Education and environmental sustainability: culture matters

Hikaru Komatsu
*International Degree Program in Climate Change and Sustainable Development,
National Taiwan University, Taipei, Taiwan*

Iveta Silova
*Mary Lou Fulton Teachers College, Arizona State University,
Tempe, Arizona, USA, and*

Jeremy Rappleye
Faculty of Education, Graduate School of Education, Kyoto University, Kyoto, Japan

Abstract

Purpose – Humans remain unsuccessful in their attempts to achieve environmental sustainability, despite decades of scientific awareness and political efforts toward that end. This paper suggests a fresh conceptualization, one that focuses on education, offers a fuller explanation for our lack of success and calls attention to alternatives.

Design/methodology/approach – The authors first critically review mainstream approaches that have been used to achieve environmental sustainability, then introduce an alternative that the authors call the cultural approach. The authors finally discuss how educational research should be re-articulated based on the cultural approach.

Findings – The authors identified three mainstream approaches – the technological, cognitive approach and behaviorist – all of which function to reproduce modern mainstream culture. In contrast, the cultural approach assumes modern mainstream culture as the root cause of environmental unsustainability and aims to rearticulate it. To elaborate a cultural approach, the authors recommend education scholars to (1) bring attention to the role of culture in sustainability and (2) identify education practices that are potentially useful for enacting a cultural shift, primarily developing richer synergies between qualitative and quantitative research.

Originality/value – Unlike many previous studies in the field of education, the authors' account highlights how current mainstream approaches used for current global education policymaking often merely reproduces modern mainstream culture and accelerates the environmental crisis. It thus proposes to redirect educational research for a cultural shift, one that allows human society to move beyond the comforting rhetoric of sustainability and face the survivability imperative.

Keywords Anthropocene, Cultural psychology, Individualism, Ontology, Self-construal, Survivability

Paper type Research paper

1. Introduction

Warnings about environmental unsustainability have been widely discussed since the 1960s and 1970s. For example, *The Limits to Growth* provocatively suggested that human society

would face environmental catastrophe (e.g. drastic decline in population and human welfare) if it continued along its existing trajectory (Meadows, Meadows, Randers, & Behrens, 1972). This and other classic texts in environmental studies provided new concepts to rethink issues around environmental sustainability, all aimed to induce changes in human behavior towards that end.

In the intervening 50 years, humans have exerted much effort in changing their collective trajectory, attempting to steer it away from environmental catastrophe (e.g. Glavovic, Smith, & White, 2022). Natural scientists and education scholars and practitioners have successfully disseminated scientific information related to environmental problems. Engineers have improved energy and resource efficiency relative to economic output. These efforts have been matched by various international agreements, all adopted with the aim of reducing humans' environmental impacts (e.g. the Paris Agreement in 2015).

Despite these achievements, humans have remained woefully unsuccessful in achieving environmental sustainability. As Glavovic *et al.* (2022) note, "the tragedy of climate change science is that at the same time as compelling evidence is gathered, fresh warnings issued and novel methodologies developed, indicators of adverse global change rise year upon year" (p. 1). O'Neill, Fanning, Lamb and Steinberger (2018) comprehensive study found that all countries in the Global North exceeded biophysical limits of Earth in multiple ways, despite the fact that most of the vocal proponents of sustainability emanate from the North. The United States exceeded all seven biophysical limits considered in this study. Even Germany, a country with a strong tradition of environmentalist thought, exceeded five of the seven biophysical limits. Disappointingly, human achievements over the past half century are too small to be detected using quantitative data at a global scale. Empirical studies have confirmed that historical data at a global scale matched best with the business-as-usual scenario of *The Limits to Growth* created more than 50 years ago (Turner, 2012; Herrington, 2021).

Why are we failing to achieve environmental sustainability? What approaches have we been using to avert our environmental catastrophe trajectory? Why haven't our existing approaches worked? Are there any alternatives? These are some of the most important questions that scholars and practitioners can ask in our era of heightened awareness of the environmental crisis. Our own approach focuses on education, broadly conceived. Education includes not only practices implemented in formal education settings, but all learning-related activities that function to reproduce and redirect human society toward particular goals (Bowers, 1995).

This paper aims to address these questions. We critically review mainstream approaches that have been used to achieve environmental sustainability (Section 2). We then introduce an alternative approach that we call *the cultural approach* (Section 3). This approach assumes that the root cause of our unsustainability is mainstream modern culture, particularly the dominant concept of selfhood. From the perspective of the cultural approach, we suggest that mainstream approaches have been unsuccessful to mitigate the environmental crisis because these largely function to reproduce modern selfhood. In line with this, the cultural approach seeks to shift this modern selfhood for greater sustainability. As an extension of this core project, we discuss how educational research could be re-articulated based on the premises of the cultural approach (Section 4).

2. Mainstream approaches
This section reflects on the dominant approaches used to address sustainability challenges. For conceptual clarity, we roughly classify human efforts into three dominant approaches, which we respectively label as the technological, cognitive and behaviorist. While each of these groups contain variations, each is rooted in a particular way of viewing the relationship between humans ("Modern Man") and nature.

2.1 Technological approach

The basic assumption of the first two approaches is that humans are intelligent, that is, creative, rational and autonomous (see Table 1) – an assumption rooted in Western Enlightenment thoughts. Western Enlightenment thinkers such as Kant posited this new model of Modern Man, declaring *Sapere Aude!* wherein men would mature by coming to autonomous reason, rather than rely on tradition. Unlike the past where humans merely followed God's orders, Modern Man was expected to create an ideal society with his own will, reason and power.

The technological approach highlights human creativity and mastery among various dimensions of Modern Man. This approach assumes that human creativity enables the development of innovative technologies for extracting unused earth resources and managing them more efficiently. One previous attempt based on this approach was the development of nuclear energy generation, which was once regarded as one major solution for our increasing energy demand. For example, the United States planned to replace fossil fuel energy generation with nuclear energy generation in the 1960s (IAEA, 1997). To this end, the United States invested much in science education at the secondary-school level and scientific and engineering research at the university level (President's Science Advisory Committee of the United States, 1960). However, repeated international accidents (e.g. The Three Mile Island Accident in 1979, the Chernobyl disaster in 1986 and the Fukushima disaster in 2011) demonstrated the risk of nuclear energy generation and prevented the plan from being realized (IAEA, 1997).

As this example suggests, the technological approach is not always successful. More importantly, technology that once appeared to be successful often proved to cause other problems. Notwithstanding, the technological approach still has a great number of supporters, including luminaries such as Bill Gates. Asked whether it is too late to stop the climate crisis, Gates (2020) responded in a recent podcast:

> No. The same kind of innovation that got us into this where we invented electricity and cars, that it had brought so many benefits, that same kind of innovation power accelerated will let us do those things but in ways that don't emit greenhouse gases... We are smarter today than ever and a lot of great people are working on these solutions.

Although Gates may sound overly optimistic, the assumption of the technological approach is actually widely shared in policymaking circles. Both international organizations (e.g. the Organisation for Economic Co-operation and Development, OECD) and national governments adopt Green Growth as a major policy, assuming that investment in technology will enable technological innovation that reduces human environmental impact while simultaneously sustaining economic growth (see Wiedmann, Lenzen, Keyßer, & Steinberger, 2020). In response to this political trend, many countries are strengthening science, technology, engineering and math (STEM) education to secure a workforce capable of driving Green Growth (e.g. Maclean, Jagannathan, & Panth, 2018; Mochizuki, 2019).

Approach	Assumption	Behavioral change of the ordinary public	What brings sustainability
Technological	Modern man is intelligent (creative)	Unnecessary	Innovative technologies
Cognitive	Modern man is intelligent (rational and autonomous)	Necessary	Dissemination of scientific information
Behaviorist	Humans behavior aims for self-preservation	Necessary	Institutions providing rewards and punishments

Table 1.
Mainstream approaches for sustainability

Unfortunately, recent research underscores that celebrations of Green Growth strategies fall far short of the scale of changes required (Hickel & Kallis, 2020).

2.2 Cognitive approach

The cognitive approach also assumes that humans are intelligent, but it differs from the technological approach in two respects (Table 1). First, the cognitive approach assumes that behavioral change among the wider public is essential. Second, the cognitive approach highlights rationality and autonomy of Modern Man, rather than creativity of the Modern Man. The cognitive approach assumes that human rationality and autonomy allow the ordinary public to change their behavior and lifestyle once they are presented with scientific information about potential future scenarios (e.g. environmental crisis).

This cognitive approach has been widely implicit in the work of the majority of scientists, policymakers and education scholars and practitioners. One major example is the Intergovernmental Panel on Climate Change (IPCC), which states on its official webpage that "the objective of the IPCC is to provide governments at all levels with scientific information that they can use to develop climate policies" (IPCC, 2021). The IPCC thus implicitly assumes that dissemination of scientific information will change behavior of national governments and eventually the minds of the ordinary public as well. The same assumption is also found in *The Limits to Growth* (Meadows *et al.*, 1972). The foreword of *The Limits to Growth* explains why the Club of Rome published their warning:

> We hope that it [*The Limits to Growth*] will encourage each reader to think through the consequences of continuing to equate growth with progress. And we hope that it will lead thoughtful men and women in all fields of endeavor to consider the need for concerted action now. . .. (p. 12)

Hence, there is a belief that the dissemination of scientific information will catalyze change in human behavior for greater sustainability because Modern Man is assumed to be rational and autonomous. Indeed, *The Limits to Growth* explicitly states that "Man possesses, for a small moment in his history, the most powerful combination of knowledge, tools and resources the world has ever known" (p. 183–184).

The same cognitive approach is also widely used in education to raise environmental awareness of the ordinary public. Current curriculum at all levels – from general schools to universities – usually covers environmental problems, albeit in varying degrees (OECD, 2009; International Association for the Evaluation of Educational Achievement, 2017). This partially helps explain the fact that most people in the world, except those in countries with limited education opportunities, are aware of environmental problems including the climate crisis (Lee, Markowitz, Howe, Ko, & Leiserowitz, 2015). However, environmental awareness does not always translate into changes in lifestyle, a problem largely overlooked by those working within a cognitive approach. This problem will be discussed in the next section.

2.3 Behaviorist approach

The behaviorist approach attempts to induce behavioral change of the ordinary public, similar to the cognitive approach (Table 1). However, the behaviorist approach differs from the cognitive approach (and technological approach) in that it does not assume that humans are intelligent. Rather, the behaviorist approach assumes, building on Darwin, that Modern Man is, at root, qualitatively the same as animals: both have a strong drive for self-preservation. The behaviorist approach thus attempts to change the behavior of the wider public by creating institutions (e.g. laws) that provide reward and punishment.

One representative figure of this approach is Burrhus Frederic Skinner. Skinner (1971) first deviated from the technological approach by saying that "[a]lmost all major problems involve human behavior, and they cannot be solved by physical and biological technology alone"

(p. 29). Skinner thus sought behavioral change among the public by the stimulus given to humans from the social environment, as opposed to relying on human rationality and autonomy.

The behaviorist approach has been used widely for achieving sustainability, although this approach is far less popular than the technological and cognitive approaches in the area of education. Indeed, there are numerous national laws and international agreements for conserving the environment and promoting sustainability. One representative example is the Kyoto Protocol, an international agreement adopted in 1997 to reduce carbon dioxide and other greenhouse gas emissions. This agreement was different from its precursors in that it mandated binding commitments of participant countries. The Kyoto Protocol sought to impose penalties on countries that exceed their allowed greenhouse gas emission quota, because "there was a clear understanding by almost all parties... that the voluntary approach had proven to be inadequate and that hard, verifiable, and enforceable obligations were absolutely necessary" (Ott, 1998).

Although participating countries collectively achieved the Kyoto Protocol target, the Kyoto Protocol contributed little to the reduction in carbon dioxide and other greenhouse gas emissions. The achievement of the target was mainly attributed to the economic recession and reduction in greenhouse gas emissions for Russia and Ukraine after the collapse of the Soviet Union (Circular Ecology, 2015). Additionally, compliance with the Kyoto Protocol did not succeed in keeping the global temperature rise to below 2 degrees because the Kyoto Protocol reduction target was too modest (Rosen, 2015). One factor underlying the ineffectiveness of the Kyoto Protocol is that no one has the free hand in designing the institutions (i.e. setting targets). The designer thus needed to compromise, designing institutions that would not greatly conflict with the dominant culture of society. The Kyoto Protocol's modest reduction target with a neo-liberal style emissions exchange market is one consequence of such compromise (Ott, 1998; Rosen, 2015).

3. An alternative approach: the cultural approach
3.1 Basic idea of the cultural approach
Despite the efforts to achieve environmental sustainability – mainly through the three approaches sketched above – humans have remained unsuccessful in changing their catastrophic trajectory. As such, there is a continued need to explore alternatives. We call the alternative proposed here *the cultural approach*. This approach has yet to be deeply engaged, let alone mainstreamed. Yet, it has a long, rich history. The cultural approach was originally proposed approximately 50 years ago by scholars in the humanities, primarily philosophers, historians and sociologists (e.g. White, 1967; Naess, 1973). Similar to the cognitive and the behaviorist approaches, the cultural approach assumes that behavioral change of the ordinary public is necessary for achieving sustainability. However, the cultural approach aims to induce this behavioral change through shifting modern mainstream culture (Table 1). The basic assumption here is that the root cause of our environmental problems is modern mainstream culture. According to White (1967), modern mainstream culture has indeed inherited a particular attitude towards nature, one derived out of early Judaism and further elaborated through Christianity.

To clearly understand the cultural approach, it is necessary to clarify the key differences between the behaviorist approach and the cultural approach. The behaviorist approach explains human behavior based on human tendency for self-preservation. The behaviorist approach thus assumes a direct relationship between human behavior and human tendency for self-preservation. The cultural approach argues that although human behavior can be rooted in human tendency for self-preservation, culture mediates these two. The cultural approach thus assumes that different groups of people with different cultures behave

differently, even under the same conditions. The cultural approach then asserts that modern mainstream culture is one major obstacle to achieving sustainability and therefore shifting the culture is essential to changing behavior among the public for greater sustainability.

The cultural approach differs from the cognitive approach in that it recognizes a diversity of cultures. In contrast, the cognitive approach assumes the universality of modern culture, or its correlate: the "backwardness" of pre-modern or a-modern culture(s). That is, according to the cognitive approach, if one finds a different culture, it should be an immature form and will inevitably give way to modern culture.

3.2 Self as focal field

The cultural approach primarily focuses on the concept of self, as a core component of culture, one that impacts all aspects of life. Founders of the cultural approach collectively and consistently suggested that our behavior is affected by how one conceptualizes the relationship between self and other, including nature (White, 1967; Naess, 1973). White (1967), for example, stated that "what we do about ecology depends on our idea of the man-nature relationship" (p. 1206). Founders of the cultural approach often differed in their emphasis. Some highlight whether one's self is viewed as independent or interdependent with others (including with nature), whereas others highlight whether one is superior to other non-human beings. The former point is more fundamental than the latter. If one believes in interdependence of oneself with others, the latter hierarchical mode does not make sense. The reason is that interdependence assumes the indivisibility of one's self from other beings.

The founders of the cultural approach in the 1960s and 1970s lacked models to clearly explain their former point. However, since the 1990s psychologists have developed such models to describe different concepts of self. These models are classified into two types: models focusing on the relationship between oneself and other humans (e.g. Markus & Kitayama, 1991) and models focusing on the relationship between oneself and nature (e.g. Restall & Conrad, 2015). All these models share one important element, i.e. the openness of the self to others (Lee, Ashton, Choi, & Zachariassen, 2015). We thus do not distinguish these two types of models in this paper and use the terms *the independent self* and *interdependent self* consistently.

What are the independent self and interdependent self? An individual who has an independent self assumes that the basic unit of the world is an atomized element, usually predicated on an essential core. One's self has its own boundary and the selves of others have their own boundaries (solid circles in Figure 1a). One's self and those of others have no overlapping areas. Consequently, one assumes that one's self exists independently from others and that the self then creates relationships with others in accordance with one's own necessity and desires. That is, relationships with others are assumed to be secondary. Individual agency is paramount. The task for such an individual is therefore to pursue one's own goal.

In contrast, an individual who has an interdependent self assumes that relationships rather than entities are the constituent elements of the world. One's self and those of others do not have clear boundaries (dotted circles in Figure 1b) and these overlap each other. That is, one's self and those of others are assumed to co-arise with the relationships among these entities and therefore entities are ontologically inseparable from webs of relations. The task for such an individual is therefore to pursue collective attainment and co-agency. To effectively use these concepts of the independent self and interdependent self, it is important to note that these models are heuristic tools and no one can be either completely independent or interdependent (Kasulis, 2002).

Using these concepts, we can now rephrase what the founders of the cultural approach asserted. The founders meant that modern mainstream culture valorizes the independent self,
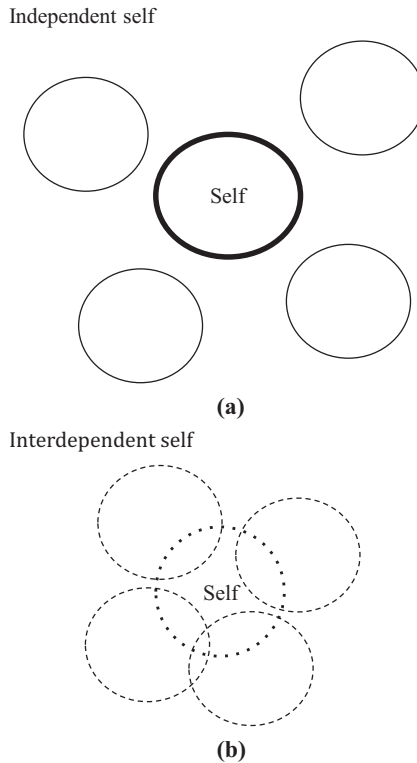
Independent self

Self

(a)

Interdependent self

Self

(b)

Figure 1.
Schematic drawings of
(a) the independent self
and (b) the
interdependent self

Source(s): Adapted from Markus and
Kitayama (2010)

a mode of selfhood that blinds people to environmental changes and prompts people to pursue their own individual goals and interests. The founders thus wanted to propose shifting the dominant concept of self from the independent one to the interdependent one. Indeed, Naess (1973) viewed "the man-in-environment image" as one major cause of the environmental problems and then proposed to replace this image with "the relational, total-field image". These terms correspond to the independent and interdependent self in our terminology.

The cultural approach, which aims to shift the mainstream culture, is often critical of the mainstream approaches we have reviewed above. The reason is that those approaches often function to reproduce and even reinforce the mainstream, modern culture. Indeed, those mainstream approaches all assume and valorize the independent self. The technological approach and the cognitive approach (i.e. the approaches widely used in the area of education) assume that it is not necessary for an individual to learn to attune to the webs of human and more-than-human relations. Rather, these approaches assume that individuals should develop more innovative technologies, manage natural resources more efficiently and/or change their behavior in more autonomous and independent ways. The behaviorist approach does not assume such a modern concept of self, but it still insists that an individual should maximize her/his own benefits rather than work towards collective ones. The cultural

approach thus views these mainstream approaches as components of the unsustainability problem itself (Komatsu, Rappleye, & Silova, 2019, 2020; Silova, 2019, 2021; Sterling, 2021). This does not mean that the cultural approach rejects or downplays the importance of innovative technology, science and institutions. The cultural approach recognizes their importance, but it critically questions whether innovative technology, science and institutions can affect the necessary shift in mainstream culture. Importantly, the cultural approach warns instead that these mainstream approaches simply reproduce the very culture that has brought about the environmental crisis itself.

*3.3 The cultural approach coming to the fore*
An increasing number of scholars and practitioners have begun to recognize the importance of the cultural approach (e.g. Plumwood, 1993; Bowers, 1995). These scholars include the authors of *The Limits to Growth* who originally employed the cognitive approach as their main strategy. These authors call their original attempt to change human behavior through the cognitive approach as "youthful optimism" (Randers, 2012, p. xv) and now highlight the importance of shifting culture for achieving sustainability (Meadows, Randers, & Meadows, 2004, p. 283).

To make the cultural approach more recognizable, scholars in psychology have been playing an increasingly important role. Psychological studies have reported quantitative evidence for the importance of culture. For example, Arnocky, Stroink and DeCicco (2007) reported that individuals with the independent self tend to show only egoistic concern (i.e. concern about environmental degradation because of the negative impact it will have on oneself) instead of ecocentric concern (i.e. concern about environmental degradation because humans are a part of nature). Martinsson, Myrseth and Wollbrant (2012) and Chuang, Xie and Liu (2016) reported that individuals with the independent self tend to less effectively control their own desire for the sake of social and ecological benefits. Consequently, individuals with the independent self tend to engage in pro-environmental behavior (e.g. sorting garbage and driving less) less frequently (Chuang *et al.*, 2016; Davis & Stroink, 2016; Komatsu, Fu, *et al.*, 2022).

Recently, several studies reported data suggesting that the concept of self affects not only people's pro-environmental behavior, but actual environmental impacts, including carbon dioxide emissions and Ecological Footprint (Komatsu *et al.*, 2019, 2020, 2021; Komatsu, Rappleye, & Silova, 2022). Komatsu *et al.* (2019) discovered that countries where the dominant form of self is independent tend to have higher Ecological Footprint (Figure 2a). Importantly, these findings partially support the hypothesis posited by White (1967). In countries with strong Christian traditions, independent selfhood is more prevalent (i.e. high individualism scores) and environmental impacts are high (i.e. high Ecological Footprint).

Additionally, the 2020/2021 coronavirus pandemic provided an opportunity to recognize how individuals with different cultural orientations respond to the same crisis in different ways (Rappleye, Komatsu, & Silova, 2021). We found that countries where the dominant form of self is the independent self tend to have higher death rates (Figure 2b). These countries often insist on prioritizing individual freedoms (e.g. the US and the UK) and downplay basic public health measures (e.g. wearing facemasks). In contrast, countries where the dominant form of self is not independent prioritize collective action over individual freedoms by not delaying economic shutdowns, mobility restrictions and social distancing mandates (e.g. Taiwan, Vietnam, South Korea and China).

The importance of culture is now increasingly recognized by international and national organizations (UNESCO, 2016, 2020a, b). UNESCO's 2016 Global Education Monitoring Report is arguably the first report published by a major international organization that casts strong doubts on the existing mainstream, modern education paradigm and urges to learn
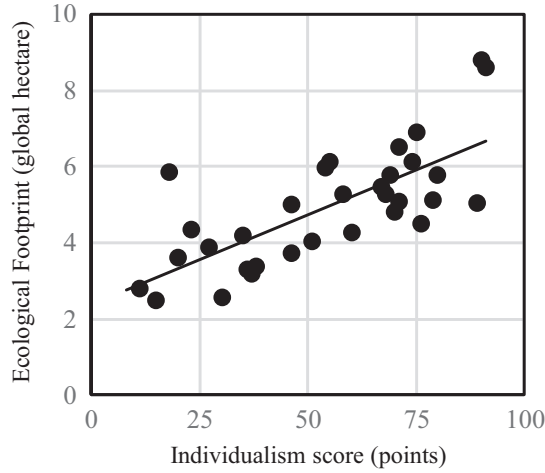
Source(s): Adapted from Komatsu *et al.* (2019)

(a)
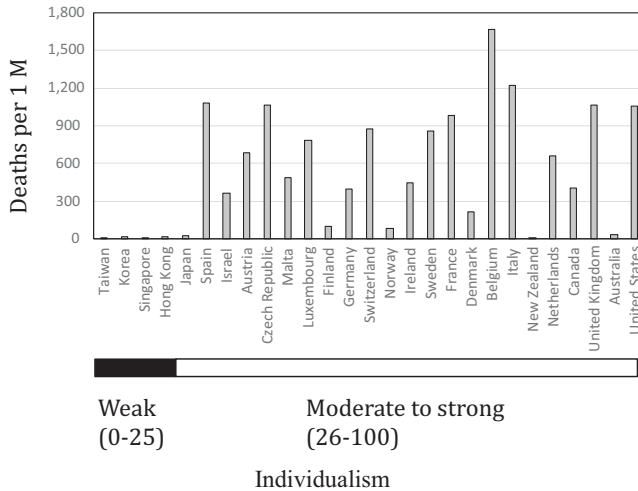
Source(s): Adapted from Rappleye *et al.* (2021)

(b)

from the Global South with different cultures. One recent UNESCO report admits the failure of the mainstream education paradigm using stronger words:

What we know, what we believe in and what we do needs to change.

What we have learned so far does not prepare us for the challenge.

This cannot go on. And the window of opportunity is closing fast.

We must urgently learn to live differently. (UNESCO, 2020a, p. 6)

Importantly, this UNESCO report views Sustainable Development Goal (SDG) 4.7 as the key goal among others in SDG 4 (education). SDG 4.7 differs from other goals in that it aims to transform, rather than extend, existing education through shifting culture. Another recent UNESCO report asserts that education should be transformed to cultivate humans' interdependence with nature, place and other beings (UNESCO, 2020b, p. 44). The direction indicated in these reports resonates strongly with one proposed for decades by proponents of a cultural approach.

4. Ways forward
Despite the potential and growing recognition, the cultural approach has neither been widely used nor clearly visible in global education policymaking. As explained above, UNESCO reports mention the importance of shifting mainstream culture. However, this has yet to become UNESCO's official position. Indeed, all the UNESCO reports cited above explicitly state that "[t]he ideas and opinions expressed" in the reports "are those of the authors; they are not necessarily those of UNESCO and do not commit the Organization". Other powerful organizations such as the World Bank and the OECD have failed to recognize the importance of culture for sustainability (Komatsu, Rappleye, & Silova, 2020).

Indeed, one central policy declaration created th   the collaboration of leading international organizations including UNESCO, the World Bank and others (Education, 2030 *Incheon Declaration and Framework for Action*) makes no mention of the necessity of shifting culture for sustainability (World Education Forum, 2015). This declaration identifies education as the way towards Sustainable Development Goals (SDGs), not questioning the success of previous global education policy by saying that "[t]he world has made some remarkable progress in education since 2000, when the six Education for All (EFA) goals and the Millennium Development Goals (MDGs) were established" (p. 22). The document asserts the necessity to "complete the unfinished agenda" (p. 22). It thus makes sense that both SDGs and Education 2030 actually emphasize access and quality of education (i.e. literacy and numeracy skills, p. 30) over environmental sustainability.

The implicit assumption here is that thorough implementation of the existing education paradigm, one focusing on knowledge and skills, would be sufficient to prepare students to contribute to sustainability. This assumption approximates those of the technological approach and cognitive approach: having been schooled in modernity, Modern Man can then achieve sustainability through their creativity, rationality and autonomy. We should recall here that this assumption has already been widely used but has failed to make sustainability a reality.

4.1 Recommendation #1: Bring attention to the role of education in transforming culture
To mainstream the cultural approach, what should education scholars and practitioners do? The first task is to keep bringing attention to the role of culture in sustainability. As discussed in this article, human habits and behaviors are difficult to change, because they entail altering culture, including attitudes, norms, values, incentives, ethics and politics at the personal, community and national levels (Castree, 2016; Overland & Sovacool, 2020). This requires both shifting research priorities, as well as transforming curricula and pedagogies in education institutions at all levels.

While a small number of education scholars and practitioners had attempted to bring attention to the role of education in cultural transformation before, more and more scholars and practitioners have recently joined this effort (e.g. Silova, Rappleye, & Komatsu, 2019; Vargas Roncancio *et al.*, 2019; Common Worlds Research Collective, 2020; Takayama, 2020). For example, Vargas Roncancio *et al.* (2019) analyzed textbooks (ones in law and governance,

economics, environmental sciences and animal husbandry) commonly used in North American universities and found that virtually all textbooks implicitly assume independence of human society from nature. In the textbooks, nature is either simply ignored or merely regarded as a resource to produce goods and services to benefit humans. Universities in North America are thus functioning to reproduce and reinforce human independence from and superiority over nature. Komatsu, Rappleye and Silova (2021) suggested that student-centered learning, which is deeply rooted in Christian narratives-turned-Western Enlightenment ideas, encourages students to pursue their own interests autonomously and independently and therefore reproduces the dominance of the independent selfhood and prevents us from achieving environmental sustainability. Komatsu and Rappleye (2017), Rappleye and Komatsu (2017), Komatsu *et al.* (2019) and Komatsu, Fu *et al.* (2022) also proposed several alternative pedagogies that promote interdependence over independence. Building on and expanding these efforts of problematizing a dominant form of education from a cultural perspective will be necessary until education policymakers clearly recognize the importance of shifting modern culture.

To support research on education from a cultural perspective, research funding priorities should be drastically rethought. For too long, science, technology, engineering and mathematics (STEM) subjects have dominated research on the environmental crisis (Castree, 2016). Social sciences received only 0.12% of all research funding related to climate change during 1990–2018 (Overland & Sovacool, 2020). This runs counter to the fact that the environmental crisis is getting more serious with time, despite drastic improvements in human knowledge on the environmental crisis in recent decades. We must now pay attention to the more urgent problems – "how to get people to act on what they know, that is to say, how to alter society to mitigate climate change" (Overland & Sovacool, 2020, p. 1). These problems require serious reconsideration of the role of culture. Educational researchers and practitioners alike can use this sort of argument to obtain competitive research funds in the field of interdisciplinary sustainability, developing projects to explore pathways for cultural transformation.

4.2 Recommendation #2: Identify education practices for a cultural shift
Another major obstacle to mainstreaming the cultural approach is our limited awareness of education practices that enable a cultural shift necessary for sustainability. This is perhaps why the UNESCO reports that emphasize the importance of shifting culture rarely make concrete methodological and practical recommendations for the cultural shift (UNESCO, 2016, 2020a, b).

We thus encourage education scholars and practitioners to identify education practices that are potentially useful for enacting a cultural shift. Specifically, we recommend increasing the quantity and quality of research that identifies, documents and shares alternative education practices. To improve the quality of research, it is useful to understand the following two shortcomings of currently available studies.

First, many studies fail to provide the whole picture of the education practices. The description of the target education practices is often thin and therefore difficult to understand (e.g. Braun & Dierkes, 2017; Mullenbach, Andrejewski, & Mowen, 2019). For example, one widely-cited study allocated less than one page for the explanation of the practices used in an education program (Braun & Dierkes, 2017). Here is one excerpt from the explanation in Braun and Dierkes' (2017) paper:

> Both one-day and five-day environmental program were conducted by environmental teachers. . . . While trekking the rainforest with the field biologists, searching, collecting, examining and determining plant and animal species students learned about ecosystem ecology and natural heritages. Students participating in the residential program stayed with the staff at a resort for five

days undertaking various trips into the rainforest whereas students of the one-day sample made a singular full-day field trip to the rainforest. . .. (pp. 4–5)

Although this is a good summary of the program, this description does not offer readers a clear image or understanding of the education practices used in the program. If this paper had included information about learning materials used in the program, teachers' concept of nature-human relationships, pedagogical approaches and what shifts in selfhood emerged from these lessons, it would have been even more useful for readers.

To investigate these various components and describe education practices holistically, the methodology used in ethnographic studies can help. Ethnographic studies, which are often used in the field of comparative education, describe not only education practices of an education program independently, but the relationships between education practices and other elements including teachers' beliefs and intentions, teacher-student relationships, learning materials and their underlying philosophy and more (e.g. Tobin, Hsueh, & Karasawa, 2009; Hayashi, 2022). Although comparative education has paid limited attention to sustainability, the methodology developed in the field will help analyze education practices holistically to enable a cultural shift for greater sustainability (Rappleye & Komatsu, 2020).

Second, the effectiveness of education practices for a cultural shift toward sustainability has yet to be thoroughly examined in most research (Silova et al., 2019). Many studies examining education practices for a cultural shift use qualitative measures such as the ones based on students' self-reporting (e.g. Frank, Fischer, Stanszus, Grossman, & Schrader, 2021). Although qualitative measurements have their own advantages, using quantitative measures along with qualitative measures allows clear demonstratation of the effectiveness of the target education practice for shifting culture and then facilitates uptake by policymakers.

To examine the effectiveness of education programs for a cultural shift, we may wish to incorporate quantitative measures developed by psychologists (e.g. Singelis, 1994; Restall & Conrad, 2015). Using such measures, several studies have been already successful in quantitatively assessing the effectiveness of an education program (e.g. Liefländer, Fröhlich, Bogner, & Schultz, 2013; Braun & Dierkes, 2017). We thus hope that education scholars and practitioners in other fields of education might consider using quantitative measures for their studies. Using quantitative measures has another major advantage: they help in conducting meta-analyses to distill lessons from different case studies. This is particularly important, considering that findings from different case studies are often diverse.

We encourage education scholars and practitioners to develop methodological approaches that use qualitative and quantitative approaches in a complementary, synergetic way. We find a divide in the field of education unproductive. Scholars who are familiar with qualitative approaches (e.g. ethnography) often criticize quantitative measures for failing to capture a certain dimension of education practices. Those who are familiar with quantitative approaches criticize qualitative approaches for lacking analytical rigor and generalizability. These two groups should collaborate and develop new quantitative measures that capture the target dimension of education practices elaborated by qualitative studies. This collaboration aims not only to translate academic findings into policy making, but also to remake our existing vocabulary to articulate possible education trajectories. The assumption here is that education scholars are currently part of the unsustainability problem. Unlike the behaviorist approach, we cannot assume that scholars observe the problem objectively and shift the mainstream culture from the outside. We need to create a new language and remake our own selves to shift modern mainstream culture.

This collaboration should finally lead to the transformation of how education practices and policies are measured and assessed. While international efforts have primarily focused on establishing a "universal scale" to measure education's contributions to sustainability (e.g.

through large-scale assessments), most of these efforts have been driven by the logic embedded in the cognitive approach, narrowing the purposes of education to basic cognitive skills. From this perspective, it is more urgent than ever to reframe the discussions about education purposes, as well as rethink the role of international large-scale assessments that drive these discussions, away from the exclusive focus on cognitive skills and toward broader planetary challenges we face (Silova *et al.*, 2019). If we still believe in the effectiveness of having universal scales, we suggest that relevant scales should be redirected to "measuring" ontological and psychological dimensions that help us understand the relationships, including religious and spiritual ones, with nature. Fortunately, useful knowledge and preliminary tools to guide us in the task have been already accumulated in various subfields of psychology, including environmental, social and cultural psychology. Through connecting approaches found in these subfields of psychology with education policies and awareness of actual embodied practices, we collectively work to fundamentally reimagine the role of education in transforming culture towards environmental sustainability and ultimately toward planetary survivability.

References

Arnocky, S., Stroink, M., & DeCicco, T. (2007). Self-construal predicts environmental concern, cooperation, and conservation. *Journal of Environmental Psychology*, *27*(4), 255–264. doi: 10.1016/j.jenvp.2007.06.005.

Bowers, C. A. (1995). *Educating for an ecologically sustainable culture: Rethinking moral education, creativity, intelligence, and other modern orthodoxies*. New York: State University of New York.

Braun, T., & Dierkes, P. (2017). Connecting students to nature – how intensity of nature experience and student age influence the success of outdoor education programs. *Environmental Education Research*, *23*(7), 937–949. doi: 10.1080/13504622.2016.1214866.

Castree, N. (2016). Broaden research on the human dimensions of climate change. *Nature Climate Change*, *6*, 731. doi: 10.1038/nclimate3078.

Chuang, Y., Xie, X., & Liu, C. (2016). Interdependent orientations increase pro-environmental preferences when facing self-interest conflicts: The mediating role of self-control. *Journal of Environmental Psychology*, *46*, 96–105. doi: 10.1016/j.jenvp.2016.04.001.

Circular Ecology (2015). The Kyoto Protocol: Climate change success or global warming failure?. Retrieved from https://circularecology.com/news/the-kyoto-protocol-climate-change-success-or-global-warming-failure (accessed 20 April 2022).

Common Worlds Research Collective (2020). *Learning to become with the world: Education for future survival*. Paris: UNESCO.

Davis, A. C., & Stroink, M. L. (2016). Within-culture differences in self-construal, environmental concern, and proenvironmental behavior. *Ecopsychology*, *8*(1), 64–73. doi: 10.1089/eco.2015.0061.

Frank, P., Fischer, D., Stanszus, L., Grossman, P., & Schrader, U. (2021). Mindfulness as self-confirmation? An exploratory intervention study on potentials and limitations of mindfulness-based interventions in the context of environmental and sustainability education. *The Journal of Environmental Education*, *52*(6), 417–444. doi:10.1080/00958964.2021.1966352.

Gates, B. (2020). Is it too late to stop climate change?. Retrieved from https://www.gatesnotes.com/Podcast/Is-it-too-late-to-stop-climate-change (accessed 20 April 2022).

Glavovic, B., Smith, T. F., & White, I. (2022). The tragedy of climate change science. *Climate and Development*, in press (online). doi: 10.1080/17565529.2021.2008855.

Hayashi, A. (2022). *Teaching expertise in three countries: Japan, China, and the United States*. Chicago: The University of Chicago Press.

Herrington, G. (2021). Update to limits to growth: Comparing the World3 model with empirical data. *Journal of Industrial Ecology*, *25*(3), 614–626. doi: 10.1111/jiec.13084.

Hickel, J., & Kallis, G. (2020). Is green growth possible?. *New Political Economy*, *25*(4), 469–486. doi: 10. 1080/13563467.2019.1598964.

International Association for the Evaluation of Educational Achievement [IEA] (2017). *Becoming citizens in a changing world: IEA international civic and citizenship education study 2016 international report*. Amsterdam: IEA.

Intergovernmental Panel on Climate Change [IPCC] (2021). About the IPCC, Retrieved from https:// www.ipcc.ch/about/ [accessed 20 April 2022].

International Atomic Energy Agency (IAEA) (1997). 50 years of nuclear energy, Retrieved from https://www.iaea.org/sites/default/files/gc/gc48inf-4-att3_en.pdf (accessed 20 April 2022).

Kasulis, T. (2002). *Intimacy or integrity: Philosophy and cultural difference*. Honolulu: University of Hawaii Press.

Komatsu, H., & Rappleye, J. (2017). A PISA paradox? An alternative theory of learning as a possible solution for variations in PISA scores. *Comparative Education Review*, *61*(2), 269–297. doi: 10. 1086/690809.

Komatsu, H., Rappleye, J., & Silova, I. (2019). Culture and the independent self: Obstacles to environmental sustainability?. *Anthropocene*, *26*, 100198. doi: 10.1016/j.ancene.2019.100198.

Komatsu, H., Rappleye, J., & Silova, I. (2020). Will achieving SDG4 promote environmental sustainability? Critical reflections looking towards 2030. In A. Wulff (Ed.), *Grading Goal Four: Tensions, Threats and Opportunities in the Sustainable Development Goal on Quality Education*. Leiden: Brill-Sense. doi: 10.1163/9789004430365_014.

Komatsu, H., Rappleye, J., & Silova, I. (2021). Student-centered learning and sustainability: Solution or problem?. *Comparative Education Review*, *65*(1), 6–33. doi: 10.1086/711829.

Komatsu, H., Rappleye, J., & Silova, I. (2022). Social mindfulness for global environmental sustainability?. *Proceedings of the National Academy of Sciences of the United States of America*, *119*(4), e2118710118. doi: 10.1073/pnas.2118710118.

Komatsu, H., Fu, S., Lin, M., Hsieh, Y., Rappleye, J., & Silova, I. (2022). Measuring the transformation of university students' self-construal for greater environmental sustainability. *Sage Open*, *12*(1), 1–12. doi: 10.1177/21582440221079836.

Liefländer, A. K., Fröhlich, G., Bogner, F. X., & Schultz, P. W. (2013). Promoting connectedness with nature through environmental education. *Environmental Education Research*, *19*(3), 370–384. doi: 10.1080/13504622.2012.697545.

Lee, K., Ashton, M.C., Choi, J., & Zachariassen, K. (2015). Connectedness to nature and to humanity: Their association and personality correlates. *Frontiers in Psychology*, *6*, 1003. doi: 10.3389/fpsyg. 2015.01003.

Lee, T. M., Markowitz, E. M., Howe, P. D., Ko, C.-Y., & Leiserowitz, A. A. (2015). Predictors of public climate change awareness and risk perception around the world. *Nature Climate Change*, *5*(11), 1014–1020. doi: 10.1038/nclimate2728.

Maclean, R., Jagannathan, S., & Panth, B. (2018). *Education and skills for inclusive growth, green jobs and the greening of economies in Asia*. Singapore: Springer Open.

Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review*, *98*(2), 224–253. doi: 10.1037/0033-295X.98.2.224.

Markus, H. R., & Kitayama, S. (2010). Cultures and selves: A cycle of mutual constitution. *Perspectives on Psychological Science*, *5*(4), 420–430. doi: 10.1177/1745691610375557.

Martinsson, P., Myrseth, K. O. R., & Wollbrant, C. (2012). Reconciling pro-social vs selfish behavior: On the role of self-control. *Judgment and Decision Making*, *7*(3), 304–315.

Meadows, D. H., Meadows, D. L., Randers, J., & Behrens, W. W., III (1972). *The limits to growth*. New York: Universe Book.

Meadows, D., Randers, J., & Meadows, D. (2004). *The limits to growth: The 30-year update*. White River Junction: Chelsea Green Publishing.

Mochizuki, Y. (2019). Rethinking schooling for the 21st century: UNESCO-MGIEP's contribution to SDG 4.7. *Sustainability: The Journal of Record*, *12*(2), 88–92. doi: 10.1089/sus.2019.29160.

Mullenbach, L. E., Andrejewski, R. G., & Mowen, A. J. (2019). Connecting children to nature through residential outdoor environmental education. *Environmental Education Research*, *25*(3), 365–374. doi: 10.1080/13504622.2018.1458215.

Naess, A. (1973). The shallow and the deep, long-range ecology movement. A summary. *Inquiry*, *16*(1–4), 95–100. doi: 10.1080/00201747308601682.

OECD (2009). *Green at fifteen? How 15-year-olds perform in environmental science and geoscience in PISA 2006*. Paris: OECD Publishing.

Ott, H. E. (1998). The Kyoto Protocol: Unfinished business. *Environment: Science and Policy for Sustainable Development*, *40*(6), 16–20. doi: 10.1080/00139159809604595.

Overland, I., & Sovacool, B. K. (2020). The misallocation of climate research funding. *Energy Research & Social Science*, *62*, 101349. doi: 10.1016/j.erss.2019.101349.

O'Neill, D. W., Fanning, A. L., Lamb, W. F., & Steinberger, J. K. (2018). A good life for all within planetary boundaries. *Nature Sustainability*, *1*(2), 88–95. doi: 10.1038/s41893-018-0021-4.

Plumwood, V. (1993). *Feminism and the mastery of nature*. New York: Routledge.

President's Science Advisory Committee of the United States (1960). *Scientific progress, the universities, and the federal government*. Washington: United States Government Printing Office.

Randers, J. (2012). *2052: Global forecast for the next forty years*. White River Junction, Vermont: Chelsea Green Publishing.

Rappleye, J., & Komatsu, H. (2017). How to make lesson study work in America and worldwide: A Japanese perspective on the onto-cultural basis of (teacher) education. *Research in Comparative and International Education*, *12*(4), 398–430. doi: 10.1177/1745499917740656.

Rappleye, J., & Komatsu, H. (2020). Towards (comparative) educational research for a finite future. *Comparative Education*, *56*(2), 190–217. doi: 10.1080/03050068.2020.1741197.

Rappleye, J., Komatsu, H., & Silova, I. (2021). The best vaccine: Nature, culture, and covid-19. *Norrag Special Issue*, *6*, 120–123.

Restall, B., & Conrad, E. (2015). A literature review of connectedness to nature and its potential for environmental management. *Journal of Environmental Management*, *159*, 264–278. doi: 10.1016/j.jenvman.2015.05.022.

Rosen, A. M. (2015). The wrong solution at the right time: The failure of the Kyoto Protocol on climate change. *Politics & Policy*, *43*(1), 30–58. doi: 10.1111/polp.12105.

Silova, I. (2019). Toward a wonderland of comparative education. *Comparative Education*, *55*(4), 444–472. doi: 10.1080/03050068.2019.1657699.

Silova, I. (2021). Facing the anthropocene: Comparative education as sympoiesis. *Comparative Education Review*, *65*(4), 587–616. doi: 10.1086/716664.

Silova, I., Rappleye, J., & Komatsu, H. (2019). Measuring what really matters: Education and large-scale assessments in the time of climate crisis. *ECNU Review of Education*, *2*(3), 342–346. doi: 10.1177/2096531119878897.

Singelis, T. M. (1994). The measurement of independent and interdependent self-construals. *Personality and Social Psychology Bulletin*, *20*(5), 580–591. doi: 10.1177/0146167294205014.

Skinner, B. F. (1971). *Beyond freedom and dignity*. Cambridge, Indianapolis: Hackett Publishing.

Sterling, S. (2021). Concern, conception, and consequence: Re-Thinking the paradigm of higher education in dangerous times. *Frontiers in Sustainability*, *2*, 743806. doi: 10.3389/frsus.2021.743806.

Takayama, K. (2020). Engaging with the more-than-human and decolonial turns in the land of shinto cosmologies: "Negative" comparative education in practice. *ECNU Review of Education*, *3*(1), 46–65. doi: 10.1177/2096531120906298.

Tobin, J., Hsueh, Y., & Karasawa, M. (2009). *Preschool in three cultures revisited: China, Japan, and the United States*. Chicago: University of Chicago Press.

Turner, G. M. (2012). On the cusp of global collapse? Updated comparison of the limits to growth with historical data. *Gaia*, 21(2), 116–124. doi: 10.14512/gaia.21.2.10.

UNESCO (2016). *Education for people and planet: Creating sustainable futures for all. Global education monitoring report 2016*. Paris: UNESCO.

UNESCO (2020a). *Education for sustainable development: A roadmap*. Paris: UNESCO.

UNESCO (2020b). *Humanistic futures of learning: Perspectives from UNESCO chairs and UNITWIN networks*. Paris: UNESCO.

Vargas Roncancio, I., Temper, L., Sterlin, J., Smolyar, N.L., Sellers, S., Moore, M., . . . Babcock, M. (2019). From the anthropocene to mutual thriving: An agenda for higher education in the Ecozoic. *Sustainability*, 11(12), 3312. doi: 10.3390/su11123312.

White, L., Jr. (1967). The historical roots of our ecologic crisis. *Science*, 155(3767), 1203–1207. doi: 10.1126/science.155.3767.1203.

Wiedmann, T., Lenzen, M., Keyßer, L. T., & Steinberger, J. K. (2020). Scientists' warning on affluence. *Nature Communications*, 11(1), 3107. doi: 10.1038/s41467-020-16941-y.

World Education Forum (2015). *Education 2030: Incheon declaration and Framework for action for the implementation of sustainable development goal 4*. Paris: UNESCO.

Corresponding author
Hikaru Komatsu can be contacted at: kmthkr@gmail.com