Australian Journal of Environmental Education (2024), **40**, 601–611
doi:10.1017/aee.2024.40

CAMBRIDGE UNIVERSITY PRESS

ARTICLE

Engaging Environmental Education Through PISA: Leveraging Curriculum as a Political Process

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(Received 24 June 2024; revised 09 August 2024; accepted 10 August 2024; first published online 02 October 2024)

Abstract
The Organisation for Economic and Cultural Development (OECD) works with countries worldwide to implement testing in the areas of science, mathematics and reading through the Programme for International Student Assessment (PISA) every three years, and this process is recognised to influence education systems through areas such as curriculum. Over the past decade, the OECD increasingly has acknowledged the need to include a greater emphasis on environmental issues, including developing student competencies specifically in this area. For the 2025 PISA round, we were invited as environmental science education experts to contribute to the Science Framework, which underpins the science assessment. This paper explains how we responded to that invitation, including foregrounding the urgent need to understand the competencies of 15 year-olds to address critical socio-ecological challenges such as climate change. We argue that this provides environmental education practitioners and scholars with a powerful opportunity to gain world-scale data for research and advocacy, which could enhance the visibility and leverage for our field in curriculum, whilst also recognising the political process within which we were engaged.

Keywords: Agency; competencies; environmental education; PISA; politics; socio-ecological challenges

Environmental education in a socio-political context

Environmental education is an evolving field of endeavour with a strong agenda to promote change. From its beginnings in 1969, it was purposefully political, as it sought to empower people to engage in social change (Palmer, 1998; Stapp, 1969). Its genesis was in response to rapidly emerging and continuing signs of environmental degradation as a consequence of human activity (Ruckelshaus *et al.*, 2020); it also moved beyond existing conservation and natural resource education programmes by empowering learners to engage with change processes. With an international focus on sustainability developing over the following decades, environmental education evolved to address unsustainable human lifestyles (Steffen *et al.*, 2011). The evolution was stimulated by those who were bringing attention to burgeoning environmental issues (e.g. Carson, 1962; Shiva, 1988) and taking action to address these issues. This movement clashed with the dominant doctrine of development, which privileged economic growth at the expense of environmental integrity, social cohesion and cultural practices (Jackson, 2009).

As environmental scholars and activists increasingly raised concerns about unsustainable development, local, national and global authorities responded politically in a variety of ways. At a global level, this manifested through a series of meetings and associated documents such as the World Conservation Strategy (IUCN/UNEP/WWF, 1980), the Earth Summit of 1992 (United Nations, 1992),

the United Nations Decade of Education for Sustainable Development (2005–2014) (UNESCO, 2024), the United Nations Millennium Development Goals (United Nations, 2015) and the United Nations Environmental, Scientific and Cultural Organisation's Sustainable Development Goals (United Nations Development Programme, 2024). Each of these documents suggested how nations might adopt more sustainable practices through a range of strategies and practices, including education.

Education itself is a political endeavour, as many have argued and theorised (Apple, 2011; Freire, 1996) and as anyone who has participated in it will have experienced. The act of education — with its focus on a body of knowledge, values, skills and the processes to develop these — is invariably influenced by global bodies, governments, vested interests, educational institutions, educators, students and their communities. When education concerns the tension between development and sustainable outcomes, environmental education can be highly political (Chapman, 2011; Payne, 2016).

To further complicate the matter, environmental educators hold themselves to account over democratic, inclusive, critical, learner-centred and action-oriented processes. This means acknowledging the urgency of addressing many issues while eschewing pedagogies that are instrumental in favour of those that are emancipatory (Jickling, 1992), for deeper and more durable learning that is needed for collective, sustainable change (Wals & Benavot, 2017). It also means long overdue attention to the ravages of colonisation (Muller *et al.*, 2019) and the engagement with indigenous knowledges (Maclean *et al.*, 2015) as powerful contributors to our understanding of the changes required. Environmental education emphasises action to resolve environmental problems (UNESCO, 1978). Learners develop essential skills and strengthen efficacy through the process, but what they do and how they do it are ultimately political decisions involving educators, administrators, or students themselves.

In this paper, we focus on a relatively recent and ongoing political process in environmental education, which involves the Programme for International Student Assessment (PISA), an activity of the Organisation for Economic Cooperation and Development (OECD). PISA offers participating countries an opportunity to assess their young people (15-year-olds) in science, reading and mathematics, with each domain being a major focus in successive years of implementation. Since PISA's first implementation in 2000, assessments have been offered every three years, with the next iteration in 2025 having a science focus (delayed by one year due to COVID-19).

In 2021, the OECD approached us (the authors) to contribute to PISA's 2025 Science Framework from an environmental science perspective. The Science Framework underpins the design of the assessment. We defined our contribution as *Agency in the Anthropocene* (White, Ardoin, Eames, & Monroe, 2023) and argued that young people need to be able to work individually and collectively with hope and efficacy to understand diverse perspectives on socio-ecological challenges and act to create a more just and resilient future (White, Ardoin, Eames, & Monroe, 2024). Through this framing, we positioned three environmental competencies as central to science education: (1) understanding that humans have impacted Earth's systems; (2) respecting diverse knowledges, demonstrating hope and seeking solutions for socio-ecological challenges; and (3) making informed decisions to act based on evaluation of diverse sources of evidence and application of creative and systems thinking to regenerate and sustain the environment.

Here, we outline the opportunity for environmental educators to engage with science education, science educators and education policy through including *Agency in the Anthropocene* in the PISA 2025 Science Framework. We begin by providing background to the politics of the OECD's developing focus on environmental education, and we discuss how, as environmental education scholars, we sought to leverage the opportunity within science education. We examine our argument for including social-ecological challenges in curriculum design. We explore the politics and process of incorporating environmental education through PISA into curricula internationally. Finally, we discuss the power and politics of curriculum policy and reform within PISA, and how our work can be viewed as educational reform and resistance, in the face of urgent social-ecological challenges (Watts *et al.*, 2024), in enabling young people to have agency to thrive in the Anthropocene.

https://doi.org/10.1017/aee.2024.40 Published online by Cambridge University Press

PISA and curriculum reform

The first PISA in 2000 focussed primarily on mathematics, followed by a focus on reading in 2003 and then science in 2006 and so on with an ongoing triennial rotation (except for disruptions due to COVID-19) (OECD, 2023). All assessments include some questions relevant to each of the three focal areas, providing an enduring feature and generating comparative data across the last two decades. Each assessment includes cognitive items that function as benchmarking tools to enable longitudinal analysis regarding 15-year-olds' competencies. It also includes a set of questionnaires for students, school administrators, and educators that relate to teaching practices, young people's values and attitudes, and other relevant themes (e.g., global competence; critical, creative and collaborative thinking; and digital learning). The OECD make all data and some reports regarding PISA available via their website (https://www.oecd.org/pisa/). Data generated are used to understand complexities of education and can provide analyses from national and international perspectives.

These analyses motivate many countries to regularly participate in PISA and to use the PISA results to consider curriculum reform (conceived here broadly as change to what is taught and how it is taught). PISA data provide one measure for educators within participating nations to gauge their nation's educational effectiveness across the years and in comparison with others. Countries (represented by education academics and policy representatives) have been known to ask, "How does my country 'win' at PISA?", with a "win" considered to be a high ranking in comparison with other countries. This desire to demonstrate the value of a country's education system (including curriculum, teaching capability and resource provision) through success at an international standardised assessment can drive curriculum reform. We argue, therefore, that positioning *Agency in the Anthropocene* as an important feature of the Science Framework 2025, and PISA 2025 overall, could enhance the visibility and relevance of education concerning socio-ecological challenges among curriculum designers internationally.

PISA'S developing focus on the environment

Over the past decade, the OECD has demonstrated a growing interest in and commitment to understanding how young people develop competencies to address environmental issues, especially those related to climate change (Bybee, 2008; OECD, 2019). The OECD recognised that previous PISA results revealed gaps between young people's knowledge and concerns about environmental issues and their ability and willingness to take action to address them (OECD, 2022).

In 2006, the OECD undertook the first science-focused PISA. Researchers conducted a retrospective analysis of 15-year-olds' competencies related to environmental science and geoscience using data from this assessment (OECD, 2009). This analysis, *Green at 15,* illustrated how 15 year-olds demonstrated some strong knowledge about their environment, and that those who demonstrated this knowledge also performed well across the entire assessment. Those findings suggested that 15-year-olds with competence in environmental science and geoscience were able to perform with competence in most sciences.

The next science-focussed PISA, administered in 2015, included questions more specifically focused on environmental sustainability. Data indicated that, while 15-year-olds understood ideas of sustainability and the complexity of the challenges facing the world, they did not demonstrate competence related to what they could do about those challenges (OECD, 2022). This discrepancy between knowledge and pathways to action was mirrored in the 2018 PISA Global Competencies assessment (OECD, 2020). This apparent lack of agency represented in the data is what motivated development of *Agency in the Anthropocene* as a contribution to the 2025 PISA Science Framework.

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The 2025 PISA will be the first to purposefully assess student environmental science competencies through the lens of agency. Recent escalation of climate impacts (including biodiversity loss and the increasing amplitude and frequency of climate events) undergirds the importance of assessing what 15-year-olds know and can do now and in the future with respect to these challenges. Although many schools are implementing sustainability programmes and some curricula that include climate science (Ben Zvi Assaraf *et al.*, 2024; Dawson *et al.*, 2022), many more are not undertaking efforts that reflect the scale of global change needed. PISA could serve as a motivation to generate the curriculum policy that will enable teachers and schools to educate our future citizens at the scope and scale necessary.

Raising the profile of social-ecological challenges in PISA

In our work on *Agency in the Anthropocene*, we intentionally framed what is happening in the world as social-ecological challenges, rather than simply environmental issues, to ensure that both the cause of these challenges and the responsibility for change is assigned to privileged societies, rather than mistakenly on environments or ecosystems. Within the fields of earth system science, political ecology and interdisciplinary environmental sciences more broadly, environmental issues are often contextualised within this social-ecological systems framing (Colding & Barthel, 2019; Reyers *et al.*, 2018). Developed to draw together ecological and social science principles, scholars in a range of fields — including anthropology, ecology, economics, engineering and political science — initiated this language in the 1970s as they forwarded ideas of coupled human-natural systems (Berkes & Folke, 1998; Ratzlaff, 1970). Increasingly prevalent across diverse contexts, a social-ecological systems approach emphasises the embedded nature of environmental issues, as well as the holistic perspectives necessary to develop solutions.

Social-ecological systems theory is grounded in key principles including that such systems are *interconnected, complex* and *nested* (Ostrom, 2009), with human activities impacting ecological processes, and vice versa. This interconnected nature gives rise to *reciprocal feedback loops*, which contribute to stability — or lack thereof — within systems. These non-linear relationships emphasise *transformability* and *leverage points*, or places within systems where individuals and institutions can be most impactful in responding to crises and challenges (Chan *et al.*, 2020). Relatedly, these systems are *adaptable* and *resilient*, characteristics that emphasise opportunities for shifting the trajectory through individual and collective human actions (Chan *et al.*, 2020; Ardoin *et al.*, 2023).

As work by political scientist, economist and Nobel prizewinner Elinor Ostrom and others (McGinnis & Ostrom, 2014; Partelow, 2018) demonstrate, human action at individual and collective scales is intimately intertwined with environmental processes; hence diagnosing environmental issues and seeking leverage points for change occurs most effectively when undertaken through a complex systems lens. Thus, this social-ecological systems framing is foundational to addressing environmental issues as *human* problems. Centring the human dimension of these problems, framed within the context of the Anthropocene, requires adopting the social-ecological language and key principles, which are rooted not only in natural science, but also in the social sciences, including politics.

Opportunities for social-ecological framing in PISA

As the field of environmental education is inherently inter- and transdisciplinary, our positioning as environmental education scholars participating in the PISA 2025 process drew not only on the natural sciences, but also on the social sciences and humanities. Moreover, our training and onto-epistemological perspectives also motivated us to frame current crises as social-ecological. While the social-ecological systems framing is not so common within science education, we successfully argued for its inclusion in the environmental science supplement, which became part of the

https://doi.org/10.1017/aee.2024.40 Published online by Cambridge University Press

Science Framework 2025. This is because the social-ecological framing includes critical perspectives and lenses, namely an emphasis on human/nature interactions and leverage points for action, or places within a system where institutions and individuals can make a difference in a way that is disproportionately impactful (Chan *et al.*, 2020). Such an understanding is essential to addressing large-scale, pressing socio-ecological challenges such as climate change and biodiversity loss. Similarly, within this framing, rather than using the term "climate impacts" as a standalone, we encourage educators and students to consider the causes of, and multiple complex solutions to, environmental change alongside the opportunities for societal change.

These perspectives led us to argue for the conceptualisation of *Agency in the Anthropocene* (White *et al.*, 2023), in which we describe key competencies that push beyond the boundaries of traditional Western scientific thinking and science education practices (Reyes-García *et al.*, 2019). We emphasise principles of interconnected, complex and dynamic systems, where actions motivate feedback loops and can spark adaptive change (Berkes & Folke, 1998; Reyers *et al.*, 2018). Additionally, we focus on ideas of hope and efficacy, highlighting the ways in which human actions can make a difference. Particularly important within a social-ecological systems frame is to recognise that efficacy requires a combination of knowledge and skills at individual and collective scales (Ostrom, 2009).

In addition to the environmental science competencies, we encouraged inclusion of social-ecological language in the explanation and justification for the Science Framework. This shift in language expands "environment" beyond the ecosystem unit of biology and stresses the importance of an interdisciplinary approach to explaining, understanding and, necessarily, to working to address current challenges through action. We see application of the social-ecological systems language as a political decision to push beyond traditional conceptualisations of environmental issues in science education, contextualising the issues in ways that reflect their nestedness in broader governance and power structures (Muller *et al.*, 2019; Salomon *et al.*, 2019), which is desirable and necessary for today's young people.

Yet, this shift is not without challenges. Given the choice of mathematics, reading, and science as PISA focal areas, social-ecological perspectives most closely align with science. But how many national science education curricula explore and encourage action towards social-ecological challenges, developing learners' competencies to address those challenges? For example, competencies in communication and group collaborative processes, learning about local government and governance more generally, analysing power in decision-making and weighing economic costs of various potential solutions are all critical to preparing students for working on social-ecological challenges. Yet, developing these competencies is rarely considered as the domain of, or comfortable for, science educators. Therefore, a great opportunity exists for environmental educators to offer important assistance for science and other educators interested in fostering the student competencies emphasised in the PISA 2025 Science Framework.

Of course, these stances come with acknowledgement that those societies who have contributed the least to current socio-ecological challenges are often the worst impacted (IPCC, 2023). To ensure that young people have opportunities in their education practices to comprehend the complexity of these challenges, we framed *Agency in the Anthropocene* as strongly as possible to position enactments of science through social lenses. Science education provides a valued opportunity for 15-year-olds to develop competencies about what is happening in our world (Earth's systems) and their role in crafting futures where all species thrive.

Designing items for PISA 2025

Although we were keen to advance interdisciplinary notions of environmental education, we were also cognisant that the product would sit in the PISA Science Framework 2025. Herein occurred

https://doi.org/10.1017/aee.2024.40 Published online by Cambridge University Press

our first challenge: If the environmental science curriculum is structured around content knowledge, such as the biology, chemistry and physics of ecosystem function, it can be easy to ignore issues that arise from human ingenuity. The water cycle, for example, is a science-based process that exists apart from human intervention, but without understanding the broader complexity of various systems and how people influence water use, movement and pollution, young people are disadvantaged in addressing water problems. Because the science education field often takes a position on how science is taught and the intended goals of science education — such as inquiry learning, systems thinking and attracting young people to STEM careers (Carter, 2005; Hurd, 2000) — we endeavoured to use the OECD's commitment to change to expand the vision of science education. By linking environmental issues to social studies, geography and language arts curricula — through the socio-ecological framing — more opportunities exist to develop competencies that prepare young people to build the skills to do something about those issues; such skills include communication, teamwork, interest group analysis and evaluation, among others. In this way, a wider range of teachers and a broader swath of the curriculum can become relevant to PISA science outcomes.

The OECD contracted the Australian Council for Educational Research (ACER) to develop and test items for the two elements of PISA: the cognitive test and the non-cognitive questionnaire. ACER's task was challenging, as PISA assessments do not focus on facts, but rather on students' abilities to interpret information and data, and reach valid conclusions. The cognitive test is delivered through scenario-based problems with 3 to 5 questions for each. (For a science example, see PISA, 2015.) ACER developed new test items to assess socio-ecological challenges, such as energy transitions, invasive or endemic species management, or water conservation and management. The test scenarios often included graphs or figures designed to be relevant to young people on every continent. The questions varied in complexity and provided opportunities to investigate stakeholders' interests and potential consequences. For scenarios rooted in science rather than an issue, test items might address the cost or long-term sustainability of a product.

PISA uses the non-cognitive survey with scale items to assess preferences, attitudes and behaviours. ACER aimed to adopt items to address self-efficacy, hope and personal responsibility in line with the recommended competencies in *Agency in the Anthropocene*. We worked on each of these items to distinguish between future intention and past behaviour; explore potential subjective norms with peers, family members, or others; and add components on collective efficacy with community-based actions. These items were scaled by frequency (*rarely* to *often*), quantity (*none* to *a lot*), importance (*not at all* to *a great deal*), or agreement (*strongly disagree* to *strongly agree*) and will provide researchers opportunities to explore students' actions and opinions with possible correlations to cognitive skills.

The 2025 assessment is likely to be completed in over 90 countries, enabling a variety of analyses to be conducted. OECD researchers and others can compare scores from previous assessments for older items that were retained, or within and among nations. While it would be possible to link population-based science-based cognitive skills to non-cognitive actions, attitudes and preferences, because the constructs are measured in different tests, researchers may analyse these constructs separately. Environmental education practitioners and scholars might query whether such a separation appropriately reflects and adequately assesses the reality of our work with young people as the environmental education field tends to convey attitudes in the context of knowledge. With renewed interest in indigenous knowledges, for example, the line between cognition and emotion/beliefs has become even more porous. In such instances, we wonder to what extent do PISA's forward-thinking efforts to engage with socio-ecological challenges remain constrained by the existing assessment tools?

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Leveraging curriculum as a political process

Given these opportunities and constraints, how might environmental education practitioners and scholars engage with PISA as a political process to leverage curriculum and wider education concerns? And to what extent should we do so? Some educators and scholars argue that such engagement with PISA risks hegemonising the educational agenda (Engel *et al.*, 2019; Lewis, 2020), running counter to the espoused environmental education vision of being democratic, inclusive and critical. Some scholars have raised concerns that tools such as PISA can lead governments to reform policies in ways that fit conveniently into a neoliberal agenda fostered by the ranking of countries (Engel *et al.*, 2019). This has been argued to emphasise competitiveness within a globalised world and, combined with the focus of PISA on competencies, which are (supposedly) non-aligned to a specific country/orientation/knowledge system, can promote a search for causality of education "success" based on a flawed assumption of homogenous systems and cultures (Lewis, 2020). These emphases challenge environmental education's philosophical approaches, which are inherently collegial and collective (Chawla & Cushing, 2007), and increasingly recognise the place-based significance of indigenous and other local knowledges (Muller *et al.*, 2019).

These words of caution help us consider an aspect of PISA's underpinning philosophy that education is crucial for economic development, rather than focussing on other goals or considerations, such as environmental health. Moreover, concerns arise that leveraging PISA could perpetuate the authority of the powerful (Sjøberg & Jenkins, 2022) through its focus on workforce development, and that PISA continues to decontextualise environments and marginalise societies. PISA has also been criticised for being portrayed as *the* way — rather than *one* way — to understand how young people are ready to meet the challenges of the future (Zhao, 2020), with additional concerns arising that its outcomes have been used to influence education policy (Grek, 2009).

While recognising and appreciating these concerns, we suggest that opportunities also exist through engagement with the PISA process. First, we celebrate the OECD's recognition of the need for a greater focus on students' competencies related to socio-ecological challenges (OECD, 2022). We also appreciate the willingness of our science education colleagues to engage with the *Agency in the Anthropocene* (Authors, 2023) competencies. Conversations related to these concepts have opened the door to a greater focus on environmental education and to appropriately frame socio-ecological challenges in PISA.

Second, as a consequence, the outcomes of PISA 2025 can help education policymakers within participating countries gauge their students' environmental competency levels, both with respect to their own curricula and as a benchmark against other countries. Such avenues have been shown to be effective political tools with regard to numeracy and literacy (She *et al.*, 2018; Suna *et al.*, 2020), with governments and other interested parties using the data for lobbying and decision-making. The provision of these data by the PISA process gives environmental educators some ready-made tools for their advocacy.

Third, the inclusion of competencies related to socio-ecological challenges in each nation's dataset raises the profile of these challenges, thus potentially influencing educational policy-making and curriculum development. *Agency in the Anthropocene* emphasises that these competencies are a rich blend of knowledge, concern and action infused with hope and inclusivity, which has two important implications for educational practice. In fostering these competencies, schools and other educational institutions will be encouraged to take an interdisciplinary approach to teaching and learning. This may, in some cases, require substantial structural changes and professional learning. For example, while geography teachers may be quite comfortable with this interdisciplinary focus (Meadows, 2020; Mitchell, 2023; Yli-Panula *et al.*, 2020), and some science teachers might be willing to branch out as they address socio-scientific challenges, others might create teams of social studies and science educators who collaborate (Sadler, 2011).

https://doi.org/10.1017/aee.2024.40 Published online by Cambridge University Press

Educators must also work towards developing student agency by using examples of how others bring about resolutions to socio-ecological challenges, engaging in skill-building exercises and community action projects. This positions students as political actors who have a stake in their futures and encourages educators to engage with pedagogies that embrace this approach. The recent school strikes for climate illustrate how challenging political activism can be for schools and their communities (Garner-Randolph, 2023), but including *Agency in the Anthropocene* in PISA provides some mandate for doing so.

Concluding thoughts: PISA as a political tool for change

We recognise a delicate balance for environmental educators in engaging with PISA. On the one hand, it can provide a lever for environmental education to gain a voice for change in national (and international) educational politics (Kaya & Elster, 2018), offer a vehicle for research (Anderson *et al.*, 2007), and foster subsequent advocacy. The OECD's Learning Compass (OECD, 2023), for example, claims to be an "Aspirational vision for the future of education." Curriculum writers around the globe consider this tool as they look to design curricula that enable students to perform well in PISA. Including *Agency in the Anthropocene* concepts and competencies brings environmental education pedagogies and practices into the educational curriculum and, more specifically, into science. This is a position of power not afforded to environmental education since the Decade of Education for Sustainable Development.

On the other hand, environmental education risks becoming co-opted and diluted through the assessment process, disenfranchised through restricted interpretation of data, or dismissed as irrelevant by policy makers in the face of other perceived educational challenges such as mathematics outcomes (Arzarello *et al.*, 2015). It also positions the endeavour at the potential mercy of economic development (Lewis, 2017), whose goals may run counter to those of environmental education. Additionally, PISA's testing structure makes it challenging to assess some non-cognitive attributes, leading to outcomes that can only as yet give a partial understanding of young people's agency in the Anthropocene.

By inviting environmental educators to participate in framing the 2025 PISA science assessment, the OECD has brought us to the table. We have attempted to leverage this opportunity to engage politically in the potential power of PISA. There are risks and the journey has included negotiation and compromise; however, with careful attention to the goal of a sustainable future always in mind, this process could provide one lever for greater engagement in environmental education around the world. The ultimate goal is, of course, increased agency among young people that leads to more sustainable futures for all.

Acknowledgements. We acknowledge the kind invitation and support from the OECD to participate in PISA 2025.

Financial support. The authors were contracted by the OECD to develop "Agency in the Anthropocene". No funding was provided for the development of this manuscript.

Ethical standard. Nothing to note.

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Cite this article: Eames, C.W., Monroe, M.C., White, P.J., & Ardoin, N.M. (2024). Engaging Environmental Education Through PISA: Leveraging Curriculum as a Political Process. *Australian Journal of Environmental Education* **40**, 601–611. https://doi.org/10.1017/aee.2024.40