is more than mere or passing curiosity. John Dewey calls it a 'concern', arising from an ongoing and responsive engagement with others, for the destiny of one is fundamentally intermingled with the projects, hopes and desires of others. Returning to the questions posed at the beginning of this article, and whether there is necessarily a common future that is inherently good for everybody, we can see that from a Deweyan and embodied conception of learning, the answer is not straightforward.

On the one hand, an embodied stance on learning shifts attention from representation to experience, literally demanding education researchers, teachers and pupils to open their gaze to the world in its multiplicity, diversity and jarring inequities. On the other hand, if we simply took this line of thinking we would find ourselves empty-handed and devoid of a purpose, as a Deweyan conception of the organism—as critiqued by Gert Biesta (2022)—may give the impression of a subject that is slave to his own desires, pursuing goal-directed actions within an environment that poses a strong cultural framing over students' attentions and interests. As John Hansen also stressed, the role of the teacher—and by extension also that of educational researchers—is limited for teachers cannot re-direct students' interests and concerns directly, "as if they were magicians or wizards who could manipulate at will students' minds, hearts, and spirits" (Hansen 2002, p. 269). Such fractures are particularly visible in the articulation of curriculum and pedagogy, and curriculum and teaching, whereby the latter is put to the delivery of the other. In science education, we often witness this operation through the numerous attempts to make science relevant to pupils, to raise their interests in the curriculum, for example, by increasing practical work, or through ad hoc provision of 'topical' and real world science (see Hermann, Clough and Rao 2022 for a recent account in this field).

More recently, attention has been given to the world of the arts as a medium to facilitate access to less palatable or accessible subjects such as in particular conceptions of STEAM (Science, Technology, Engineering, Art and Mathematics), where the Arts are seen as an addition to serve the more powerful STEM agenda (for an expanded critique and reconceptualization see Colucci-Gray, Burnard, Gray and Cooke 2019). Framed in this way, waves of pedagogical innovation, from the teaching of socio-scientific issues to outdoor learning projects, have punctuated in quick succession the teaching of the core discipline, leaving the door open to the growth of a multiplicity of different forms of education. From STEM education to STEAM education, SSI (socio-scientific issues) and ESD—to name but a few—emphasis has been given to the acquisition of additional or even alternative competencies and skills, yet without ever attempting to dismantle instrumental and linear conceptions of education, and without ever engaging with the potentialities of the educational gesture 'in plain sight'.

As I discussed earlier, taking the latter as a way of enacting dialogue in a space filled with symbols, metaphors and artefacts, addresses the critical disconnect between mind and body: we expect children to be instructed first and to make decisions later (as in the evidence-driven policy); and similarly, between the democratic and the existential: we expect children to participate as active citizen without concerning ourselves with the quality of

their experiences in the world; the ways in which sensorial perceptions are modulated and structured by technological and linguistic artefacts (Colucci-Gray and Gray 2022). These are questions of aesthetics as in the exercise of the senses, which are not easily accommodated in science education, and more easily pushed aside or into other realms, such as the arts.

Gesturing in plain sight: enacting dialogical inquiry in science education

In *Aesthetic Theory*, a series of essays pointing directly to the modern human condition, and the relations between arts and society, Theodor Adorno (1970) criticised the fetishisation of exchange value in commodity culture, noticing the objectifying effects of standardisation of the modern subject—a ‘tragic’ subject who is in need of art as the expression of their own alienated and unreconciled condition. The human subject enmeshed in structures of power, its desires directed and controlled by economic forces, is devoid of freedom and looks towards the arts as the place where such freedom can be reclaimed. Yet, this is a paradoxical state of semi-autonomy for both the arts and the individual subjects themselves, as within a system of capital, art can only be valued to the extent to which it can be used and consumed.

Pushing against such fractures, understanding cognition as fundamentally embodied challenges representational views of knowledge to foreground that values are both linked and integral to actions. So, if we are really concerned with the question of public participation in matters of sustainability, then the starting point for a change of direction may well be that a science education worthy of its name should not simply consider the instructional, but most importantly, the imaginative, the material and the communicative; ‘gesturing in plain sight’ is thus concerned with and arises from the shared and collective experience of making one’s place in the world, a world that is tangible and present in our physical experience (Colucci-Gray 2021).

Resonating with the work of Merleau-Ponty on education, as articulated by Thorburn and Stolz (2021), a renovated focus on the materiality of experience as embodied has ramifications for understanding that “experience exists in its differentiated as well as holistic forms, within which the child becomes immersed in a shared universe of discourse” (p.6). Crucial in this is the recognition that an embodied experience is not solipsistic but is fundamental to understand how we relate to each other, and the quality of the relational space therein. While the authors do not expand on the practical aspects of this methodology, there are similar accounts both in science and arts education, such as those reporting on drama as a distinct method of inquiry, that problem solve by enacting situations in the minds of the onlooker, but also by enacting and reflecting on the plurality of children’s experiences (White, Raphael and van Cuylenburg 2021). Specifically, in STS, drama and role-plays have also been used to simulate decision-making processes, which bring the lived experiences of the voiceless in the shared experience of others, so that the lived experience of children at school becomes present to themselves, enacting their ideas and values as social and political agents (Bencze, Pouliot, Pedretti, Simonneaux, Simonneaux, and Zeidler, 2020).

Drama performances and the performing arts more broadly are thus powerful enactments of ‘gesturing in plain sight’ in that they bring into tangible visibility possible and desired futures as well as the enactment of what such futures might be like for different

people. In dramatic performances, scientific and technological artefacts—like the bridge over the Forth described earlier—are reinserted into the dialogical and relational space; they are effectively models ‘to think with’ and to make sense of the experiences of people in the world. In this sense, these approaches would respond to Thornburn and Stolz’s (2021) questions of needing to combine the first-person benefits of choice and autonomous thinking, with a shared sense of conduct and responsibility, “whereby how others respond is closely aligned with first-person sensitivity and alertness” (p. 8).

Yet, within an educational system that is rooted in epistemic inequality, a dialogical space in itself may not be sufficient to draw out, and bring forth, the shared experiences of others non-human; for the plurality that is presupposed here is not simply between particular disciplines or categories of people, but between *participating organisms*. This turn notably expands Gudrun Jonsdottir and Anne Kristine Byhring’s concern for a dialogical space well beyond the idea of ‘voice’ as an expression of subjectivity, to embrace the aesthetic qualities of gesturing in the dialogical space, ‘thinking with’ artefacts of polytemporality and poly-rhythmicity.

As Helena Pedersen (2015) points out, there are “many ways of relating to the world, of which ‘human’ ways only constitute a small subset” and human language is after all, only “part of a wider natural semiotic system”, transcending “traditional disciplinary boundaries between natural sciences and social/humanist sciences” (Pedersen 2015, 60, 65). By taking this invitation seriously, ‘gesturing in plain sight’ brings a new and fundamental shift in science education, by extending the concept of dialogue as a pluri-perceptual and pluri-perceptive affair. This is the quality of a pedagogical process that brings *into tangible presence* the layered imagery and ‘double-voicedness’ of the chrysalis as well as that of the butterfly; a process that is not afraid of the tragedy arising at the disjuncture of place, time and the seasons, between different rhythms. How such rhythms are trumped or understood is a key question that transcend the particular disciplines; a question that brings into force STEAM enactments within the realm of co-existence with others, the realm of sustainability (Colucci-Gray, Burnard, Gray and Cooke 2019).

From a methodological point of view, this stance begins to reach out to the idea of a body that is not self-contained and individualised but one that is always present in space–time moments of intense relational connection. This attention to the aesthetic nature of education would thus mean that education has aesthetic qualities which are felt and made available to sense perception. In his view, as Dewey (1934) maintained, the act of teaching is not simply concerned with pointing attention to what is deemed to be important, but is concerned—as in being preoccupied with—how such attentions are shaped through and towards something. Teaching is thus concerned with the dialogical space and its gesturing, taking an interest both in what directs and what demands attention and how. Teaching is thus concerned with the dialogical space and its gesturing, taking an interest both in what directs and what demands attention and how. It makes room for a different educational aesthetic, one that may be suggestive, tentative and invitational, rather than directional.

Significant in this regard is pedagogical practices that both intersect and interrupt the politics of time and space in science education, its westernised, gendered metaphors, laboratory spaces and iconography; aesthetic practices may be cultivated through experimentation, that involves playful, sensorial, tactile perception, to nurture attentionality to how the material flows of bodies—humans and other than humans—affect one’s own and others’ as part of the world (Burnard, Colucci-Gray and Cooke 2022).

Important here is the notion of a *sentient body* that transcends the mind–body dualism, for ‘embodied’ here means ‘transindividual’ (Gentile, 2020) and transcorporeal (Barad 2007): the body is not a unit with a boundary defined in space and time, either

historically or geographically, but an in/determinate subject, in continuous becoming with its contradictions and multiplicity. Many examples of educational, transcorporeal practices are emerging from post-humanist scholarship (see for example Renold and Ivinson 2022). Specifically as part of my own teaching and research practice in science education, examples of transcorporeal, time–space methodologies are embedded in gardening and walking practices (see for example Gray and Colucci-Gray, 2019; Gray, Colucci-Gray and Robertson 2021), whereby attention is neither on the Science that should precede learning in the garden, nor in the Art that may follow as the expression of an experience, but it is situated both within and in-between, as embodied, transcorporeal and sensorial perceptions (Fig. 2): the moment in which the rainbow pattern appeared above the ground is all at the same time the moment in which the water hose reached the plants on a warm, summer evening, and it is also the moment of intense and sustained *sensing-with* the plants, interspersed in the spectrum of heat, water, pressure and light.

The gesture is in the watering: combining the practical with the emotional side of attention; and yet, such aesthetic attention is far from esoteric or detached, as the capacity to notice and to prolong contact with the object is a central dimension of science education as well as the premise for ethical action: the shared lives of humans, light, heat, water and plants become materially present in the dialogical and relational space so created.

Instructionally, this gesture clearly comprises subject knowledge and vocational skills as they may be embedded in gardening practices; but from an educational perspective, recognising the gardening space as a significant dialogical space presupposes a pause, a rather significant turn from myself *to the other*, an ‘other’ with whom we may have very little in common, an ‘other’ which sits on an abyssal line (Bonaventura de Sousa Santos 2014). From this perspective, an aesthetic inquiry is educational in its wider purpose of *sensing*

Fig. 2 Diffracting light and water as present transcorporeality in the garden (courtesy of Donald Gray)



and being sensitised to one's own and other natures: a 'touching encounter', a co-mingling in which "human and non-human matter composes" (Springgay 2019, p. 59).

So, turning away from the regimented times and spaces of formal education, gesturing in plain sight calls for a different form of scientific literacy. Following Renold and Ivanson (2022), approaching education through a relational aesthetic, is a praxis that is both affective and dynamic, literally 'moving' research into a more direct and ethical engagement with multiple worldings. Such a practice *moves* as it strives to generate and to make possible new ways of seeing, along with new ways of sensing and defining a concern; but it is also a research that *moves* along different generative lines, both responding and redressing the frenetic changes of techno-scientific developments, by opening spaces for deeper time as a key dimension of dialogue 'with the other'. Referring to the work of the translator, Campbell and Vidal (2018) make a similar point by referring to the "double-duty" of the translator, which is both ethical and poetic.

Differently from the inter-lingual translator that operates within a relatively given set of known parameters of source and target languages (e.g. as it may happen for simpler translations of guidelines and instructions), the inter-semiotic translator is the one that operates across a multiplicity of signs, a complex, dialogical and relational aesthetic that is open to the descriptive as well as to the metaphorical, the narrative and the poetic, the critical and the hyperbolic. He/she has the freedom of choosing the material, the genre and technique that is best suited to the task, nabbing, and at the same time, giving form to that gesturing in plain sight that affect both others' and oneself *sensing with*.

This is a challenge to what counts as research in science education, how it unfolds and how it matters (Taylor, Quinn and Franklin-Phipps 2020). It calls for a much wider understanding of scientific and technological artefacts as symbolic gestures and thus for a broader understanding of pedagogical experimentation, to involve figurative, compositional and performance practices. These become pedagogies, not in the sense of being tools for the transmission of content, or even being tools for dialogue, but in the sense of enabling dialogue, that is, partaking in matters from *within*, for what is discovered is both, and at the same time, inter and intra-acting in the world.

Conclusions

In this paper I sought to address and respond to the question set by Gudrun Jonsdottir and Anne Kristine Byhring about education and its capacity to bring forth a common future. While the framework of the SDGs is framing education as a tool towards a desired destination, in this paper, I argued that questioning such framing could open up new paths for imagining and enacting sustainable futures for all. Core to this idea is a redefinition of the 'dialogical space' which Gudrun Jonsdottir and Anne Kristine Byhring construed as a plurality of discourses which are often in tension: how far do we value diversity in the science classroom? How do we reconcile different educational purposes and agendas?

'Gesturing in plain sight' brings a new turn in science education. As an embodied and relational communicative practice is in no way different from well-respected scientific inquiry originating from the cultural, social and linguistic practices of its scientists; yet, this is an educational practice that unfolds in full presence, "without any illusion of clean hands", but as Barad (2012) powerfully expressed, "unapologetically express their enthusiasm and amazement for the world and the possibilities of cultivating just relationships among the world's diverse ways of being/becoming" (p. 206). This calls for a multiplicity

of temporalities; beyond fast and slow, backwards and forwards, to embrace suspension, interruptions, quiescence and hibernations. A multiplicity of spaces, beyond open and closed, wide or narrow to embrace the cogent as well as the rarefied. Such is the essence of an education for sustainability: not something that *gets done* but something in itself a gesturing in plain sight, a way to attend to the world, and in so doing bringing different worlds into being. Gesturing is an enactment of attention: it asks not only about how we might engage with the material world differently, but to linger and notice how our own experiences unfold, and are bound up with the experiences of others, *differently*.

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Declarations

Competing interests The authors declare no competing interests.

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