Recebido: 06-03-2025 | Aprovado: 20-05-2025 | DOI: https://doi.org/10.23882/rmd.25297

Climate change denial as a catalyst for transformative education

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Abstract: Climate change denial in the face of overwhelming contradictory evidence has left many young people confused and anxious. This paper argues that transformative education is a way to enable students to counter the obfuscation of denial by combining understanding of climate change with activities demonstrating possibilities for reducing or reversing its damaging impact. Three examples of transformative education reveal the sense of empowerment students gain as learners-cum-activists on climate-related issues. Teacher education programs and teachers' professional learning communities are likely to contribute to further advances in transformative education.

Keywords: Climate change, Professional learning communities, Student empowerment, Transformative education, Teacher education

Resumo: A negação das alterações climáticas face a provas contraditórias esmagadoras tem deixado muitos jovens confusos e ansiosos. Este documento defende que a educação transformadora é uma forma de permitir que os estudantes contrariem a ofuscação da negação, combinando a compreensão das alterações climáticas com atividades que demonstrem as possibilidades de reduzir ou inverter o seu impacto negativo. Três exemplos de educação transformadora revelam o sentido de capacitação que os alunos adquirem enquanto aprendizes e ativistas em questões relacionadas com o clima. Os programas de formação de professores e as comunidades de aprendizagem profissional dos professores são suscetíveis de contribuir para novos avanços na educação transformadora.

Palavras-chave: Alterações climáticas, Comunidades de aprendizagem profissional, Capacitação dos estudantes, Educação transformadora, Formação de professores

Introduction

The mounting impact of climate change on the earth's oceans, landscapes, and wildlife has generated widespread consternation throughout much of the world. Yet in the face of overwhelming evidence regarding the human induced causes of this crisis, variations of climate change denial remain a stubborn hindrance to curtailing its effects. This is especially critical in view of the quasi-rationalist aura that many of the voices of denial have assumed. For scientists, climate activists, and citizens at all levels of society who are striving to respond to the frequency of natural disasters and to alert the public regarding the dangers of humanity's continuing reliance on harmful fuel emissions, climate change has become a political and ideological quandary as well as an environmental problem. Since future generations of young people will inherit this complex global crisis, climate change has become a challenge that must be given greater precedence in systems of education. Accordingly, the focus of this paper is to briefly highlight the various intransigent forms of climate change denial, and thereupon argue that effective refutation of the voices of denial, along with the development of strategies for more effective stewardship of the earth's atmosphere and natural environment, will necessitate the adoption of transformative initiatives in the education of children and young people.

The Iterations of Climate Change Denial

Climate change denial has become a key factor in humanity's failure to address what is now regarded as an existential global crisis (McLaughlin, 2024). Until recently, the most common forms of denial have been two-fold. One has drawn from scientific reports that point to ecological correlations between cyclical weather cycles, geological eruptions, sporadic ocean patterns, and changes in the sun's energy output which imply that human causation of climate fluctuations may be exaggerated (Stephenson, 2018). The second form of denial stems from populist mistrust of authoritative figures such as scientists, political leaders and mainstream journalists who opponents argue invoke the rhetoric of climate change as a way to deflect public attention away from the assumed iniquities of governing elites (Rogers, 2022; The Guardian [a], 2023). The obduracy of these positions has almost always been reinforced by selective social media sources which inspire adherents to rely on arguments that support "what they already believe they know" (The Climate Reality Project, 2022, n.p.).

Increasingly, however, as the frequency and destructive effects of climate change have become apparent in all parts of the world, and as the popularity of alternative sources of energy such as solar- and wind-powered infrastructure and mass production of hybrid and fully electric vehicles has increased, climate denialism has become more varied and nuanced. In efforts to assuage public concerns regarding the persistence of ecological disruptions, a coterie of energy corporations, right-wing political groups, and ultraconservative think tanks and media outlets have propagated selective reports aimed at refuting public fears and forestalling climate-related policies as being precipitous and needlessly expensive (Marshall, 2014; Maslin, 2019). Other forms of 'furtive' denial refer to the benefits of carbon emissions for trees and plants, and the positive effects which warmer temperatures can have on agricultural productivity (Maslin, 2019; Selby & Kagawa, 2018).

In a compelling article entitled, Reconceptualizing climate change denial, Petersen et al. (2019) have observed that other subtle forms of denial are couched as pragmatic approaches to addressing the effects of climate change while failing to question the destructive juggernaut of macro-economic growth. These versions of denial include "techno-optimism" which contends that the damaging effects of climate change can be rectified by technological advances such as geoengineering, innovative forms of energy efficiency, and alternative energy sources; voluntary community-based initiatives such as "reduce, reuse, and recycle" campaigns; market-oriented incentives such as carbon credits designed to encourage business investment in fossil fuel alternatives and energy efficiency; and "green growth" policies that promote the adoption of cleaner and more resource-efficient growth strategies (Petersen et al., pp. 124 – 131). As the authors assert, these types of moderate and seemingly practical undertakings are forms of "ideological climate denial" that shift public attention away from the "growth-dependent capitalist order" that depends on extraction of the world's natural resources and ceaseless carbon emissions (p. 135). Accordingly, their conclusion is unequivocal: in order to avert global climactic catastrophe, the world must shift to a macro-level "de-growth" strategy that will necessitate "dematerialization, [and] fundamental changes in existing structures of ownership and governance" (p. 133). Similar conclusions have been made by other scholars who argue that hegemonic

capitalism, reinforced by the weakening of government institutions and traditional values, has led to the destruction of natural environments, and that only by reversing "growth mania" and "breaking free of the crippling world of. . . market mechanisms that make high-cost products appear cheap on supermarket shelves" can the acceleration of ecological collapse be effectively addressed (Shiva, 2009, p. 19. See also Maslin, 2019; & McLaughlin, 2024).

These are persuasive arguments advocating the necessity of radical structural transitions in order to avert the rapidity of massive environmental devastation. Unfortunately, however, macro-level proposals often entail a significant leap of faith. Without considering the dynamics of power, politics, and multiple social and economic interests, the vision of "de-growth" risks being little more than a utopian ideal. In view of the current global disorder, characterized by the fragility of democratic institutions, rising sectarianism, failed states, regional wars, and unprecedented displacement of peoples, it is difficult to imagine how an extraordinary re-structuring of the world economy can occur any time soon. The devil is in the details. Proposals for sweeping structural changes as a basis for reducing climate change that do not account for these other deep-seated crises offer little in the way of pragmatic guidance.

Education and Student Engagement: A way to address climate change denial

How then to respond to the various forms of denial that reinforce the lack of consensus concerning the causes of climate change and the ways to address its harmful effects? This is indeed a conundrum; yet it need not be a source of despondency. For what is also evident is that we now live in a period in which the combined effects of mass education and rapid technological developments have led to an extraordinary expansion of knowledge and learning opportunities, and hence to unprecedented possibilities of innovation and planned change. In effect, as education has been greatly enhanced by the expansion of information and communication technology, it has the potential to enable young people to critically examine the layered causes and consequences of climate change, and thereby gain knowledge to undertake actions that contribute to the structural changes envisaged by scholarly critics.

There is, however, a caveat. Systems of mass education are highly institutionalized and consequently, alongside their inherent role in fostering students' critical thinking, they also embody many of the contradictions of the societies in which they are integrated (Hajisoteriou & Angelides, 2020). As extensive comparative studies have shown, historically and culturally education has functioned as the main process through which children and adolescents inculcate the knowledge and values of the prevailing societal status quo (Apple, 1982). In pre-industrial societies, this has often taken the form of traditional initiation ceremonies in which young people take on the designated roles and responsibilities of their elders (Spindler, 1974). In modern and post-colonial nation states, school systems have served a similar, albeit more complex, function – to steer young people into adult roles that accord with specific knowledge and skills transmitted through predetermined curricula (Jackson, 2025; Maclure, et al., 2009). In all such circumstances, because of the significance of the norms of the social contexts in which they are growing up, students manifest high levels of engagement in the forms and content of education that they receive (Zepke, 2015).

Increasingly, however, as the perceived certainties of the world order of nation states gives way to global volatility epitomized by the decline of the earth's commons and the vulnerability of democratic of systems of governance, faith in the legitimacy of established institutional norms has waned (Diamond, 2022). As one observer has written, "It is as if the unprecedented environmental traumas experienced by the natural world are being matched by similarly exceptional stresses in human society" (Tisdall, 2019, n. p.). This is reinforced by evidence that the effects of climate change as exemplified by contaminated water, deforestation, desertification, and declining biodiversity are having a disproportionate effect on the mental health of children and adolescents (Royal College of Psychiatrists, 2021; The Guardian [b], April 19, 2023). As these symptoms of distress increase, concerns about the quality and relevance of mainstream education systems have likewise risen (Smyth et al., 2014; Tarabini, et al., 2018). For educators, psychologists, and parents, the signs of youth anxiety and disenchantment are akin to canaries in the coal mine. Declining morale and confidence among young people in most parts of the world underscore the need for fundamental reforms in education (Olsen, et al.,

2024). As climate change has become a source of world-wide anxiety and discussion, it clearly is an issue that needs to figure more prominently in school curricula, and in ways that will engage children and adolescents both cognitively and intuitively throughout their years of formative schooling. To this end, many educators are embracing ideas of transformative education as a path to re-energizing student engagement for a troubled and fast-changing world (Morote & Hernández, 2022; Selby & Kagawa, 2018).

The Significance of Transformative Education

Transformative education is a term that captures a variety of curricular and pedagogical innovations. Its overall thrust draws upon the ideas and practices of ground-breaking adult educators such as Paolo Freire and Myles Horton who encouraged low-income and disenfranchised adult learners to see themselves not as passive recipients of received knowledge, but as agents of their own learning. In practice this meant that by combining new learning with their own lived knowledge and experiences, adult learners would then be able to critically examine the socio-ecological problems detrimental to their lives, and through dialogue assess the root causes of these problems and develop strategies for collectively resolving them (Freire, 2005; Horton & Freire, 1990).

These ideas of transformative education have begun to percolate through curriculum reforms and new pedagogical practices in all levels of schooling (Rousell & Cutter-Mackenzie-Knowles, 2019; Torres-Harding et al., 2018). While not discarding the foundations of conventional academic learning, transformative education in school settings is animated to go further by integrating significant societal and ecological issues in core subjects such as science, history, literature, the arts, and physical and health education. As examples, by enabling students to explore the multiple effects of global warming on their everyday lives, to examine how human settlement and land use have historically affected local ecologies, and to connect STEM subject matter with arts programs so as to create climate related presentations in schools and in local communities, cross-curricular climate related teaching and learning exemplify the ideal of transformative education (Karpudewa, et al., 2015; Kumar et al., 2023; O'Gorman & Davis, 2013).

In addition, because of its propensity to connect learning with problems affecting many people, transformative education is oriented towards collaboration and the potential of students to become co-producers of knowledge (Camponovo, et al., 2021). Pedagogically this entails less of a systematic adherence to pre-determined curricula and to pre-scripted lectures and assignments, and more emphasis on guided student-centered learning that encourages young people to identify specific topics of interest and to follow up by seeking evidence from myriad sources within their own communities (e.g., libraries, municipal service organizations, and individuals with relevant expertise) and through internet access (e.g., scholarly journals, data bases, videos, and direct communication with knowledge specialists such as scientists, policy-makers, and entrepreneurs). Other pedagogical approaches conducive to transformative education include place-based or on-site experiential learning, participation in community service programs, collaborative online projects involving peers living elsewhere in different regions and countries, and the integration of collaborative student-led initiatives that are aligned with principles of progressive social and environmental change. In summarizing this transformative perspective of education, Elop and Puri (2019) have stated categorically, "We must teach students how to engage with disruption by disrupting our own model of education" (n.p.).

The shared goals in all these approaches to transformative education are to enable students: a) to think critically about the characteristics and effects of prevailing socio-ecological problems; b) to examine why and how these problems persist; c) to discuss the strategies they envision to resolve these issues; and d) to initiate actions, either individually or collectively, that exemplify incremental steps that citizens of all ages can undertake to rectify the problems students have identified (Bivens et al., 2009; Zepke, 2015).

Transformative Climate-related Education: Three selected examples

While conceptually the idea of transformative education is still relatively new in established school systems – the "performativity" aspects of learning such as standardized tests and letter grades are not about to end anytime soon – there are now voluminous examples of the fusion of curricula, pedagogy and research that demonstrate how student engagement can be stimulated through transformative

climate change education (Bradbury-Jones & Taylor, 2015; Kottie, n.d.). Given the short length of this paper, only three are summarized here; but they capture the range of possibilities for educators to consider.

Place-based Environment Education (Ottawa, Canada)

In Ottawa public school boards have established partnerships with various outdoor education programs that aim to stimulate student engagement in place-based environment education. The Ottawa Forest & Nature School for primary school children is focused on "child-centered, interest-led, inquiry-driven, educator-supported, learning and connecting through play on the land" (Andrew Fleck Children's Service, n.p.). Similarly, the Ottawa-Carleton District School Board's two outdoor education programs – the MacSkimming Centre and the Bill Mason Centre – have long been providing hands-on outdoor education that complements classroom learning. Both centres are widely used by school classes – at last count, over 22,000 elementary and secondary school students were undertaking field trips every year (OCDSB, 2022) – and these include overnight and weekend learning activities. The Rideau River Outdoor Education Program likewise serves as a site for environmental education for students ranging from pre-school to Grade 12 and post-secondary levels (Rideau River Conservation Authority, n.d.). These programs all maintain a similar broad aim – to actively engage students of all ages in cross-curricular learning that connects their general awareness of climate and ecological change with activities aimed at stimulating evidence-based understanding of the forces that are generating these changes. With the support of teachers, the end goal is to empower students by encouraging them to collectively undertake hands-on learning activities which, however small & locally based, will enable them to recognize that they are participants of an emerging global undertaking aimed at arresting the forces which are damaging the natural environment (OCDSB, 2022).

Collaborative Design Workshops (Toronto)

In 2021 the Ontario College of Art and Design University (OCAD) initiated "It's My Future Toronto" (IMFTO) program for seventeen BIPOC elementary school students. The focus of the program was to enable the children to identify and

analyze problems in their communities, and to follow up by designing and presenting possible solutions. Within two years, in partnership with the Toronto District School Board, the 3-month program had expanded to include more than 100 elementary school children aged 9 – 12 years. Many of the students were recent immigrants for whom English was a second or third language. The topic of the 2023 program was the climate crisis. The main activity was for each student to create a three-dimensional design detailing a climate solution which they then disseminated with the help of professionals working in the fields of journalism, policy development, and advertising. The project culminated with a showcase of their work at the Royal Ontario Museum in Toronto. Project designs included prototypes of carbon capture and air filtration, a model of a solar-powered tree planter, and policy proposals for tax incentives (Globe & Mail, April 25, 2023).

The Heat-Cool Initiative (UK)

In an article highlighting student engagement with new technology and scientific experimentation, Kumar et al. (2023) describe a combined arts and science project they co-developed to enable primary and secondary school students in the UK to learn about the causes and impacts of climate change. Entitled the Heat-Cool Initiative, the project involved students producing images of heat transfer between physical objects and the environment through the use of thermal imaging cameras. With the assistance of parents, teachers, and researchers, the students created vivid representations of thermodynamics and the causal connection between atmospheric warming and heating of the earth's surface. Key educational aspects of the project were the collaborative dynamics of cross-curricular project design, active engagement of students in creating images and presenting their findings, and the subsequent discussions concerning the implications of the findings and holistic "citizen-science approaches" aimed at fostering broader public understanding of climate change.

Although these selected examples of climate-related educational programs for young people clearly were different in many ways, they nonetheless shared a host of characteristics that demonstrate the transformative possibilities of climate change education. The target populations of these programs consisted of students enrolled

in primary, middle, and secondary schools. They all involved collaboration between schools and other organizations – the wildlife and nature conservancy centres in the Ottawa-based environment education programs; a post-secondary institution and a nationally renowned museum with the Toronto-based design workshops; and a post-secondary institution, two environmental research centres, and local community associations with the primary and secondary school Heat-Cool Initiative project. The programs were all cross-curricular in content, with an emphasis on environmental science, but with corresponding integration of art and design, as well as with placed based and experiential activities. Rather than heavy reliance on teacher-directed instruction, pedagogical methods consisted of a combination of student-directed inquiry and, depending on the specific activities of each program, skills development such as experimentation, systematic observations, report writing, and oral presentations. Methods of assessment varied, and certainly extended beyond the use of testing and other quantitative forms of evaluation. While teachers were the main adult facilitators of student learning, these projects also included other supportive adults, notably parents, outdoor educators, and research scientists. In all cases as well, in view of the current relevance of the issues addressed in these programs, the underlying goals of learning were to stimulate further collaborative inquiry and to disseminate what students had learned not only among their school peers, but elsewhere in their communities and through virtual dissemination. One can assume as well that the collaborative learning approach with peers and adults engendered a sense of pride and empowerment among the student participants. Taken altogether, these aspects of transformative teaching and learning were significant factors in fostering student engagement with the multiple dimensions of climate change education.

Discussion

The causes and effects of climate change are complex and unpredictable. What we do know, however, is that the deleterious effects of climate change on the natural world, as well as on human societies, will have intergenerational consequences. Children and adolescents today, and those not yet born, will be inheriting an existential crisis that they will have to manage. Although its form and impact vary

from region to region, overwhelming evidence indicates that the current global techno-economic system has generated enormous carbon emissions, precipitated extreme and destructive weather patterns, and led to the rapid decline of many species of flora and fauna. Unfortunately, with systems of governance and dominant modes of societal behaviour embroiled in the global pursuit of material growth and consumption, there is no immediate or identifiable panacea to the crisis. Entreaties for "de-growth" strategies, while addressing the root causes of climate change, skirt over the complex political and behavioural challenges that such strategies would necessitate, even in local communities. Likewise, various ideas that propound partial or transitory solutions cloaked in an aura of rationality avoid acknowledging deeper structural forces. The economic, political, demographic, socio-cultural, and – ultimately – environmental dimensions are far too intertwined. In the face of these contradictions, it is hardly surprising that climate change has become a politically charged issue that governments and civil societies are ill equipped to deal with effectively (carbon taxation being an example). Understandably, therefore, awareness and first-hand experience of the impact of climate change leaves many people with a pervasive sense that there is little that humanity can do to arrest atmospheric pollution and the steady deterioration of natural environments.

Yet this underestimates the potential of transformative education to foster human aptitudes for imagination and innovation. Just as Rome wasn't built in a day, so the intergenerational knowledge, inventiveness, and spirit of enterprise that are essential to undertake the changes needed to manage, if not fully overcome, the detrimental impact of global warming will take time to develop. As discussed above, this has significant implications for the education of children and adolescents. Because the implications of climate change are transformative, it is becoming apparent that education systems need to address this issue by adopting the building blocks of scaffolded transformative teaching and learning. By stimulating the reasoning, the sensibilities, and the inherent cooperativeness of students, transformative approaches to climate education ought to enable young people to move past the distractions of climate change denial so they can effectively tackle the technical, societal and structural challenges that rapid changes in the earth's atmosphere have brought about (Morote, et al., 2022).

A transformative approach to climate change education is also significant for student wellbeing. As widespread accounts of the destructive impact of human-induced climate change are omnipresent and inevitably have generated discussions ranging from alarmist to factually erroneous to well-reasoned, climate change has become a source of anxiety for many young people. As mental health specialists and growing numbers of educators have concluded, the adoption of transformative education approaches can be effective in mitigating climate change stress among children and adolescents (Biven, et al., 2009; Barton & Pretty, 2010; Royal College of Physicians, 2021). By engaging students as learners-cum-activists, transformative education can foster a sense of self-confidence and collective empowerment. Exemplifying this type of approach are "green activities" (comparable to the three examples highlighted above) in which students collate and analyze information related to local environmental spaces, and subsequently undertake collaborative actions aimed at further community greening (Barton & Pretty, 2010; Kingsley, 2019). This form of integrated learning, information dissemination, and collaborative action, sometimes in partnership with, or under the guidance of, individuals or organizations that share the interests and concerns of students, has been demonstrably effective in improving young people's wellbeing (Bowler, 2010; Kottie, n.d.; Royal College of Physicians, 2021).

Ultimately, the roles of teachers and curriculum developers are critical in fostering the integration of climate change learning as a commonplace form of transformative education. This is not a task that can be undertaken without considerable planning and effort, especially in view of standardized practices that have long maintained curriculum disciplines as silos of learning. However, in view of the cross-curricular nature of education as it pertains to climate change, it is becoming clear that this is an area for the promotion of transformative pedagogical approaches in teacher education programs and in individual schools and classrooms (Jimenez & Moorhead, 2021). In the wake of fast changing social, economic, and political developments in all countries, along with the revolutionary impact of rapid ICT advances, and most recently the incursion of artificial intelligence (AI) as a force for learning and exposition, teacher education programs and groups of classroom teachers are engaged in examining & enacting transformative education,

particularly with respect to climate change (Dunlop & Brown, 2015; Flanagan,2022; Nishiyama, 2019; Selby & Kagawa, 2018). This has been facilitated by the emergence of teachers' professional learning communities (PLCs) that congregate in conferences and through regular virtual interaction. Through PLCs teachers can learn from and with each other in developing new modes of student engagement in their subject areas (Liljedahl, 2018; Sachs, 2016). By sharing lesson plans and selected assignments undertaken by their students, as well as their own reflections and professional experiences in PLC forums, teachers can gain experience in designing and contributing to transformative, cross-curricular modes of teaching and learning (Boylan, 2021; Kennedy, 2016). In turn, through the means of virtual networks PLCs are able to generate further collegial activities among teachers in their own schools and their subject departments (Lovett, 2020).

Conclusion

The various narratives of climate change denial have clearly undermined common understanding of the long-term effects of human induced climate turbulence. It is precisely for this reason that young people should be granted opportunities to learn about climate change in ways that will enable them to critically de-construct the discourses of climate change denial and develop capacities to constructively respond to the destructive effects of climate change. This is an extraordinary global challenge, and at present it is impossible to know what the long-term outcomes will be – in forms of governance, economic exchanges, social behaviours, and ultimately in the natural environment itself. But for the sake of future generations, transformative education is clearly a path to follow.

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