5. Critical imagination and conscientisation for just post-pandemic Science Education: Park Rangers as public science educators

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Abstract: This chapter develops a framework to analyse critical scientific imagination and how it leads to processes of conscientisation to agentically move towards just post-pandemic futures. Through analysing a case of an environmental conflict in Chile through the stories of two park rangers, the chapter advances two elementary issues for critical imagination and conscientisation. First, there is a need to expand who counts as science educators, and second, there is a need to expand the time scales on which we think about the crises and challenges we experience. Acknowledging actors other than humans, such as non-humans and more-than-human entities, can help us dispute science discourses in public spaces and make scientific socio-political issues more pedagogical. At the same time, increasing the scales from which we think, moving beyond focusing on individualist and capitalist temporal rhythms, will allow us to cultivate our imagination for just post-pandemic futures through and within science education.

Keywords: critical imagination, conscientisation, agency, public science educators, environmental conflicts.

5.1 Introduction

Efforts to move towards just post-pandemic futures encounter a significant challenge: how to imagine and enact our transformative agency that works towards such a world? Education, and particularly educators, has a main duty in this 'conscientisation' process and in advancing these efforts towards just and sustainable worlds. A process of scientific conscientisation might imply understanding the role of science, in harmony with the position of human beings within nature: a transition towards understanding society in interdependence with nature and not as it is currently done traditionally in western modern and hegemonic science (Kato et al., 2023) through a false human-nature dichotomy (Jones, 2023). This approach to conscientisation could be articulated with dialogues between critical pedagogies (Torres-Olave et al., 2023), feminisms (Saeed, 2023), and framed in decolonisation of science education (Gandolfi, 2021). However, as Freire (1998/2018) has argued, even though our work towards conscientisation is essential, educators are not the only ones in charge of such a duty. Now, specifically in our field, science education, the role of scientists and other public science educators is also at the core since it shapes the bases on which science education is grounded: its values and practices. Therefore, in this chapter we also aim to learn with and from public science educators and their agentic practices towards imagining just post-pandemic worlds. We draw on a case of institutionalised park rangers as public (Giroux, 2004) and so-called informal science educators to advance answers towards how to imagine just post-pandemic science and environmental education.

The role of our critical imagination as a "force that makes different possibilities visible" (Bazzul & Tolbert, 2019, p.307) is scarce in science education literature (Bazzul, 2022). However, its essentiality as part of our agency as educators has been highlighted both in science education (Torres-Olave et al., 2023) and in futures studies (Facer, 2023). In the case of agency in science education, attention to the temporal dimension of it is crucial to how we imagine and reimagine possibilities to act (or not) across spaces (Torres-Olave, 2022). However, time for such a task is usually not considered in educators' work (Torres-Olave & Dillon, 2022), or agency is reduced to what educators do in practice without considering other elements of such practice, such as those political imaginative practices (Stetsenko, 2019). In that line, Facer (2022) has argued that "we now need to turn our attention towards understanding how temporal frames structure and delimit the nature of the problems we present to students as well as the as-yet unexplored potential for working with diverse temporal frames as a means of opening up new sites of dialogue and collective agency" (p.47). On a similar line, Bonelli and Dorador (2021), Chilean scientists, have argued that we need to think *temporally* not just with other humans but also with non-human and more-than-human actors. Non-human entities refer to beings or entities that are not classified as human beings: this can include animals, plants, ecosystems, and other living organisms that exist independently of human presence. On the other hand, more-than-human entities are part of a larger web of life, and our actions and well-being are intertwined with the well-being of these diverse entities (Gudynas & Acosta, 2011). For many indigenous communities, more-than-human entities must be recognised to move towards a deeper understanding of the interconnectedness and interdependence of human beings with the natural world (Carvalho et al., 2020) which transcend larger temporal frames that our own existence (Bonelli & Dorador, 2021). More-than-human entities are part of our intergenerational stories as communities which are considered, for instance, by indigenous wisdom through nonlinear ontological understanding of time, perceiving past, present, and future simultaneously. In that sense, more-than-human actors might contribute to encompassing the relationships between humans, animals, plants, ecosystems, landscapes, geological formations, technologies, and other elements that shape our lived experiences in cyclical and multiple rather than linear perception of time. For instance, in the words of Bonelli and Dorador (2021),

> salares' (salt flats) deep-time history, which includes the periods of geological formation and biological evolution, the history of the Chilean neoliberal extractivist economy, its historical time, is extremely insignificant. It is only in recent decades that mining companies have successfully exploited the salares' subterranean waters and brines, an exploitation they typically justify by the current need to implement global energy transitions (p. 3)

As they notice, those ways of portraying extractivism as a technoscientific solution to justify their practices reduce our relationships with more-than-human entities within short anthropocentric time scales. Those practices in the name of technoscientific progress undoubtedly affect how science education is understood (Kim & Dionne, 2014; Kimmerer, 2012). There are, however, other stories where the scientific imagination has been linked to processes of conscientisation through, for example, learning with coastal communities caring relationships with the sea (George & Wiebe, 2020) or working with reparative environmental justice frameworks (Agathangelou & Killian, 2021) contesting the singularity and linearity of time and space moving away from narratives of 'science for domination' and exploitation. (see Kato et al., 2023)

Those past and present stories are important for highlighting and shaping how science, particularly the imaginaries, practices, and commitments of scientists and *public* science educators, are emphasised in science education. They serve as examples of public pedagogy, illustrating what the world has taught and is teaching us today (Giroux, 2004, 2006) regarding the roles of scientists, public science educators, the purpose of science, and the temporal scales and rhythms we engage with (Torres-Olave, 2024).

We begin this chapter by introducing the theoretical framework that informs our positionality and thinking –grounded in critical pedagogies, as well as futures studies. Subsequently, we contextualise this study within the backdrop of Chilean neoliberalism and its influence on science education, laying the groundwork for the case study we will delve into using this framework. To conclude the chapter, we engage in a discussion regarding how our example can serve as a form of public pedagogy, with potential inclusion in science curricula for both school and higher education contexts. Furthermore, we reflect on the implications of our example in shaping our conception of science and its role in envisioning just post-pandemic futures more broadly.

5.2 Theoretical framing

5.2.1 Public pedagogies and public science educators

To envision fairer post-pandemic futures, we position ourselves within the framework of critical pedagogies, given their emphasis on equity, justice, and social change (Giroux, 2011). One of their central tenets is the pursuit of justice as a goal that education can contribute to through processes of emancipation and conscientisation (Darder et al., 2017), both on an individual and collective level. This process involves and demands reading and understanding the world in order to transform it (Freire, 1998).

When we examine the realm of science education through this critical lens, we uncover stories of oppression and inequalities that have been perpetuated in the name of science, as well as various socioscientific challenges (Tolbert et al., 2023). In that line, the journal Nature, through guest editors Nobles et al. (2022) recently published a special issue recognising the toxic legacy of science, and themselves as journal, in perpetuating systemic racism. Similarly, authors have engaged in unveiling stories where science discourses have helped to perpetuated racists views of certain bodies (Bernal-Munera, 2023), homophobia (Tielsen, 2023), and other intersected oppressions. However, we also encounter narratives of critical hope around science through the actions of individuals and communities (Torres-Olave, 2022), which demonstrate the potential for science education to advance towards epistemic, social, and environmental justice by engaging with diverse ways of knowing (Warren et al., 2020) while recognising the needed reparations of wrongs.

Within the context of the climate planetary emergency and from the perspective of critical pedagogies, questions have been raised regarding the content, social practices, and skills that should be encompassed within the science curriculum (Gilbert, 2023). The actions and positions of different scientists and public science educators inform these practices and skills, thus serving as public pedagogy by teaching us something about the world: what holds value in science, how

scientific inquiry is conducted, how science connects with real-world scenarios, and how science *can* and *should* contribute to the creation of fairer societies.

Public pedagogies as a framework, are rooted in critical pedagogies, encompassing the understanding that teaching and learning occur not only within formal educational settings but also through various cultural practices and spaces such as arts, media, museums, and parks, which impact knowledge about the world (Sandlin et al., 2011). Consequently, public pedagogies explore how different sites of practice function *pedagogically*, either directly or indirectly. In that way, public pedagogies hold the potential to address explicit and implicit narratives of science that have emerged in recent years, including the COVID-19 pandemic, women's rights discourses, science controversies, socio-environmental issues like the planetary climate crisis, and other topics that bridge scientific knowledge with society. When those narratives reproduce discourses of science that oppress or exploit others, they need to be unveiled and contested. For instance, using public pedagogies as a framework, Eaton and Day (2019) unveil the strategies employed by fossil fuel industries in their educational materials targeted at teachers. Their analysis reveals how these industries design learning resources that deflect responsibility for climate crises onto individuals. Eaton and Day (2019) demonstrate that through these pedagogical interventions, fossil fuel companies attempt to redirect attention away from corporate accountability and their industry's role in accelerating the effects of climate change. Hansson and Öhman (2022) have examined the role of museums as public pedagogies in promoting sustainability and sustainable development goals. Similarly, Park et al. (2022) have grounded their work on public pedagogies to develop 'food pedagogies' aimed at advancing social justice in the realms of health and food rights. These examples emphasise the significance of exploring diverse social issues as public pedagogies, explicitly informing learning, and enhancing pedagogical values within public discussions. These discussions are shaping how various disciplines are learned and understood within the public sphere by either reproducing or contesting hegemonic narratives of science.

Following this line of thinking, Giroux (2004) argues that public pedagogies are about making the political *more pedagogical*. Building upon this approach, Mayes and Center (2023) analyse students' climate activism, particularly their use of memes and humour on cardboard signs during protests, as a form of public pedagogy through political interventions, effectively acting as public climate educators. In another example, challenging the boundaries between techno-scientific knowledge and public knowledge of science, McEntee et al. (2023) contend that park rangers in Aotearoa/New Zealand possess a rich understanding of "science, place, multiple publics, and their limits" (p.135), making them valuable public science educators and what the authors refer to as "environmental caretakers." Unfortunately, their voices are often marginalised due to epistemic hierarchies regarding who possesses, produces, and communicates scientific knowledge.

In the case of Chile, the country where we both grew up, different forms of public pedagogies and therefore public science educators have been in the spotlight in the last years due to ongoing discussion about the country's constitution. Those discussions have conquered the public imagination about different themes regarding science. We have seen ideas around women and LGBTQIA+ communities' rights (e.g. Hiner, 2022) rights of nature, indigenous lands (e.g. Green Rioja et al., 2022), and in general, how we relate to the other using scientific knowledge to frame such discussions. It is here where we set the context of this chapter, as we will further explore later.

5.2.2 Agency, temporality, conscientisation, and what is imaginable.

Public pedagogies can also inform us about what the world is *being today*, and together with visions of futures we can explore what it *could be* (Facer, 2022). Futures studies deal with several issues but of particular interest for us are time, critical imagination, and conscientisation as part of what frames our sense of agency. Here, agency is understood as the power that lies within us to read the world for writing new ones (Torres-Olave, 2022) which have different dimensions: relational, practical, and temporal. It is that temporal dimension that we want to expand here through the concepts of critical imagination and conscientisation: how we think we shall live, how we imagine that potentiality, and what that means for our actions today.

In that line, Facer (2023) has argued that in neoliberal times, certain times are of value, with the tendency to put people "on track" and "behind". These neoliberal timescapes, rhythms of life (Adam, 1998), frame how we understand our relationships with human, non-human, and more-than-human actors. In Facer's (2023) words, "[w]hen timescapes are allied with power, as industrial and colonial histories show, arrhythmia becomes subject to intervention and control, bodies are forcibly and violently brought into dominant time structures" (p.61). These dominant time structures then justify the exploitation of nature through accelerated environmental impacts (Kingsbury, 2022), unsustainable growth (Hickel, 2019), and scientific practices (Misiaszek & Rodrigues, 2023). They even define what is possible and what is not within and through science, delimiting our imagination and, therefore, our potential actions. As Freire argued a while ago (1997), the accelerated understanding of science and technology has been "the main bastion of capitalism" (p.56) and its relationship and time dynamics. However, timescapes are not natural or given, nor are they singular; therefore, they can be rethought (Torres-Olave, 2024) in the same way we can reimagine our actions today and those futures we could advance towards.

But how do we imagine how shall we live and the role of science in such living? Imagination is essential to make sense of our actions and to go beyond limited situations (Torres-Olave et al., 2023). In this context, Bonelli and Dorador (2021) explored their imagination in terms of their work in microbiology. They developed what they call a “sympoetic imagination” which allows them to rethink and critique extractivist practices in the name of science, and to expand on other ways of scientific relations “through and by [their] affective engagements with salares” (p. 12). In these examples, their look at the more-than-human to allow themselves *to be taught* about the world: the *salares* can then be a *public pedagogue.* In that sense, public pedagogues of science are not just humans, but also the other actors we coexist with. As such, who we recognise as a public science pedagogue needs to be widened. They are not just the formal and schooled science educator.

Putting together these ideas, we can crystallise a framework that allows us to see the world in different terms. Public pedagogies about science are out there and they need to be unveiled to reflect on how they contribute to notions of science and how some of these practices and values, such as thinking and imagining with nature and contesting neoliberal ways of relating, can be incorporated in science education to illuminate other ways of linking science and societies through conscientisation towards transformative agentic practices.

A critical scientific imagination and conscientisation are both essential in science education at school (Morales-Doyle & Frausto, 2019), in out-of-school contexts (Hecht & Nelson, 2022), and

in higher education (Misiaszek & Rodrigues, 2023) levels because transformative actions are crucial to ending anti-environmentalism and unsustainability by disrupting what is thought as the mainstream practices of (neoliberal) science that falsely justifies acts of socio-environmental injustices in the name of progress and growth (Hickel, 2019; Liboiron, 2021).

5.3 A case to learn and think with: Alto Maipo, the monster in the park.

To explore these ideas and develop our argument, we will draw on a case study that forms part of an ongoing research project (Guerrero, 2024). This study focuses on socio-environmental conflicts and involves collaboration with science educators and park rangers who act as public science educators in El Morado natural monument, a national park in Chile.

Unfortunately, the national park is currently experiencing the adverse impacts of Alto Maipo hydroelectric project, referred to as Alto Maipo hereafter. This project has constructed underground tunnels that run directly beneath the El Morado natural monument, which is part of a glacier cirque, resulting in significant and irreparable damage and a lot of predicted dangerous impacts such as: threatening the safe supply of drinking water to 7 million people in Santiago (the capital of Chile); endangering irrigation waters for agriculture; accelerating the melting of glaciers and recharging of aquifers, also decertifying 100.000 ha of the basin and its area of direct influence (Folchi & Godoy 2016).

The Alto Maipo project is being developed by AES Andes S.A. (previously AES Gener S.A.), a subsidiary of AES Corp, North America's second-largest energy company (Folchi & Godoy, 2016). STRABAG SpA Chile, an Austrian multinational with a workforce spanning over 20 countries, is responsible for the project's implementation. Situated near Santiago in San José de Maipo, the project remains under development. A 2011 agreement between AES Gener and Aguas Andinas, Chile's primary sanitary company, allows for the redirection of water originally destined for Santiago's water supply to the hydroelectric project. The plan aims to divert water from the Maipo River's main tributaries into a tunnel network, resulting in a severely limited ecological flow in the river that is insufficient to sustain life (Godoy, 2014). The infrastructure associated with the project includes two run-of-the-river centrals and 73 kilometres of abduction tunnels with diameters ranging from 6 to 8 meters. It is essential to note that this network of tunnels passes directly beneath the Andes Mountains, the El Morado National Park, and the San Francisco Glacier.

Like many high-cost projects, Alto Maipo depends on economic collaboration with foreign investors, relying on large investment groups and both national and foreign banks. Consequently, the project's financing is intricately intertwined with global capital. The network of investors involved comprises national and international institutions, banks, global corporations, subsidiaries, and associate companies. Information gathered from the Environmental Justice Global ATLAS platform[1] (Temper et al., 2015) reveals that Alto Maipo is co-financed by the International Finance Corporation and the US Overseas Private Investment Corporation (Folchi & Godoy, 2016). Through collaboration with a syndicate of international development banks, including the

[1] https://ejatlas.org

Overseas Private Investment Corporation (OPIC), the International Finance Corporation (IFC), as well as Chilean and international commercial banks, the project's financing has been increased to approximately US$3.05 billion, with 60 percent in debt and the remaining 40 percent in equity. Notably, despite significant flaws in the environmental impact assessment and inadequate consultation processes, Alto Maipo has received funding from nine banks (Temper et al., 2015). Paradoxically, Alto Maipo has been registered with the Clean Development Mechanism, enabling companies to earn carbon credits for initiatives aimed at reducing carbon emissions (UNFCCC, 2008). This demonstrates the involvement of international organisations and laws, such as the United Nations, within the network, and highlights how discourses surrounding carbon credits permeate the Chilean State within this framework. This phenomenon differs from traditional extractivism (Gudynas, 2018) and is now recognised as 'progressive' neo-extractivism (Svampa, 2019).

Neo-extractivism in the Global South constitutes a structural feature of capitalism (Svampa, 2019). Unfortunately, the dynamics of economic growth, based on historical extractivist, neoliberalism, and a particular mode of accumulation, have increased socio-environmental conflicts in Latin America. Therefore, analysing the successive economic cycles and historical or potential future dimensions of environmental conflicts are important to discuss the roles of science and environmental educators towards conscientisation (Guerrero, 2024). Consequently, new counter-hegemonic discourses and critical imagination are needed in science and environmental education to defend land, water, and territories that are also part of how we understand process of conscientisation in the name of science as a concrete and material socioscientific and political issue.

5.3.1 Park rangers as public science educators

The case we are presenting here is part of a larger project on envisioning opportunities for collective activism in science education –specifically within the context of extractivism in Latin America. The project is examining a critical approach to scientific and environmental literacies grounded in conscientization and drawing inspiration from outdoor science education. In the larger project, environmental conflicts are understood as potential scenarios/opportunities to analyse power dynamics and networks of actants (including humans, non-human, and more-than-human entities) involved in socio-environmental issues (Guerrero, 2022).The project develops a collaborative pedagogical approach to conscientisation with a critical focus, specifically tailored to address the Alto Maipo conflict shared above; and over the course of 2020-2022 interviews, conversations and focus groups were conducted with different actors, i.e., pre-and in-service teachers, scientists, and park rangers (Guerrero, 2024).

In this chapter, we focus on examining the discourses of awareness and critical imagination exhibited by specific group of park rangers who took part in the larger project positioning them as public science educators. Situated as public educators, park rangers could connect science, and particular science justice issues (Morales-Doyle, 2023) to local problems such as access to water and food security, environmental vitality, and nature preservation. In that way, their discourses can make the political conflict of Alto Maipo more pedagogical. The Park Rangers site of work, El Morado natural monument is visited roughly by 15.000 visitors per year, including students and science teachers from different schools, mainly from Santiago, tourists, and general public. These

park rangers' role in this national park is then relevant because of their proximity to significant events, their local knowledge, and a special relationship with the natural monument. Moreover, they shape discourses of science and environmental education out of school and university for students, teachers, and general public. For anonymity purposes, park rangers' names and characteristics are not shared, however, it is important to highlight that they both have been working in the park over a decade. The excerpts of the interviews conducted by the second author of this chapter, are part of a research visit conducted by a participatory research group —which included 4 pre-service teachers, 2 in-service teachers, and 2 scientists.

5.3.2 A monster in the park, a precious resource in danger: two storylines to learn with

Through interviews and conversations, the park rangers shared different stories of the tensions navigated while doing their work. Here, the focus is on excerpts from two stories that we would like to think with to expand on the role of public pedagogies for imagining just post-pandemic science education and working towards conscientisation processes.

> (...) well, we usually teach about the impressiveness of the glacier at a low altitude, how the glacier was formed, and the importance of the water cycle. We also reflect on why the water cycle is essential, along with teachers. The glacier is *a fundamental part of everything*, serving as the base for the commune of San José de Maipo and meeting the water needs of all of Santiago. We intertwined all this information so that the children could understand where the river originated, the significance of its tributaries, the importance of water to the community, and why it was crucial to take care of this precious resource.

> (...) nowadays, protected areas are an opportunity for social, cultural, economic, or scientific development, and obviously, everything is interconnected. That's why I was saying that El Morado is a small laboratory, *a scientific area, a very small scientific laboratory*, where you can benefit greatly, not only in terms of chemistry, physics, and biology. Many visitors, such as schools or universities, also come to talk about history, geology or landscape geomorphology, painting, photography, physical education, mathematics, and they link it all with what the protected area is about. (Park Ranger 1)

During the park visit, the park rangers narrate the natural history of the location, including the stories of pre-Columbian peoples who inhabited and protected the area. They also highlight the sensitivity of insects to the impact of Alto Maipo, for instance, the changes in sound and temperature of the ground which in turn has cascading effects on the entire trophic chain of the park, including the glacier. These examples demonstrate the limitations of relying solely on reports or environmental regulations that fail to capture such nuanced effects and several concerning observations:

> (...) however, in this entire sector, there are noticeable changes. For instance, the mountains and the glacier in the background, situated in the San José volcano, have undergone significant alterations. Comparing the present to a decade ago, the glacier was much wider and larger. The glaciers in the central zone are estimated to melt up to 6 meters per year. Unfortunately, it has become apparent

> that the dust emitted by the Alto Maipo trucks, along with the exhaust pipe emissions and the heat produced by the truck engines, have a negative impact. The dust, coupled with increased temperatures, is being carried by the wind and affecting the glaciers. These changes in temperature and dust accumulation are influencing the glaciers' melting process. For instance, if you shine a torch at night and realise that there is dust in the environment, I have done the test, it is like, I do not know. It is like the light from Star Wars, it's very similar.

> (...) the consequences are also affecting the local wildlife. Species are migrating away from their usual habitats due to the lack of food caused by the changes in the environment. Additionally, the direct pollution of rivers, noise pollution, and the rise in water temperatures due to the altered water flow are concerning issues. The project seems to be releasing heavy minerals and materials into the rivers, further aggravating the situation. Moreover, atmospheric impacts are being observed. The large number of vehicles and trucks moving in the area contributes to the dispersion of dirt and dust particles. These particles adhere to the glaciers, causing them to warm up and accelerate the melting process. (Park Ranger 2)

However, as shared in the next excerpt, there are some tensions between public science and environmental educators and unfortunately, when it comes to addressing more political or critical issues, the voices of park rangers are often silenced by institutional constraints:

> (...) well, I could talk about Alto Maipo a lot, but, probably, we are conditioned... We cannot talk about a project of which we are prohibited from issuing judgments because, of course, technically, we have the expertise, but here the one who has the voice are those who participated in evaluating the project. (Park Ranger 1)

Consequently, their agency is diminished, leaving the task of engaging with these political issues primarily to teachers or those fortunate enough to possess deeper knowledge about the happenings beneath the glacier and specifically about Alto Maipo.

5.4 Discussion: A Glacier as a transdisciplinary actor to develop critical scientific imagination and conscientisation.

A fundamental part of everything is how one of the park rangers portrays the Glacier. For both of them, the Glacier represents not just nature but also brings with its humanity and fairer conditions for living for human and non-human actors. As noted by them, "the consequences are also affecting the local wildlife" and the presence of Alto Maipo brings questions about "the importance of water to the community". In that way, in their discourses, we can see how the threat to the Glacier has become a transdisciplinary actor to think with. It brings and facilitates discussions not just about science, but also about basic human rights such as water, and how knowledge and voices are distributed and valued. Moreover, it fosters discussions about what is essential for living, either a National Monument, or an industry, and the need to bring new relationships through science that

are not exploitative and extractivist for the sake of development for a few at the expenses of others. In Kimmerer's (2012) words, the environmental crises we are suffering today are also part of "the degradation of our relationship with the living world and the extinction of an ethical responsibility for the land which sustains us" (p. 317). Expanding what counts as science education to think with and within nature as the park rangers do, is a way of developing a critical scientific imagination that can help us, researchers, educators, and students, develop conscientisation of what is of value, what is essential, and whose knowledges we bring to learn with when learning science in different settings.

However, there are actors, such as the park rangers and the Glacier itself, whose voices have been erased and silenced. When a voice is silenced, that silence also carries out discourses of science (Torres-Olave & Dillon, 2022). What is untold can be presented as of non-value or not essential for the experience within the park and what the park in itself represents for the local community, not only today but at larger scales. As noted by George and Wiebe (2020), learning with more-than-human entities, and thinking time with other rhythms and scales can present challenges to Western modern science, particularly shifting "possessive, property-driven forms of citizenship and instead center reciprocal relations of abundance and care with and among human and more-than-human lifeworlds" (p. 519). Learning through the relationship between the park rangers and the Glacier has meant learning stories that travel across generations. Stories that can be of value to science and other disciplines. Stories that can advance caring, ethical, and conscious relationships through science for intergenerational justice.

Even though this process of developing conscientisation is neither simple nor solely the responsibility of schoolteachers, there are ways of distributing such ethical tasks. There are different discourses of science to whom we also need to demand ecological responsibility and, consequently, actions. For example, using the park, as the same park rangers stated, as a *scientific laboratory* to learn and cultivate imagination. An imagination that expands the relationships we build with others, that is ecological, ethically responsible and that centres learning experiences not just in students but also within the world of which we are also part and the relationship we build in the process (Hecht & Nelson, 2022). This is necessary not just for school experiences but also for higher education, such as through land-based pedagogies (Hage et al., 2022) for science teacher education or other science-related professions, as the park rangers also shared. If this goes beyond a visit to a sustainable practice, park rangers' knowledges can be set in an ecology of knowledges needed for science education, overcoming epistemic hierarchies of who owns scientific knowledge and the different ways of knowing science. As argued by McEntee et al. (2023), these stories also show that park rangers "have a nuanced knowledge of place" (p.127). The movements, changes, losses and impacts of the park highlighted by them, require a rich understanding of the relationships, the geographies, and the diversity of habitats of the park. Through their knowledge of affective, structural, and content-related dimensions, they advance notions of science and ecological ethics essential for conscientisation processes.

Park rangers' stories also highlight the cruciality of the space to learn with and the value of oral stories of those who have been in the space for, as them, over two decades. When they say, "Comparing the present to a decade ago, the glacier was much wider and larger", they bring with it other stories and dimensions of science to which we usually do not pay the necessary attention: non-linear, more broad temporal dynamics and rhythms. As such, park rangers play a crucial role

in introducing students to different temporal and spatial scales. Similarly to Bonelli and Dorador (2021), park rangers are thinking not only in human but also in non- and more-than-human time scales. One of our problems today is that we are having temporal gaps between imagination and socio-cultural-environmental conditions. Those temporal thinkings have political effects because in the case of the Glacier, shapes what is of value *today* for *a few*. Thinking within extractivist and immediatism temporal scales frames our beliefs, our need, and to what we pay attention to or not (Torres-Olave, 2024). As stated by Facer (2023) we need to "cultivate such a temporal imagination as a resource for possibility thinking...start[ing] from the assumption that the temporal imagination, as with any other imaginative activity, is resourced by social and cultural resources that offer tools, images and concepts to scaffold and mediate our ideas of the world" (p.62). Park rangers' stories of and with the Glacier can help to scaffold those ideas of the world realising the impacts that monsters such as Alto Maipo have on it.

In their stories, park rangers also share about other *starting* points. It is not just the Glacier and what it is *today*, but also *what it was*, and *what it could be* in the future with its influences on life more broadly. Those stories of science are vital because they problematise when time "starts" to be counted, which as a consequence, impacts our ways of thinking and the limits of our imagination. If we continue thinking in the scales we inhabit, or in the short term, conscientisation process will be hindered because moving towards fairer worlds is not just about *us:* it also needs to include the past and futures to which we do not belong. Those temporal scales strongly influence how we live today. For example, in the case of Chile, neoliberal logic has shaped neo-extractivist practices, and notions of techno-scientific futures as linear with infinite accumulation and growth.

In the case of Alto Maipo, the project poses a serious threat to the water supply of over 7 million Chileans. Regrettably, the potential consequences of this undertaking have not been adequately considered. The importance of addressing this issue cannot be underestimated. The impact on local flora and fauna, as well as the fragile habitats in the vicinity, demands serious consideration and measures to mitigate its effects. Therefore, it is vital to recognise that a climate crisis and the impact of global warming is already exerting considerable stress on the Andean ecosystems, and any additional disturbances from large-scale projects like Alto Maipo may only worsen the situation. Collective, critical, and relational responsibility from critical science educators is vital to contesting this monster in the park. As stated elsewhere, "[s]eeking just futures, pedagogically, is an attempt to enable students and educators to see, understand and transform unjust forces in our world that are temporally rooted both in the past and the present" (Torres-Olave, 2024, p.13). Bringing different visions, such as those of the park rangers, can offer different rhythms and disrupt what is considered a problem to reflect and act upon through both the seen and unseen in our science classrooms.

5.5 Conclusions

We started this chapter by proposing a challenge to move towards just post-pandemic futures through and with science education. In such a challenge, we believe in the need to cultivate critical imagination and conscientisation to enact our transformative agency towards such a worlds. However, for just post-pandemic futures, we believe in the essentiality of at least two issues: 1) widen who counts as science educators and where we set the responsibility of educating the

scientific imagination, and 2) delinking temporal thinking from our own tempos and rhythms to think with and through other scales.

Hegemonic public scientific voices have shown extractivist logic in the name of scientific progress, which will not help us move towards those fairer worlds we want to build. However, there are silenced voices, of human, non-human, and more-than-human actors that have always been there as public science educators. Attention is needed to those voices, an attention that can move us away from the self (Torres-Olave, 2024) to start seeing those actions and stories of science that can cultivate a scientific imagination which is critical, relational, and environmentally responsible with larger time scales. When thinking of who counts as a science educator, particularly in public spaces, we can then move towards asking who produces and communicates science and the role epistemic hierarchies play in diminishing certain actors' agency. Learning with park rangers has taught us how other actors are thinking and imagining with non-human and more-than-human actors. Such is the case of the river, of the salares, of the Glacier. Those ways of imagining need to be incorporated to the practices and values of science within science curriculum.

With such learning, we can move to the second task to cultivate our imagination and conscientisation: delinking temporal thinking from our own tempos and rhythms to think with other scales. An accelerated time does not allow us to look beyond our own temporal frame and therefore, leaving human, non-human, and more-than-human actors behind under the accelerated machine of capitalism. It also delimits the border of our imagination, of what is possible, and therefore our transformative agency. Thinking with other time scales and frames within science curriculum is also crucial. As such, we hope this chapter contributes to how we think and experience time, with others, through institutions, ways of thinking, and how time, its directions, and rhythms, are taught (or not) in science.

This whole book has prompted us to imagine several aspects of post-pandemic science education. Along these lines, we firmly believe that science and environmental education should be acknowledged as a collective endeavour that demands collaboration, dialogue, and attention to the position of human beings in the world. In a post-pandemic era, a transition towards understanding and reflecting on the interdependence and interconnectedness of human, non-human, and more-than-human entities (such as rivers or glaciers) seems to be imperative. And, in our specific context in Latin America, by taking these factors into account, we can promote a science and environmental education for conscientisation, aiming at protecting both the invaluable water supply and the delicate biodiversity of the Andes, paving the way for a harmonious coexistence between humans and nature.

To continue our exploration, cultivating our critical imagination and conscientisation processes, we ask ourselves to persist in challenging the borders of science education, but also its tempos and rhythms and the actors we bring along to our science classrooms. This includes not only to problematise whose voices count as science education, but also to problematise the temporal and geographical spaces in which we think. It includes asking what stories we value and want to tell of *origins* and *futures* for and within science. What temporal scales are we going to engage with in our pedagogical and research practices? What is the role of temporal pauses for that attention we highlighted as essential? We do not know yet what all these practices entail, but we believe

temporality needs our attention not just in scientific terms, but also in its social dimension to contest those hegemonies of accelerated capitalist times.

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