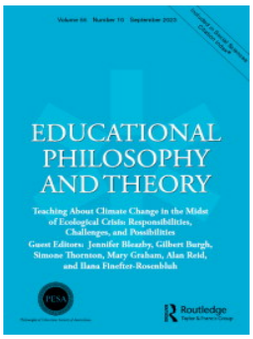

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Discovering earth and the missing masses—technologically informed education for a post-sustainable future

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ABSTRACT

Climate change education (CCE) and environmental education (EE) seek ways for us humans to keep inhabiting Earth. We present a thought experiment adopting the perspective of Earth-settlers, aiming to illuminate the planetary mass of technology. By elaborating Hannah Arendt's notion of 'earth alienation' and Bruno Latour's notion of technology as 'missing mass', we suggest that, in the current Anthropocene era, our relation to technology should be a crucial theme of CCE and EE. We further suspect that sustainable development (SD) and the education promoting it (ESD) are problematic, because the green growth proposed is inextricably linked to the unattainable goal of decoupling growth from environmental impact. We therefore suggest education for post-sustainability (EPS) that critically re-evaluates the connections between technology and sustainability. But can educators critically question technology, since educational institutions seem to be unconditionally committed to promoting technological progress? While tracing this professional dilemma, we call for educational responsibility and autonomy to question technology when it is at odds with sustainability. To this end, we outline technological literacy that introduces the arts of (a) seeing technology, (b) living with technology, and (c) delegating or sustainably assimilating technology.

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Climate change education; environmental education; post-sustainability; earth alienation; technological literacy

Introduction: An earthling approach to environmental education

Imagine belonging to a space colony that, after travelling through deep space, finally discovers an inhabitable planet—the Earth. Imagine the awe, when you realise that the extremely diverse biosphere there provides abundant oxygen and food for the foreseeable future. As you settle the planet, your respect for the lifeforms on it increases as you develop an understanding of them; but you also notice a planet-wide accumulation of technology that, for the purposes of this thought experiment, appears to have been abandoned by some civilisation. Your scanner satellite orbiting the Earth calculates that the total mass of this technosphere actually exceeds the total mass of the biosphere. Since your colony intends to permanently inhabit this planet, how would you orientate yourself in this biological and technological environment?

We suggest this thought experiment captures the situation of climate change education (CCE) and environmental education (EE): how will we humans be able to keep living on Earth?

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To surpass the apparent normality, where everyday continuities tend to hide the pace and scale of Earth's anthropogenic change, the thought experiment elaborates Hannah Arendt's notion that modern humanity is alienated from Earth. Arendt (1998, p. 1), when witnessing the first ever satellite launch, saw it as the culmination of modern humanity's wish to break free from its earthbound condition. According to Arendt (1998), not until modern technology were we able question our earthboundness, the condition so self-evident throughout human existence. Through technology, two scenarios become conceivable where we no longer inhabit Earth: we can either emigrate from Earth (p. 10) or we can ruin Earth uninhabitable (pp. 149–150). Contrasted to these options, the determination to inhabit Earth gains its full meaning.

More recently, Bruno Latour (2018) has outlined a *terrestrial politics* that aims to 'land on Earth' (p. 89), as an alternative commitment to the modernist vision, for which 'there is no Earth capable of containing its ideal of progress, emancipation, and development.' (p. 16). According to Latour, the escapistic undertone of modernism is apparent in the manner how some recent political movements ignore climate change (refuting scientific evidence and outsourcing environmental damages) as if they had no intention to keep living on this planet with other terrestrials (pp. 33–38). This escapism—including the reckless belief that future technologies will remedy ongoing environmental havoc—sustains the business as usual, and should be rejected by educators. Instead, education must commit to a terrestrial future.

We call this educational endeavour, from Earth alienation and escapism to reconnection, the *earthling approach*: how should we educate the future Earth-dwellers? Besides being a philosophical perspective to CCE and EE, this approach can have pedagogical applications, as suggested later in the article. Through education, things can be seen anew, so that well-established elements of our worldview lose their familiarity and demand fresh attention. A fitting term to grasp the Anthropocene's terrestrial strangeness—with phenomena like global warming and plastic waste blurring the boundaries of known and unknown, or safe and dangerous—is *uncanny* (Morton, 2013).

In this article, the earthling approach, informed with the fact that the total human-made mass on Earth exceeds all living biomass (Elhacham et al., 2020), leads us to suggest technological environments as a critical yet often ignored scope of EE. After considering philosophical notions of how technology tends to hide from critical thought, we set out ways in which technological awareness could be promoted by education.

In the context of the current special issue, we anticipate two challenges for educators. The first is epistemic, and merely asks how technology, the constitutive factor of modern life, can be brought under critical attention in the contexts of EE and CCE. The second challenge is emancipatory, asking if education has the autonomy to disagree with capitalist and techno-scientific assumptions of technology's salvatory nature. As sustainable development (SD) discourse often inherits techno-optimistic undertones, technologically critical sustainability education might be seen as a transgression of common norms (Ellul, 1989). Still, one could claim it is among the teacher's ethical responsibilities to address the technological factors behind the environmental crisis, even when it means questioning deeply rooted beliefs.

The technosphere as missing mass

The fact that the total mass of human-made things on this planet exceeds the mass of lifeforms on it (Elhacham et al., 2020) is both surprising and sobering. It is surprising because it seems to contradict our tendency to see nature as limitless, even if Arendt (1998, p. 150) anticipated that humankind would technologically transform planetary conditions. It is also sobering, since it reveals that the technosphere's comparable mass with the biosphere is greeted not so much as a triumphant but as an ominous milestone. Beneath the modernist dreams lies the underlying doubt that maybe our growing technological ability surpasses our understanding of it (Arendt, 1998, p. 3).

The term 'mass' both evokes something physically concrete and causal influence—especially when considering celestial objects. Indeed, once all empirically detected matter has been taken into account, in cosmology certain celestial movements can only be explained in terms of dark matter and 'missing mass'. Latour (1992) suggests that society's missing mass is technology—insofar as it is an often neglected part of our social and moral fabric. Only by adding non-human artefacts into the equation, can we make sense of our societal dynamics. If we take Latour's analogy, and apply it more specifically to the global environmental crisis, could it be that there is a missing mass greater than the sum total of human will which is causing the crisis to worsen in spite of our arguably increasing environmental awareness?

For a credible and comprehensive appreciation of the environmental crisis it should be approached from both the philosophies of nature and technology (Larrère, 2012). However, these approaches have remained separate; with the 'White hypothesis' (after Lynn White Jr.) seeking to explain the environmental crisis purely in terms of humankind's relationship with nature, and the 'Ellul hypothesis' (after Jacques Ellul) purely in terms of our relationship with technology (Gerrie, 2003; Larrère, 2012). Often the White hypothesis prevails, while Ellul's remains unthematized (Gerrie, 2003). This one-sidedness challenges the impetus of EE. 'Why advocate respect for nature', asks Larrère (2012), 'if we are not able to limit our technological power?' (p. 145).

Here we face a puzzling situation, especially when we acknowledge the stunning mass of the technosphere. In terms of weight, there is more plastic on Earth than animals, and there are more buildings than trees (Elhacham et al., 2020). Furthermore, this mass has been largely ignored by sociology (Latour, 1992) and the majority of environmental philosophy (Gerrie, 2003; Larrère, 2012), reducing the sustainability crisis foremost to a crisis of our relationship with nature (Figure 1).

As the earthling approach above proposes, the comparable masses of the biosphere and technosphere would suggest they be thematized as parallel environmental dimensions. From this perspective, the relationships of humankind to both nature and technology can be thematized and problematised (Figure 2).

Next we delve deeper into the philosophy of technology and tackle the question of how this juggernaut of the technosphere, weighing in at 1.1 trillion tonnes, has been able to hide in plain sight.

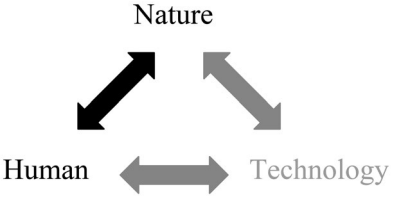

Figure 1. Technology is unthematized: sustainability crisis framed as wholly due to humankind's flawed relationship with nature.

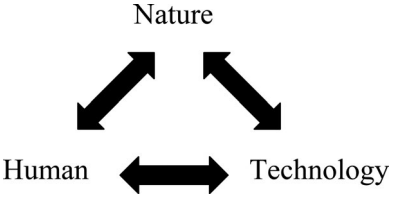

Figure 2. Technology is thematized: humankind's relationship with both nature and technology are seen as crucial to solving the sustainability crisis.

How technology tends to hide

What are the abovementioned epistemic and emancipatory challenges that hinder our understanding of technology?

Even if 'technological forms of life' are constantly reconfiguring humankind's relationship with the world, technology itself is not reflected upon, as if we were sleepwalking through it (Winner, 1983). We interact with a myriad of technological objects in our everyday lives, often barely noticing them. Also Latour (1992) describes technology as easy to ignore, with a presence that is not often felt (p. 170). Not only are we oblivious to the artefacts themselves, but also the way in which our existence is 'enframed by technology' (Heidegger, 1977).

Even some philosophies of technology regard the ontological nature of the technosphere as fundamentally immaterial, as if emerging from human ingenuity rather than crude material processes (Roos, 2021). Thus technology's extractive (Hornborg, 2021) and fossil fuel-dependent metabolism (Vadén, 2021) is mistaken for a horn of plenty, giving benefits without environmental costs. Such misconceptions about the immateriality of technology may explain why new technologies are often expected to reduce the environmental burden rather than increase it. The epistemic challenge is thus to question our everyday unthinking coexistence with technology (Mitcham, 1994, p. 1).

What then is the emancipatory challenge? Unlike in the Enlightenment tradition, where technological progress was seen to emancipate humanity from the constraints of nature, today—aware of the ecological outcome of that emancipation—one should seek 'emancipation from the capitalist and technoscientifical modes of production through a social-ecological emancipative use of technologies.' (Jochum, 2021, p. 39). This 'emancipation from technoscientific emancipation' challenges deeply rooted beliefs of our culture and worldview. According to the well-established 'technocratic perspective', technological progress is unstoppable and inherently good. This view is so resilient that, when challenged, it bounces back like a Chinese *budaoweng* doll (Smith, 1994). It is supported by a collective and spontaneous tendency to create 'noise' (Wallgren & Toivakainen, 2021) that rejects or avoids criticism by stating that technology is neutral, progressive, unstoppable, and natural. This everyday discourse refutes criticisms, leading to the current situation where 'technology has failed to reach the threshold of serious political thematisation' (Wallgren & Toivakainen, 2021, p. 32). Because the 'noise' often has a ridiculing tone, it is easily internalised, leading to a 'I'm not against technology but…' form of self-censorship.

When there is occasionally more rigorous criticism of technology for example by the environmentally concerned citizens, these discursive cracks are papered over by the technocratic authorities with the reassurances of experts, who maintain they can guarantee the safety of present and future generations (Beck, 2009). For example, concerns over the risks of long-term nuclear waste in Finland have, like the waste itself, been convincingly contained and buried deep in the bedrock by expert assurances (Värri, 2018). The conviction that modern societies are able to identify and control the risks of their own making for eternity is firmly established in our worldview.

Despite these assertions, technological accidents do occur, reminding us of the virtue of epistemic humility (Pulkki et al., 2020). Every technology has its integral accidents: 'To invent the sailing ship or steamer is to invent the shipwreck' (Virilio, 2007, p. 10), and the wrecked ship remains technology. Similarly, the Deepwater Horizon oil rig or Fukushima nuclear plant did not cease being technology at the very moment a catastrophic accident befell them (Vadén, 2017). Technological failures reveal significant epistemic limitations that question human mastery—either in the form of sudden local disasters as above, with hard-to-manage oil and radiation leaks, or slower but global disasters like CO_2 emissions and plastic waste which elude us due to their ponderous scale and entangled nature (Latour, 1993; Morton, 2013).

If educational thought has neglected technology due to historical biases (Bowers, 2000, p. 184), then we would add that technology, in its ubiquity, tends to stay hidden, hence the epistemic

challenge. Meanwhile, technocratic assurances and culturally pervasive noise suppress any profound criticisms, challenging emancipatory approaches. Even if accidents and disasters momentarily reveal technology's epistemic blind spots, the prevailing view of technology as a controlled realm nullifies alert and critical approaches. But earthlings, who intend to inhabit this planet, need to assess the technosphere free from the complacent narratives of those who built it.

Shortcomings of technological understanding in education for sustainable development

A milestone response to the ongoing environmental crisis was the *Limits to Growth* report (1972), which argued that technological breakthroughs alone cannot address the problem. The report also foresaw that the probable reaction to its alarming results would be one of dangerously misled technological optimism (Knutsson, 2018). Sure enough, the sustainable development (SD) paradigm—as proposed in *Our Common Future* (1987)—maintained that economic growth and technological progress are the twin staples for sustainability (Knutsson, 2018; Paredis, 2011). Of all the variables affecting environmental impact, it is technology that is often loaded with overly optimistic expectations (Keary, 2016), safe in the belief that economic growth will bring about the as yet non-existent green technologies (Keary, 2016; Knutsson, 2018). Such technological optimism also depoliticises sustainability by avoiding questions of political, economic and cultural change (Keary, 2016), thereby marginalising technologically critical alternatives (Mol & Spaargaren, 2000).

The technological optimism of SD rests on the belief that economic growth can be decoupled from environmental impact. However, currently there are no plausible decoupling scenarios which lead to sustainability (Hickel & Kallis, 2020; Vadén et al., 2020), so growth-oriented policies do not promote sustainability. The fallacy of decoupling for SD (Ruuska & Heikkurinen, 2021, pp. 4–8) also affects education for sustainable development (ESD); because the technological *telos* of affluent societies is unsustainable, it cannot be seen as universally desirable. Education that benefits from unsustainable technologies and thus accepts the *status quo*, is neither sustainable nor just. The framework of ESD has indeed been criticised for its capitalistic, globally unjust, anthropocentric and technologically naive features (Knutsson, 2018; Kopnina, 2020). We appreciate genuine initiatives for ESD, but unfounded faith in technology distracts from approaches that are more politically and culturally transformative by nature (Gaudiano, 2010).

Educational institutions around the globe tend to comply with the prevailing 'green growth' paradigm (Ruiz-Mallén & Heras, 2020), plus there is a pressure to keep up with rapid technological change—overriding the virtue of educational autonomy (Webster, 2017). As this increasingly aligns with 'green' technological modernisation in technology education (Knutsson, 2018), it is clear that at every level, from sustainability policies to the classroom, technology is seen as the remedy.

The fundamental criticism of ESD is thus that future scenarios of technological progress do not correspond to plausible scenarios of ecological sustainability (Bowers, 2000). Besides, these two discourses are unequal, as demands for sustainability are repeatedly overpowered by the push of technology. ESD, when pursuing both technological progress and a sustainable future, is like an unfortunate skier, whose skis are parting in different directions.

Education for post-sustainability?

We therefore suggest the ESD paradigm be replaced with an education for post-sustainability (EPS). Post-sustainability underlines the trilemma of our epoch, where the three goals of economic growth, political participation, and environmental protection cannot all be attained at once (Sconfienza, 2019). It implies we are moving into a bleaker era (Foster, 2017), where educators must question what to do next (Jickling & Sterling, 2017, pp. 4–5). A similar expression

'after sustainability' has also been used, indicating our era as following *after* the hopeful times of SD, and that we should be *after* other forms of sustainability (Le Grange, 2017). Hence by accepting post-sustainability, the growth-oriented framework of SD is abandoned, but not the goal of sustainability itself.

EPS implies radical discontinuity by obscuring the view of the future and education's role in it; '[H]ow does one go on teaching in and about the end-of-the-world?' (Beier, 2017, p. 279). The fact that post-sustainability seems like an educational dead-end—evoking nihilism and hopelessness—reveals the extent of our existential dependency on technological promise. As this beacon dims, we are horrified to realise we have hardly any other signposts guiding us into the future: how can the human condition improve if not through technology? We therefore suggest that accepting post-sustainability essentially involves a paradigm shift from an uncritical faith in technology to a reinstatement of human responsibility.

Only once the mirage of SD is dispelled, can EPS provide an effective path forward. By adopting the earthling approach and asking how (or *if*) terrestrial life can coexist with current technological mass, EPS challenges our present assumptions of how sustainability should orient itself with technology. Education must therefore establish cultural spaces where technology is approached in experimental, diverse and tolerant ways. Maintaining such open-endedness in defiance of technological determinism will certainly be a test for educational autonomy, but it is crucial since we have yet to really learn to live with technology—no single example of sustainable modernity presently exists (Vadén, 2021).

Education is precisely the one domain where an alternative relationship with technology could be offered, one that is comparatively free from consumerism, advertising, cultural fixations, and social pressures (Bowers, 2000, p. 183). But would education really have the autonomy to explore a sustainable relationship with technology (Ellul hypothesis) as it already does with nature (White hypothesis)—to pedagogically include 'obsolete' technologies and promote distrust towards modernisation so that they become as acceptable as a school nature trip? Despite the growing critical scholarly efforts regarding technology and education, an educator who rejects the promise of technology intellectually and in practice, may risk their professional credibility.

The demands of employment provide momentum which seemingly requires education to keep up with technology; but just as all technology is not desirable by default, neither is 'work' in and of itself. Especially vocational education seems to fail in taking the realities of Anthropocene seriously (Heikkinen, 2020)[1]. A scenario in Finland called 'ecological reconstruction' suggests a comprehensive transformation that would radically alter employment prospects by abandoning unsustainable work while guaranteeing sustainable jobs that are largely different from current ones (BIOS, 2020). From this perspective, the skills needed for the 21st century would be quite different from those currently paving the way for a digital economy. Broadening from a technological monoculture would also provide societal resilience in the face of unpredictable developments in the future (Brooks, 1986).

Technological literacy for earthlings

The Earthling approach intends to evoke an unsettling or *uncanny* feeling, making us aware of the gigantic biological *and* technological forces roaming the Earth. Our relations to these forces have never been properly worked out—nor even articulated.[2] We have nothing to build on, as if we just arrived to find this planet strewn with alien artefacts. This is the departure point for introducing technological literacy to earthlings, and it relies on three principles.

The Art of Seeing Technology

Our understanding of our environments determines how we value them, that is, environmental ethics can be claimed to derive from ontology (Naess, 1989, pp. 66–67). Just as our indifference

to trees may transform into awe once we learn about their central role in ecosystems, our excitement with a smartphone or electric car may become muted once we know about the ecological, cultural, and economic circumstances surrounding it. But the first step is to actually see the omnipresence of technology. We draw a parallel example from ecological thought, the 'naturalist's trance' articulated by Edward O. Wilson in 1984. Wilson describes a change in his eyesight which happened while doing field research on ants. With some imagination, he found that all living things in his field of vision glowed with light, while the non-living environment remained dark. 'I willed animals to materialise, and they came erratically into view.' (Wilson, 1984, p. 7). Note that Wilson mentions how the surrounding village and its human-made artefacts remained dark. What if that eye was trained to see not only lifeforms of the biosphere, but also artefacts of the technosphere too?

Imagine if our earthlings could see lifeforms glowing green, and artefacts glowing orange. Green is for chlorophyll—maintaining much of the biosphere's lifecycle, while orange is for burning fossil fuels—animating much of the technosphere. This 'earthling's trance', reveals the stunning amount of human-made things around us. Just as the naturalist's trance can help redefine humankind's relationship with nature, so will the earthling's trance literally redefine our relationship with technology, by exposing everyday environments as never before.

The Art of Living with Technology

Technological literacy—usually seen as handicrafts or preparing for engineering studies—is actually a central civic skill. EPS should therefore introduce technological literacy in a broader sense as *techne*, the art of skilfully combining technology with the good life (Bookchin, 1982, pp. 220–224). According to this holistic view, if an otherwise enjoyable life relies on unsustainable or unethical uses of technology, it is lacking skill, or *techne*. And since unsustainable technologies are culturally intrusive, *techne* implies the skill of preserving self-determination in relation to them: '[s]election and appropriation of artefacts and uses in the flow of (relative) abundance are the skills of the new art of living.' (Puech, 2017, p. 271).

Techne may also mean design and manufacture, but predominantly it is about choosing and using. It is a constant negotiation of what role we give technology in our lives. Neo-Luddism reminds us that one should carefully choose technologies before using them; it is perhaps easier to reject a smartphone outright than to constantly resist its inbuilt addictiveness. This selective approach often evokes ridicule and outrage, not only highlighting the intolerance of technological conformity, but how the rejection of technological norms desperately maintained in the face of ecological apocalypse is, in fact, an active micro-political struggle (Beier, 2017).

Techne reveals that much of our supposedly technological lifestyles merely express conformity (Ellul, 1980, p. 109), consumerism, and product paradigm (Elshof, 2006) —rather than technical consideration. There are many criteria by which technologies can be accepted or rejected (Mills, 1997, pp. 235–237). A teacher might use their bike to get to work rather than a car. The energy efficiency of a human-bicycle combination outperforms almost any other accomplishment of technical invention or natural evolution, not to mention the benefits of low cost, easy maintenance, health and sustainability. A student might prefer their cognitive environment and studying methods to be non-digital—pencils, paper and books, techniques old as history itself, combined with the recently introduced electric light, provide for many people an optimal environment for focussed studying.[3] A skilful use of older and simpler technologies indicates that *techne* is present, guided by criteria other than hype and novelty.

How can education promote *techne*? A sustainable, tolerant, and experimental approach to technology requires not only skill, but also imagination and a supportive educational context. A possible approach could be inquiry-based learning, of which Philosophy for Children (p4c) is one example. Based on the work of Matthew Lipman (2003) p4c involves students and teachers engaging in collaborative, dialogue-based inquiries into philosophical problems. The inquiries

are initiated by shared reading/viewing of texts or other stimulus material containing philosophical problems, which provoke students to use critical, creative and caring thinking to explore the problems. John Dakers (2011) suggests a p4c -approach to cultivate technological literacy: the pupils are led to imagine themselves as castaways and asked to discuss which technologies they would desire or produce on a desert island. In this way the question of technology is opened for the classroom to discuss, free from privileged or pregiven 'right' answers, aiming to 'reveal for children the hidden, taken for granted, technologically mediated world in which they live.' (p. 188). In a similar way, our earthling thought experiment could be used as an educational scenario, asking how Earth-settlers should utilise technology on their new home-planet.

There are also plenty of real-life examples of how actual people live skilfully with technology, such as the appropriate technology movement or *Jugaad*—the frugal innovation in India. Technological literacy empowers students to be 'less likely to accept or support substandard, short term, environmentally destructive product culture.' (Elshof, 2006, p. 28). Indeed, the aim is to foster students' own understanding and autonomy in relation to their technological environments. But these lessons will remain incomplete, if educational practice does not itself tolerate and encourage technological plurality.

The Art of Delegating Technology

According to Latour (1992), artefacts can be seen as societal actors or delegates, exercising the power transferred to them to accomplish given tasks. One of these tasks is to direct human behaviour. For example road bumps and seat belt sensors are delegated to rule out dangerous human behaviour while driving a car (Latour, 1992). These and similar omnipresent artefacts constitute the 'missing mass', whose gravitational force steers behavioural patterns in ways that mere 'soft humans and weak moralities' (Latour, 1992, p. 152) would fail to ensure. But just as technologies have side effects that exceed their actual function, so do they often 'act' in unintended ways as delegates. That's why new technologies should be questioned: what kind of ethics (Ellul, 1989), politics (Winner, 1980) and futures (Anders, 1972) might they be smuggling in? Without technological literacy there can be no democratic discourse on how to delegate technology into the community (Kahn, 2010, p. 66).

Which technologies should we then welcome to join our educational community? If indeed the medium is the message (McLuhan, 1964, pp. 7–21), then the intended content of education is never unaffected by its mediating technologies. Particularly, Ellul's (1989) claim that technical means are intrinsically hostile to extra-technical ends should not be ignored by environmental educators. For instance, environmental education that takes pre-school children to a forest trail to find and scan QR-codes, sends a double bind message—'Forest! Smartphone!'. The initial assumption of such pedagogy must be that forests and smartphones can coexist in the same future.[4] The smartphone has been delegated as a children's environmental pedagogue to literally take them by the hand (Greek *paidagōgos*, someone who leads children) through the forest and into the future. In Finnish schools, the digital leap combined with Bring Your Own Device (BYOD) practices, effectively eliminates the option *not* to equip first-graders with a smartphone as their tutor (Hohti et al., 2019).[5] Seeing technologies as agent-like co-educators reminds us that their careful questioning and selection is a pivotal part of responsible education.

In sum, the rationale of the above three goals for technological literacy implies that *seeing* technology as ubiquitous leads students to question their relation to it as *techne*, which raises further questions about technology acting as a means of political and cultural *delegation*. Together, these skills aim to prevent technology from remaining unreflected and apolitical 'missing mass', so that we would, as Arendt (1998) hoped, be able 'to think and speak about the things which nevertheless we are [technologically] able to do' (p. 3).

Conclusions

Those considering our argument might feel a tension: are CCE and EE educators entitled to foster sustainability by questioning technology? This professional dilemma derives from a broader educational dilemma laid out by Chet Bowers (2000): 'the one place in society [i.e. educational institutions] where it might be possible to learn about the cultural nature of technology, other than how to promote its further development, is unable to challenge the myth that equates technological development with social progress.' (p. 183). To face this dilemma of educational autonomy in relation to technology, we elaborated both the philosophical justification and practical approaches—why and how—education ought to be able to question technology.

It may well be that the deeply rooted confidence in technological progress—as in the ESD paradigm—is preventing us from fully acknowledging the seriousness of climate emergency and other environmental destruction. Likewise, the same confidence easily disregards education's transformative potential for a sustainable cultural change. We therefore propose education for post-sustainability (EPS), which questions technology's ability to guarantee sustainability through the current expansive and extractivist uses of natural resources. EPS is essentially a paradigm shift from Out-of-This-World modernism (Latour, 2018, p. 34) to terrestriality. Accordingly, EPS encourages us to question how current and future technologies serve our main objective, namely to inhabit this planet alongside other earthlings for the millennia to come.

Notes

1. Heikkinen (2020) aims to widen the perspective of vocational education by asking how human work and industries should serve the living earth-economy of all earthlings.
2. Here we explicitly mean technologically intensive modernism that, unlike many non-modern cultures, is struggling to establish stable relations with the surrounding reality: 'During its less than 200—hundred-year reign, fossil modernism has not created even one small-scale example of sustainable life.' (Vadén, 2021, p. 177).
3. Bicycle-based mobility or paper-based studying may be challenged by social contempt or the incompatibility with city infrastructures or educational practices, revealing technology's multilayered determinism.
4. During the industrial revolution, Ralph Waldo Emerson admired both sublime nature and nascent industry seemingly unaware that while '[man] paves the road with iron bars' (1836, p. 17), he is also paving the way for a future without wilderness. Environmental educators need to cross-examine their pedagogical technology to check if it truly agrees with a wooded future.
5. The mentioned research can be seen to include the three dimensions of seeing, living with, and delegating technology in education: '[i]f we "flatten" the hierarchy of the materialities of school, and give attention to the more neglected things that participate in classroom life, alternative forces compared to the official school become visible. […] [T]he phone can be seen as operating as an agentic and powerful actor in the classroom' (Hohti et al., 2019, p. 91).

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