Education as a Petro-Pipeline: Beyond the Limits of Education Research in the Face of Climate Change

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Abstract

Considering the key cause of climate-harming carbon emissions is the increased use of fossil fuels, we might expect research in education to engage in petrocriticism—a critical way of reading the world that deconstructs how fossil-fuelled cultural expectations and practices, or "petroculture," functions in education. To trace the intersection of fossil fuels and education, this article conducts a systematic literature review of both existing and emerging scholarship, engaging in a petrocritical reading of research themes to reveal the extent to which petroculture is naturalized and/or confronted. By examining both dominant research patterns and the notable silences, we conclude by making recommendations for how education scholarship can respond to climate science and contribute to a more livable future through research that takes up (a) petrocriticism, (b) mitigation and decarbonization, and (c) transformation toward alternatives.
Keywords: climate change education, petroculture, petrocriticism, fossil fuels, education research, systematic literature review

Résumé

Étant donné que la principale cause des émissions de carbone nuisibles au climat est l'utilisation accrue des combustibles fossiles, on pourrait s'attendre à ce que la recherche en éducation s'engage dans la pétrocritique — une lecture critique du monde qui déconstruit le fonctionnement des attentes et des pratiques culturelles liées aux combustibles fossiles, ou « pétroculture », dans l'éducation. Afin de déterminer l'intersection entre les combustibles fossiles et l'éducation, cet article effectue une revue systématique de la littérature existante et émergente, en adoptant une lecture pétrocritique des thèmes de recherche afin de révéler dans quelle mesure la pétroculture est naturalisée et/ou confrontée. En examinant à la fois les schémas de recherche dominants et les silences notables, nous concluons en formulant des recommandations sur la manière dont la recherche en éducation peut réagir au changement climatique et contribuer à un avenir plus durable grâce à des recherches qui abordent (a) la pétrocritique, (b) l'atténuation et la décarbonation, et (c) la transformation vers des solutions alternatives.

Mots-clés : éducation au changement climatique, pétroculture, pétrocriticisme, combustibles fossiles, recherche en éducation, revue systématique de la littérature

Introduction

> Humanity is on thin ice—and that ice is melting fast…. Climate change is the defining issue of our time and we are at a defining moment. From shifting weather patterns that threaten food production, to rising sea levels that increase the risk of catastrophic flooding, the impacts of climate change are global in scope and unprecedented in scale.
>
> – United Nations Secretary-General Antonio Guterres, March 2023

How is education responding to the *defining issue of our time*, and how are these responses supported and shaped by education research? There has been a surge of public interest in youth activist movements that include school strikes, engaging children in nature- and land-based education programs, and the rise of youth climate anxiety. These concerns are well founded, with a vast majority of climate science providing evidence of devastating consequences for life on the planet if carbon emissions are not decreased

starting immediately. The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 by the United Nations to assess the science of climate change and its impacts by synthesizing the work of thousands of scientists worldwide and communicating their findings. This has helped to clarify the causes and impacts of climate change, highlighting the role of human activities in driving global warming and providing critical data that shows the urgency of taking immediate action. Three key global agreements were negotiated based on IPCC work:

1. The United Nations (1992) Framework Convention on Climate Change (UNFCCC) established a path to international cooperation on climate change.
2. The Kyoto Protocol (United Nations, 1997) set legally binding targets for developed countries to reduce greenhouse gas emissions.
3. The Paris Agreement (United Nations, 2015) established an agreement to limit global warming to below two degrees Celsius.

Even with these international agreements as guiding policy frameworks, government efforts to address climate change have not managed to make a difference and, in fact, carbon emissions are increasing.

Canada was a founding member of the UNFCCC, signed the Paris Agreement in 2016, and in 2022 created an emissions reduction plan, yet it produces some of the highest greenhouse gas emissions per capita on the planet, with 19.6 megatonnes of carbon dioxide per capita equivalent compared to 6.3 globally (Government of Canada, 2024). While some emissions are attributable to the northern climate, Canada's fossil fuel sector contributes the majority of emissions (28%), with household use, particularly of motor fuels, coming in a close second (22%; Government of Canada, 2024). Thus, Canada is part of the problem, contributing to global climate injustice through outsized emissions, while those countries that emit less suffer greater climate impacts. Canada is therefore similar to other countries in the Global North that position themselves as "climate heroes" or "saviours of the planet" yet favour only those "green" initiatives that do little to address the root causes of climate breakdown, and instead choose to prioritize capitalist expansion via green technologies, as well as scapegoat emerging economies (Perry & Sealey-Huggins, 2023).

Since the key cause of rising carbon emissions is increased use of fossil fuel products (e.g., oil, gas, plastics, and agrochemicals), we might expect research in most disciplines to follow up this climate science finding and get to the root causes of the climate

crisis. Education research in the areas of policy, curriculum, psychology, adult learning, history, philosophy, and more all provide evidence of how learning happens and how that learning shapes relations, social and political systems, work and leisure activities, well-being, and a multitude of experiences related to being human. It would make sense that educators are ready to contribute research to address the most critical issue of our time, including through petrocriticism (Bartosch, 2019)—a critical way of reading the world that deconstructs how fossil-fuelled cultural expectations and practices, or "petroculture," functions in education.

Climate change education has been brought to the forefront of global policy spaces since the Greening Education Partnership was established by the UNFCCC in 2022. However, research shows that climate change education remains a low priority for national and global agendas (UNESCO & Monitoring and Evaluating Climate Communication and Education Project [MECCE], 2024). Further, climate education policy itself focuses primarily on individual climate literacy and empowerment (e.g., Organisation for Economic Co-operation and Development [OECD], 2024), as climate education is grounded in education for sustainable development under Sustainable Development Goal #4 (SDG 4) on quality education (United Nations, n.d.).Where climate change is addressed in curriculum, the focus tends to be on knowledge transmission of climate science, along with inculcation of skills, values, and attitudes that foster "student awareness, agency and empowerment for climate action" (OECD, 2022, p. 2). Current curriculum and policy therefore do not support the kinds of deep shifts necessary to excavate petroculture and shift ways of being toward a healthier and more just shared planet. In fact, education may have a counterproductive effect; countries ranking higher on metrics associated with SDG 4 are also greater contributors to climate change (Komatsu et al., 2020).

Again, Canada seems to be in line with global trends, with shallow treatment in policy (Bieler et al., 2018) and curriculum focused narrowly on climate science (Field et al., 2023; Wynes & Nicholas, 2019). The impacts of the fossil fuel sector can be seen in the uneven treatment of climate change education across provinces and territories, where the petro-provinces of Alberta and Saskatchewan have the fewest climate-oriented learning outcomes (MECCE & UNESCO, 2025). Dominated by "petro-pedagogy" (Eaton & Day, 2020), education in these two provinces particularly—but also across Canada and in other petro-states globally (Tannock, 2020)—is highly influenced by fossil fuel companies (Keary & Chestnut, 2025) across many areas of education, including gover-

nance, funding, support for education sector non-governmental organizations, curriculum development, and provision of teacher resources. In place of climate science, education therefore reflects fossil fuel interests that work to delay emissions reductions through greenwashed and techno-optimistic portrayals of the fossil fuel industry, focus on individualized climate actions at the expense of systemic change, and so-called "balanced" representations of the climate crisis that downplay anthropogenic causes and the injustices inherent to climate change (Keary & Chestnut, 2025).

Grounding our study in the theory of petroculture (Boyer, 2023; Wilson, 2020), which unpacks the denials of violence inherent to fossil-fuelled modernity, we begin by conducting a systematic literature review (Page et al., 2021) to trace the intersection of fossil fuels and education in both existing research publications and grey literature, as well as within emerging scholarship in Canada. After identifying temporal, geographic, and (inter) disciplinary research trends, we next engage in a petrocritical reading of research themes and topics to reveal the extent to which petroculture is naturalized and/or confronted. By so examining both dominant research patterns and the notable silences, we conclude by identifying gaps in the scholarship and making recommendations for how education research can respond to climate science and contribute to a more livable future. Considering the interconnected nature of climate change, where both climate contributions and effects are locally experienced yet globally distributed, we approach this future research agenda at the intersection of Canadian and global concerns, with recommendations that directly speak to the Canadian context yet are relevant across petrocultural sites globally.

From Peak Oil to Petroculture

Theories of peak oil production began in the 1950s, when predictions as to when oil would reach maximum production were made publicly by M. Hubbart, a geophysicist working for Shell Oil Company. "Peak oil" was expected to be reached in the early 2000s, but predictions continue to be pushed back in large part because of an underestimation of advances in research, leading to expanded exploration and production of oil (Al Ghais, 2024). A vast increase in demand has also opened the way for fossil fuel industry expansion into tracts of land and bodies of water previously out-of-bounds to extraction through technical, political, business and marketing, and education research, contributing to a deepening desire for the goods and lifestyles that a petro-economy provides. Mas-

sive increases in consumerism have proved immutable even in the face of climate change science identifying consumerism as a key contributor to increases in fossil fuel demands and dire warnings about what will result if we do not limit the amount of carbon from fossil fuel consumption being released into the atmosphere. Additional research shows that extraction, production, and consumption of fossil fuels contributes to species extinction through habitat loss, and is thus placing all life on the plant in a position of precarity. The Organization of Petroleum Exporting Countries (OPEC) and the fossil fuel industry frame the continual increase in demand as

> a pushback from populations comprehending the implications of ambitious and unrealistic net zero policy agendas, policymakers reevaluating their approach to energy transition pathways, and faster industrialization in developing countries, where we are seeing the emergence of a larger middle class, an expansion in transport services, and greater energy demand and access. (Al Ghais, 2024, para. 14)

The industry and its financers make no statement of how to address the problems of fossil fuel exploration, extraction, and production except through a technical optimism that future research will lead to less carbon being emitted.

Such a denial of the problems related to expanding energy extractivism is described in the emerging theory of petroculture. Boyer (2023) describes the foundation of denial in an underlying "petromania," an "obsessive commitment to petroculture reproduction" (p. 4). In turn, petromania is rooted in a collective thanatophobia, a "fear of the death of our fossil fueled way of life" (p. 4), where notions of "not only a good life but of life itself are intimately wound up with the use of fossil fuels" (p. 5). Martens (2020) makes the connection to Boyer's theory of petromania in his discussion of fossil fuel politics as thanatopolitics in settler colonial states. In this, Boyer (023) and Martens (2020) share Mbembe's (2019) description of colonialism's ongoing legacy of deadly politics that excuses death and even the extinction of some in the service of the life goals of others as *necropolitics.* Fossil fuel exploration, extraction, and production, along with the political, financial, and educational systems that support it, create "sacrifice zones" (Juskus, 2023; Lerner, 2012; Martens, 2020) where the full impact of the fossil fuel industry delivers poisoned and polluted land and waterways surrounding extraction and production sites. These sites are hidden in plain sight by the normalization of poverty,

racism, misogyny, and thanatophobia-driven consumerism. The death and often extinction of non-human species caused by human energy choices are downplayed as just a cost of progress, a valourization of domination that has long served colonial projects of modernity. The colonial matrix (Quijano, 2007; Tlostanova & Mignolo, 2012), a system of patriarchy, racism, and imperialism supported by an epistemicidal education system, is an overall violent structure that supports and normalizes extractivist energy domination through its embedded necropolitics. This makes it possible to hide the deadly results of increased fossil fuel consumption even as people experience record-breaking weather events and the collapse of the natural systems around them due to climate change.

Investigating Petroculture in Education

In the face of mounting climate science calling for an end of fossil fuels, our aim is to trace how petroculture manifests in education research, including to what extent it is naturalized or confronted. With an eye to the ways that fossil fuels are often "hidden in plain sight," we seek to uncover the specific functioning of petroculture within education both globally and within Canada, where fossil fuels are naturalized across the education ecosystem, inclusive of governance, funding and industry partnerships, curriculum and pedagogy, and more. At the same time, we also aim to make visible existing efforts to undermine petroculture and move toward decarbonization in and through education. In this vein, our research is guided by the following questions:

> What are the research trends (e.g., disciplines, time periods, education types/levels) at the intersections of education and fossil fuels?
>
> How is the relationship between education and fossil fuels referenced in the scholarship? To what extent is petroculture naturalized or confronted in the scholarship, and how?
>
> To what extent is emerging education research in Canada responding to the problem of fossil fuel emissions?

As climate change is locally experienced yet spans borders, our study brings together national and international research agendas with an eye to the potential contributions of Canadian education researchers, both nationally and to a broader global conversation.

Our systematic literature review (Monroe et al., 2019; Page et al., 2021; Trott et al., 2023) classifies and describes the intersections of education, fossil fuels, and climate change in published scholarship and grey literature, identifying trends and petrocultural gaps where fossil fuels remain hidden or unquestioned in educational futures. After discovering a paucity of research through our review, however, we became curious about whether emergent research was beginning to confront fossil fuels more directly. So, the second part of our study systematically reviewed the titles of projects funded by Canada's Social Sciences and Humanities Research Council (SSHRC). Below, we describe the "explicit, systematic methods to collate and synthesise findings of [relevant] studies" (Page et al., 2021, p. 3), before moving into a petrocritical (Bartosch, 2019) discussion of the extent to which education scholarship is complicit in the petrocultural violences described above, along with the ways it resists and contests petrocultures in response to mounting climate crisis.

Systematic Literature Review: Methods and Findings

With a view of examining the full suite of English-language research across the education system and within various geographical regions, we began our study by testing and refining our keyword searches within various databases and conducting initial scans of the literature. Exploratory scans indicated the need for various search terms to capture multiple means of discussing fossil fuels and petroculture. Our refined Boolean search therefore comprised: "education policy" OR education OR pedagogy OR curriculum OR "higher education" AND "petro-state" OR "petro-power" OR "oil-based economy" OR petroculture OR petrolized OR "oil and gas" OR extractivism. We excluded the search term, "decarboniz*,"[1] as this search term, where it did address education at all, primarily returned articles speaking to educational infrastructures—including low carbon design, retrofitting, and maintenance—rather than the research field of education (see, for example, da Silva et al., 2023; Kmetz & Norrbom, 2025). After testing the presence of these terms in various aspects of the article (namely the keywords, title, abstract, and/or references), we determined that searching the terms in the abstract was the most fruitful. We applied

1 In a Boolean search, a "*" indicates alternative forms of a word. In this case, the * would retrieve terms such as decarbonize, decarbonized, decarbonization, and decarbonizing.

this search across three databases selected for their scope and relevance, including those that are specific to education: Academic Search Ultimate, Education Source, and Education Resources Information Centre (ERIC). We restricted our search to English-language articles but placed no geographic or temporal restrictions on the search, and we included both academic and grey literature, as we were curious about the potential presence of articles in practitioner journals and reports. Our initial search returned 244 articles.

Once our initial dataset was complete, we developed eligibility criteria to determine which articles to include for analysis. Together, the authors read through the titles and abstracts of all articles, maintaining any articles that addressed our key concerns, namely education within petro-states, relationships between education and fossil fuel industries, or education about fossil fuels. Articles could address any aspect of education (e.g., educational leadership, teacher retention), discipline (e.g., engineering education, environmental education), level (e.g., schooling, higher education), or type (e.g., formal/nonformal/informal education, vocational training). Academic articles, practitioner newsletters, conference proceedings, and formal reports were maintained when relevant, but other grey literature such as news pieces and media releases were cut. If articles passed through this initial scan but no longer met the criteria upon a full reading in the next stage (described below), they were also cut. The final set of articles analyzed in this review totaled 89.

We explored the set via available metadata (including publication date and keywords), as well as by reading and manually coding each article according to the geographical location of the research and the level of education under study (e.g., K–12 schooling, higher education), which provided the foundations for visualization and analysis. We also kept researcher notes on each article's vision concerning the role of education in relation to fossil fuels; these notes inform our discussion of the themes identified through the keyword analysis described below.

Research trends: Temporality, geography, and (inter)disciplinarity. The number of publications addressing the intersection of fossil fuels and education has grown significantly since the early 2010s, indicating a relatively new area of research interest (see Figure 1). Though the United States dominates the set, research is situated in a variety of contexts globally (see Figure 2), particularly where fossil fuels are central to national economies, as with Canada, Nigeria, Norway, Russia, and Qatar. Considering the prevalence of fossil fuel industries in Canada, Canadian scholarship makes up a relatively small percentage of the corpus, with a total of six publications (7%). Upon reading the articles,

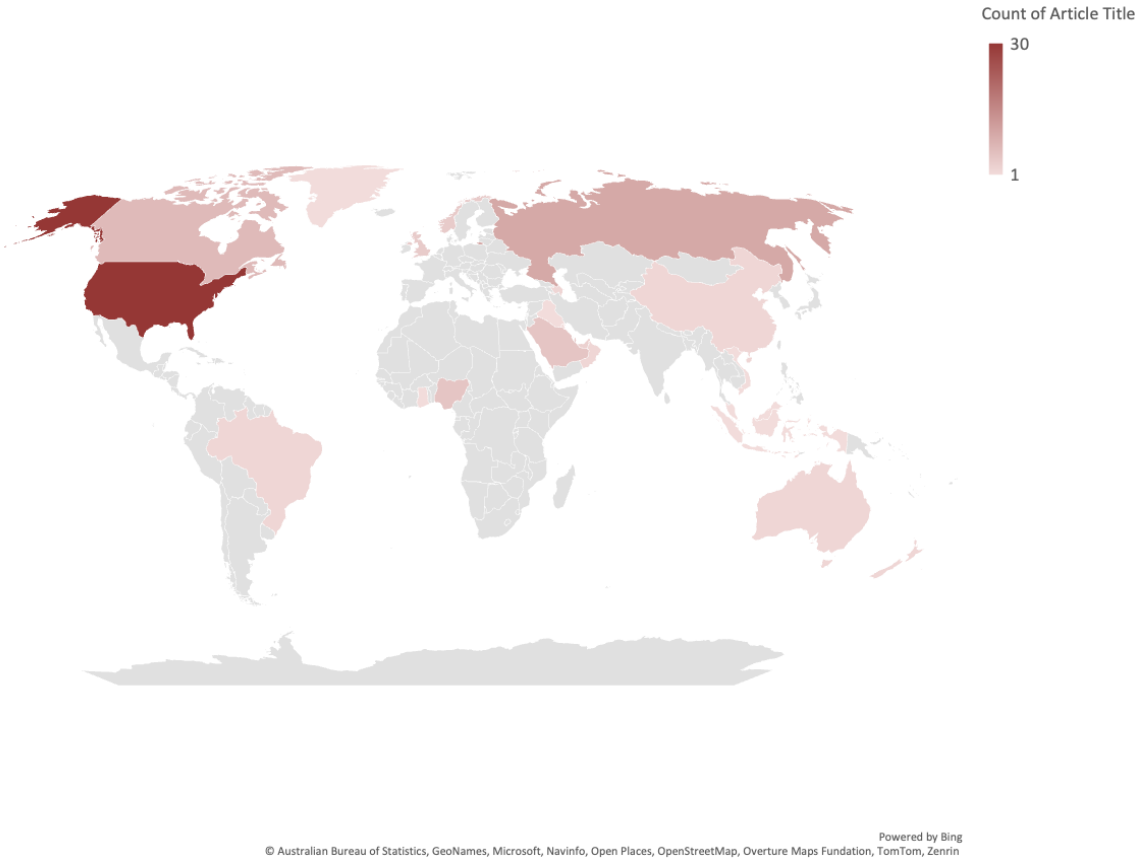
it is clear that some research addresses local and national concerns that are specific to place, such as strengthening a local workforce or national economy, though with findings that may be transferable across contexts. For example, three Canadian articles trace the interaction between the Alberta oil sands and education, revealing the delegitimization of education via fossil fuel influence through corporate sponsorship of schools (Hodgkins, 2010) and corporate influence on curriculum (Hoeg, 2020), as well as the "absurdity" of the "bizarre and unconscionable environmentally-related actions" (Lowan-Trudeau, 2023, p. 654) of petro-states that necessitate both critical and creative educational responses. Other research draws local sites into dialogue through comparison across diverse contexts (e.g., Scotland and Norway), working to establish cross-national partnerships (e.g., between the United States and Vietnam), or by tracing regional patterns (e.g., within the Middle East). The issue of fossil fuels and education is therefore both contextual and locally relevant and of global concern.

Figure 1

Number of Publications per Year

Figure 2

Geography of Research Addressing Fossil Fuels and Education



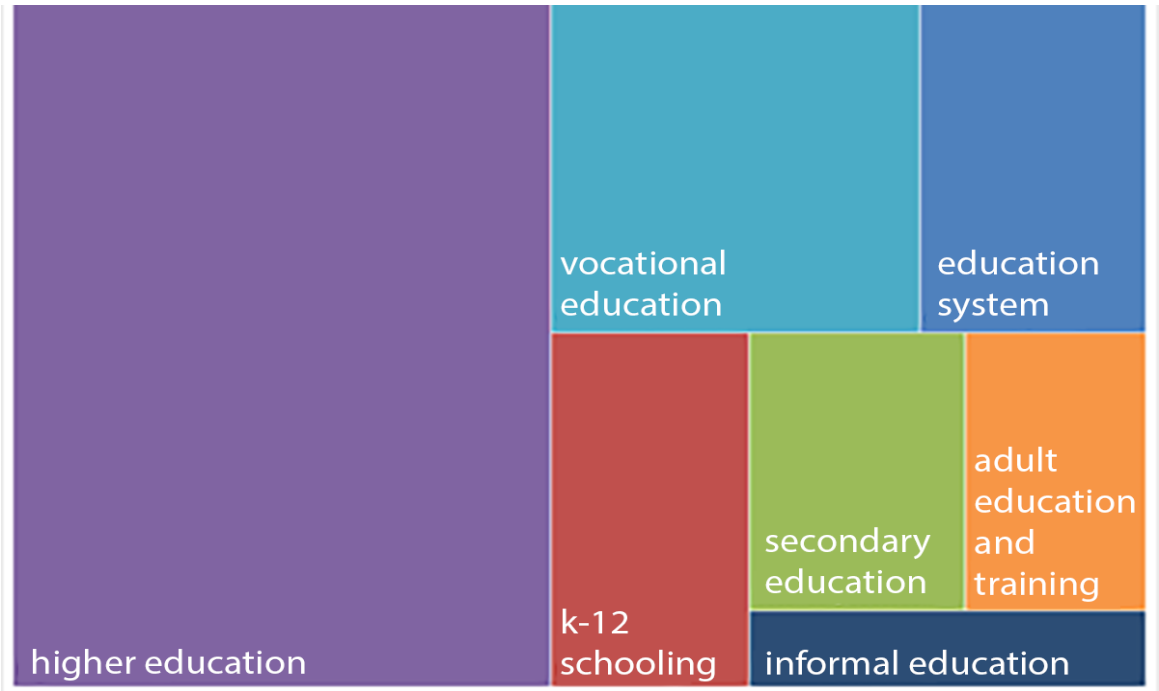
Analysis of the journals hosting these publications reveals the interdisciplinarity inherent to research at the intersection of fossil fuels and education. Only 40% of the articles (n = 34) were published in education-focused journals, though these spanned various educational sub-disciplines, including higher education, cultural studies and education, education policy, environmental and science education, curriculum and pedagogy, teacher education, careers and vocational training, and journals focused on emerging technologies, e-learning, and games-based learning. The 60% majority of articles (n = 50) were published in a variety of other journals ranging from those focused on children and youth, various sciences (geology and mining, science and technology, environmental sciences), engineering, law, business and management, and regional studies (e.g., Middle East Studies). This variety, both within and beyond educational research, indicates the inherent

interdisciplinarity of fossil fuel-related concerns in education and, therefore, the need to research beyond disciplinary borders to make our way beyond our petrocultural impasse.

While research addresses the span of education levels—from K–12 schooling to advanced education—higher education, preparation for higher education (at the secondary education level), and adult education (both on-the-job and vocational training) are of primary interest for research (see Figure 3). Various forms of informal education are touched on, such as the learning occurring through corporate greenwashing campaigns or via travel through climate-affected areas like the Arctic. Examples of system-level research include promoting science education as a central through-line to meet fossil fuel industry needs and exploring ways to strengthen education-industry partnerships. As will be explored in greater detail below, research focuses predominantly on education and training for fossil fuel industries, whether for executive and business management, engineering professions, labour workforce, or workplace safety.

Figure 3

Level of Education

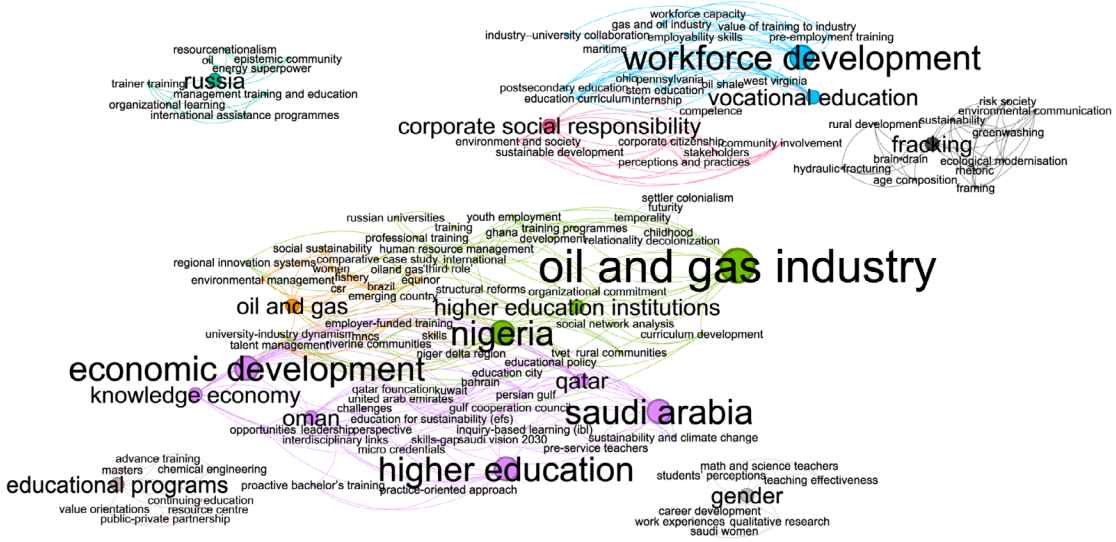


Relationships between fossil fuels and education. To explore the dominant patterns in research at the intersection of fossil fuels and education, we mapped the keywords associated with the 89 articles identified through the systematic literature review. As keywords are identified by authors not only for searchability but also to highlight the key ideas, concepts, and themes in each article, keywords enable thematic mapping of the research space, including the centrality and periphery of various ideas and issues.

To explore dominant keyword patterns, we first translated all of the keywords into a matrix, linking them by their use in a particular article. We then used Gephi (Bastian, 2023), a program that uses algorithms to visualize the relations among various keywords, to create a keyword graph (see Figure 4). Nodes are sized according to the number of times the keyword tag is used across the set so that keywords used more frequently appear larger; in this graph, keywords are used between one and four times. The graph is spatialized using Gephi's ForceAtlas2 algorithm, which maps nodes according to the frequency with which different keywords are used in conjunction (i.e., within a single article). A modularity algorithm colours clusters according to the frequent use of the same keywords within individual articles. In this way, colours enable analysis of keyword patterns, which can be named and described in clusters as below.

Figure 4

Keyword Network Graph Depicting Research Patterns and Relationships



The resultant keyword network graph features a dominant core (purple, green, and orange) linking the oil and gas industry with higher education and economic development; a secondary core (blue and pink) linking vocational education and workforce development with corporate social responsibility, and four minor clusters centred on educational programs (brown), gender (grey), fracking (black), and the Russian context (emerald). As we investigated keyword patterns according to the protocol, we also dialogued our reading of the network graph with the content of the articles themselves, read in full. In this way, we could engage in a "petrocritical" reading of the key themes, critically interpreting complicity of education research in petroculture, toward readjusting our ways of seeing and thinking the world (Bartosch, 2019, p. 16).

Note that edited from this graph are a number of other isolated clusters where no keywords were used more than once; as each of these clusters only mapped the keywords associated with a single article, we removed them from the graph, aiming instead to focus on dominant patterns in the research. However, at the end of this section, we elaborate on the marginal research areas that contest petroculture in education.

Fuelling economic development through higher education. The keyword network graph's dominant core (purple, green, and orange) reveals significant links in the research between higher education and the oil and gas industry, with particular attention to economic development. The most dominant subcluster (purple) is geographically focused on the Middle East, naming Saudi Arabia, Oman, Bahrain, the Persian Gulf, and Qatar, including Qatar's Education City—an intentionally designed aggregation of education and research institutions. Here, educational frameworks that span borders are evident, including "interdisciplinary links," "inquiry-based learning," and a "practice-oriented approach." Looking specifically to the articles, research is oriented around maximizing oil production through engaged pedagogies (Lapteva & Vorobyova, 2018), a theme that is central to many articles exploring "modernization" of vocational training (Panchenko et al., 2020) including through internships (Ramadhani & Rahayu, 2020), gaming and augmented reality (Aziz et al., 2020; Wold et al., 2016; Zhu et al., 2018), exchanges (Choi, 2018), and innovations to program delivery (Barman et al., 2013). By contrast, both "sustainability and climate change" and "education for sustainability" are named explicitly, pointing to the contestation of petroculture in education; for example, one article focuses on the potential for culture and religion to create inroads for sustaina-

bility education in oil-reliant states (Alghamdi & El Hassan, 2020). Here, we can see the conundrum within education research as it is pulled between addressing climate change and fuelling fossil fuel industries.

Despite this tension, "economic development" is central, and keywords such as "skills gap," "talent management," "opportunities," and "micro-credentials" put education in the service of a competitive, capitalist economy. For example, one article explores the organizational, external, and individual-level factors driving employer-funded worker training within multinational companies operating in Nigeria (Oseghale et al., 2018). Reference to the "knowledge economy" can be understood in relation to competition among higher education institutions within a capitalist system. However, reading of the articles also demonstrates that some petro-states are seeking to diversify economies away from fossil fuels by boosting the knowledge economy through expansion of higher education (Al Weshahi, 2023; Rowe, 2015; Weber, 2011, 2014). The dominant cluster, therefore, highlights the simultaneous reinforcement and contestation of petroculture, albeit without disrupting capitalism.

Closely linked with the dominant cluster is another cluster centred on the "oil and gas industry" and "higher education institutions." Not as regionally cohesive, this cluster references Nigeria, Ghana, and "Russian universities," indicating a thematic rather than a geographic core. Here, keywords again seem split between those contesting and those upholding petrocultures. Keywords referencing "settler colonialism" and "decolonization" point to the oftentimes unnamed and unrecognized coloniality of petroculture. Relatedly, keywords referencing "rural communities" and "structural reforms" indicate recognition of the marginalization and structural violences inherent to the oil and gas industry as with sacrifice zones, and a need for new kinds of education to address these. A closer read of these articles, however, shows that aside from one critique of "epistemic extractivism" (Stirling, 2022) in education, studies focus on structural reforms to ensure worker commitment to oil companies (Abreu et al., 2013) and a technical focus on skilling workers for oil industries. Here, the infusion of education by fossil fuel industries is simultaneously naturalized through language of "university-industry dynamism," along with multiple references to education as "training," "professional training," "training programs," and "tvet" (for "technical and vocational education and training"). Rural communities in particular are expressed as benefiting from TVET (Huston, 2016; Ovwiroro, 2017). By reducing education to training, this cluster puts education firmly in the service of industry.

Embedded within these two clusters is a smaller subcluster (orange) linked to the other clusters through the keyword, "oil and gas." Attached to a single article, this subcluster references critical research on a corporate social responsibility project run by a Norwegian company in Brazil (Strønen, 2020). In a context where corporate social responsibility is mandated for foreign oil companies by the Brazilian government, the article raises questions about how educational projects purportedly supporting community aims may instead disempower marginalized groups to critically engage with fossil fuel companies through partial accommodation and appropriation of community claims. Altogether, this article provides a critique of mandated corporate social responsibility that differs from the research described in the next section.

Workforce development and corporate social responsibility. The secondary core (blue and pink) brings together vocational education and workforce development with corporate social responsibility. Here, "industry-university collaboration" is promoted as education is put in service to the oil and gas industry—described as the "value of training to industry"—with the goal of developing "employability skills" for "workforce capacity." Education is valued for contributing to workplace success (Brundage, 2011), a central theme that echoes throughout the literature as industry-education partnerships are celebrated for their contributions to skills education (Gonzalez et al., 2019; Johnson & Nepal, 2019; Rowe, 2015) and the quality of professional graduates in geology (Bjørlykke, 2019), engineering (Guravleva et al., 2017), and economics (Katysheva, 2017). While the role of education in relation to industry is one of preparatory service, the role of industry in relation to education is one of "corporate social responsibility." By partnering with education institutions, industry can be seen as giving back through "community involvement" and "corporate citizenship," ultimately contributing to "sustainable development." Industry is valued for its ability to fund university programs (Chadwick & Cashen, 2020) in an increasingly neo-liberal climate. This industry-education dynamic thus similarly serves a petro-capitalist economy, in keeping with the themes evident in the central core cluster described above.

Thematically, the small clusters centred on "educational programs" (brown) and "gender" (grey) evoke similar themes to that of the corporate social responsibility cluster (blue and pink), albeit with slightly different orientations. While "educational programs" (grey) support "advance training" or "masters" programs in "chemical engineering," neo-liberal language of "public-private partnership" places graduate education within

the same workforce orientation as the blue cluster. Similarly, while "gender" (brown) is a vector explored in relation to "teaching effectiveness" among "math and science teachers," it also seems to be the focus of corporate social responsibility via "career development" and "work experiences" for women in Saudi Arabia. Here, rather than critically analyzing the heteropatriarchy inherent to petroculture, research seeks to expand participation to women within the existing oil and gas industry (Ainane & Bouabid, 2017; Alrowaithy, 2018) and its inherent forms of extractivist energy domination.

Fracking as an issue of concern. A small subcluster takes up the issue of "fracking" (black) in relation to education. Reading the three articles associated with this cluster reveals that oil and gas developments do not benefit rural communities, which instead see a "brain drain" as young people depart school for industry jobs (Mayer et al., 2018). By contrast, two of the studies show how increased education, including through film studies, can identify "greenwashing" of fracking projects via "framing" and "rhetoric" and can ultimately reduce support for fracking and offshore drilling (O'Neill, 2012; Scanlan, 2017).

Russia as an "energy superpower." The geo-politics of oil domination are evident in the final subcluster that is centred on "Russia" (emerald), linking oil and gas with "resource nationalism" and business development in Russia. Rather than focusing on the science and engineering education linked with fossil fuel developments, research here zeroes in on "organizational learning," "management training and education," and "trainer training" in an article focused on the globalizing business environment and the scramble for national dominant positions in the global petro-economy (Gilbert & Gorlenko, 1999).

Contesting petroculture in education? As the keyword network graph provided evidence of both adherence to and contestation of petroculture in education, we became curious about the proportion of research engaging in critique. Reading through the full suite of articles, we discovered the vast majority of articles upheld the petrocultural norms described above, placing education in the service of fossil fuel industries through partnerships that support workforce, industry, and economic development. Only nine of the 89 articles were critical of the interface of fossil fuels and education; we describe these in a bit more detail here, as they indicate possibilities toward an expanded research agenda.

Pointing directly to the oil sands in Canada, a number of these studies directly critique petrocultural ideologies and practices in education, including how industry uses philanthrocapitalism and corporate social responsibility to put education directly in its service. Interested in socially just forms of school science, for example, Hoeg (2020) traces

how the Alberta oil industry uses philanthropic educational efforts to "activate political favor" (p. 418) and reduce social resistance to oilsands developments, while centering social over environmental concerns. By contrast, Hoeg posits, critical analysis of socio-scientific issues within STEM education can support exploration of the tensions between anthropocentric ethics and ethics that support non-human life, toward a more critical view of industry development. Also writing about Alberta, Hodgkins (2008) critiques practices of corporate social responsibility in relation to petrostate theories and the rise of neo-liberalism. He demonstrates, through analysis of discursive strategies used in Alberta's curriculum, how oil multinationals infuse public education with industry propaganda and undermine critical pedagogy, in keeping with Strønen's (2020) study of Norway and Brazil, described above. In a subsequent piece, Hodgkins (2010) traces the oppression through forced dependence of Indigenous peoples on the oil industry in the Northwest Territories, bringing together Freire and Marx in an examination of critical pedagogy and resistance by the Arctic Indigenous Alliance to consider possibilities for overcoming oppression and asserting Indigenous self-determination. Alberta also receives scrutiny from Lowan-Trudeau (2023), who applies an absurdist lens to the "Alberta government's unconscionable environmentally-related actions" (p. 654), demonstrating how absurdism can render critical perspectives, introduce creative practices, and serve as "temporary comic relief for those of us who find ourselves overwhelmed, exhausted, or weighed down by our sociocritical and/or environmentally related endeavours" (p. 655). Finally, in a theoretical article that speaks to environmental education, Stirling (2022) traces the prevalence of epistemic extractivism within Canada as a settler colonial state, proposing a move toward more ethical relations and validation of Indigenous knowledge.

Beyond Canada, a few studies trace possibilities for education otherwise, introducing pedagogies that either promote education for sustainability or more directly counter fossil fuel dominance. Working in Saudi Arabia, for example, Alghamdi & El Hassan (2020) applied student surveys to understand the challenges of educating for sustainability within an oil-driven state. Then, attending to the experiences of pre-service women teachers, the authors make recommendations for further integrating inquiry-based learning in teacher education, connecting sustainability with religion and culture, and better communicating climate impacts to Saudi citizens. Similarly working with sustainability education frameworks, Fekih Zguir and colleagues (2021) compared curriculum models across countries, closely examined Qatar's efforts, and made suggestions for better

embedding education for sustainable development within Qatar. While these two studies situate climate change education within the mainstream format offered by education for sustainable development, O'Neill (2012) more directly confronts fossil fuel interests in a *Rethinking Schools* publication. In this practical piece, she takes up a film, *Gasland*, to demonstrate how secondary social studies classes in the United States can trace the environmental and social impacts of hydraulic fracturing. O'Neill's is the only article within the set that offers a petrocritical pedagogy to confront fossil fuel hegemony.

Systematic Review of Funded Research: Methods and Findings

Considering the marginality of critique within existing scholarship, we wondered whether, in the face of ever-proliferating climate science and mounting climate justice movements, emerging research might more deeply engage with petroculture and the fossil fuel industry in education. We thus turned to recent research, conducting a systematic review of projects funded by Canada's Social Sciences and Humanities Research Council (SSHRC). In January of 2025, we worked with SSHRC's public documentation of "Award Recipients" (SSHRC, 2024) to manually code all projects awarded from 2021 and 2024 within the following categories: Doctoral Fellowship, Canada Graduate Scholarships—Doctoral Program, Postdoctoral Fellowship, Partnership Engage Grant, Partnership Grant, Insight Development Grant, and Insight Grant. While other grants are available, we selected these due to their primacy for research (rather than dissemination), as well as their coverage of the span of student (Doctoral), early career (Postdoctoral and Insight Development Grants), and established scholarship (Insight and Partnership). In total, these grants accounted for 9,126 funded projects between 2021 and 2024.

The authors read through the titles of all 9,126 projects, identifying those that named fossil fuels, energy, or climate change and one of children, youth, schools, or education (inclusive of education-related terms, such as learning, curriculum, pedagogy, etc.). Of the funded projects, only one addressed the intersection of fossil fuels and education, a 2021 postdoctoral project titled "Youth Resistance to Fossil Fuel Developments: Visual Aesthetics of Public Pedagogy on Instagram." An additional 22 projects addressed climate change and education, with topics ranging from activism to youth policy engagement, outdoor education to climate displacement, and eco-anxiety to teacher education, along with ranging pedagogies for climate change education. Interestingly, the vast majority of re-

search projects were funded by grants targeting student and early career research, totalling 18 of the 23 projects (seven Doctoral, three Postdoctoral, and eight Insight Development Grants). Only two of the projects were funded by Insight Grants, which provide stable, long-term funding for research excellence: "Higher Education and Climate Justice: Engaging Youth as Knowledgeable Policy Actors" and "Learning Collective Worldmaking: Youth Activism for Climate Futures." With little engagement with fossil fuels in education scholarship, particularly by established scholars, SSHRC data point toward a trend of new scholars taking up the challenges of climate change through dedicated research programs that link the role of education and climate change problems. It remains to be seen how the fossil fuel industry is positioned in that scholarship, particularly as environmentalism and climate action has at times been shown to uphold petroculture rather than transform it (LeMenager, 2014, p. 5). Climate change and petroculture topics that benefit from interdisciplinary research such as decarbonization, diminished consumption, energy transition to renewable sources, and energy justice within systems of petro-captialism and ongoing colonial relations, are not evident in the educational research topics; however, clearly there is a contribution to both Canadian and international scholarship to be made by Canadians' experience and research. If the future is one of an increasingly urgent climate change crisis that threatens life on the planet, education will play a key role in shaping how people are able to address the causes, adaptations, and mitigation choices needed.

Discussion: Future Research Directions

This research highlights the limited amount of educational research published on the topic of education, climate change, and fossil fuels, in both Canada and internationally. Given both the substantial climate science urging immediate preventive action and the increasing lived experiences with drastic climate change weather events, such as fires, drought, floods, and cyclone bomb windstorms, a significant research gap is visible. To contribute to a livable future, education and climate change research can increase knowledge about limiting oil and gas expansion in the face of the climate crisis, strategies of mitigation to prevent further climate change–related destruction, and how deadly systems of petro-economics might be transformed. Considering the locally situated yet globally interconnected nature of the climate crisis, this research may function within but also transcend national borders.

Oil and Gas Expansion

The systematic review revealed that indeed education is a petro-pipeline, where research at the intersection of education and fossil fuels maintains the status quo. Overwhelmingly, petroculture is naturalized through industry-focused research oriented around boosting the industry workforce, streamlining technology and industry processes, and skilling learners through technical and vocational training. While some research supports climate mitigation by making oil and gas industries more efficient through engineering and science education that functions to minimize emissions, much is oriented around the growth of fossil fuel industries. Here, in direct opposition to calls for decarbonizing research generally (Conti, 2021; Pasek, 2020), education research is instead placed in service to industry, in keeping with OPEC's findings (Al Ghais, 2024) that research advances are expanding oil exploration and production.

In the face of oil expansion, we see a need for increased petrocriticism in educational scholarship that brings into view how "oil rents are centrally captured and redistributed within already existing political economies. It is the assemblage of actors and forces around this capture which needs to be understood, and to recognise that geology is not destiny" (Watts, 2021, p. 36). Denaturalizing petrocultural relations in education scholarship is necessary to unpack industry-education relations and institutional cultures, in keeping with the work of Adkin (2021, 2023), who critiques the politics, cultures, and governance of higher education within petro-states such as Alberta. In keeping with current reporting on fossil fuel influence in formal curriculum in Canada (Keary & Chestnut, 2025), research could also drive curriculum development to respond to climate science and the Earth's planetary boundaries in place of industry. Petrocriticism could also deconstruct petrocultural expectations undergirding fossil fuel expansion as they are manifest in education, including "to what extent perceptions and experiences not only of a 'good life' but of 'life itself' are intimately wound up with the use of fossil fuels" (Boyer, 2023, p. 5; see also Daggett, 2022). Through such critique, alternatives become possible.

Mitigation

Marginal within the systematic review is scholarship addressing climate mitigation and decarbonization in and through education. Apart from advancing technology to streamline fossil fuel extraction through engineering education, references to mitigation are limited

to two articles promoting education for sustainability. Some emergent scholarship addressing low carbon research (Conti, 2021; Pasek, 2020) points to a research agenda in higher education scholarship that explores ways to reduce the carbon emissions associated not only with educational infrastructures but also with research processes and expectations, such as within tenure and promotion requirements, research ethics, travel, and use of high-carbon technologies like Artificial Intelligence. Indeed, such research is imperative. Further, where decarbonization meets a lack of awareness, hesitancy, or outright resistance, educational research may also engage with institutional and schooling communities to explore concrete and accessible ways forward beyond petroculture, as Rebich-Hespanha and Bales (2023) have done through community-led collaborative experimentation with energy transition at the University of California campuses. At the level of schooling, research could further experiment with means for integrating infrastructural decarbonization projects with school curricula, for instance through experiential learning opportunities that foster learner engagement with and advocacy for emissions reductions (Kmetz & Norrbom, 2025, p. 31). Such efforts, while not addressing the violences inherent to extractivist energy domination, provide some concrete contributions education scholarship can make toward emissions reductions and the end of petroculture.

Transformation

While a small subset of scholarship is critical of extractivism and the ethics of oil and gas expansion, no research in this study questioned the thanato/necropolitics of the capitalist system and aligned petroculture—nor did any experiment with transformative alternatives. Across the scholarship documented here, there is no examination of the wastelanding effects (Voyles, 2015) of fossil fuel industries or the creation of "sacrifice zones," aside from one study by Hodgkins (2008) tracing the role of informal education in resistance to pipeline development in the Arctic. The primary response to inequity within the scholarship evokes liberal responses of access and inclusion to existing petrocultural systems, for example, by providing more jobs for women or rural communities in the fossil fuel sector. The scholarship exhibits no examples of communities transforming their energy relations that we might learn from, such as the community-based work of Eriel Deranger, the Executive Director of Indigenous Climate Action (ICA). She, along with other members of the ICA network, calls for the inclusion of Indigenous research to achieve the necessary systemic transformation that would allow an energy transition:

> Actively decolonizing Canada's and the world's responses to climate change is absolutely necessary if global society is to achieve the "transformation" of our economies and societies deemed essential for our survival by the International Panel on Climate Change (IPCC), among others. No longer can we afford to simply "tweak the system" by slotting into mainstream processes those elements of Indigenous world view that seem to "fit" most comfortably. (Deranger et al., 2022, p. 52).

The current research recommended increasing education's institutional ties with the fossil fuel industry by providing research needed for industry expansion and efficiency, training programs for skilling workers, and research to improve working conditions and worker success. By contrast, research is needed that engages with community members to address the social and environmental impacts of climate change and the education needed to create alternative futures.

Educational research that draws on theories of petroculture will contribute to challenging the fossil fuel industry's tactics of delaying and deflecting demands for limiting the production and consumption of fossil fuels (Kinol et al., 2025). A shift from petroculture to post-oil culture will require more than technical shifts and infrastructural decarbonization. Rather, what is needed is a

> shift in worldview, raison-d'être, and relationality that includes human and more-than-human relationships. Decarbonization of the environment alone is inadequate to address the challenge of climate change. Rather, we must address the root cause: the worldview that relates to bodies and their potential labor, as well as other species and nature, for the profit that can be extracted from them. (Wilson, 2020, p. 232)

Education has a long history in transformational social change. Paulo Freire, in conditions of longstanding colonial inequality and poverty in Latin America, called for teachers to act as cultural workers to teach students to "read the world" to create the conditions for justice (Freire, 1997/ 2005). Drawing on theories of petroculture, the success of the fossil fuel industry to delay and deflect demands for limiting the production and consumption of fossil fuels is made visible. The work of petrocritical research and teaching can support linking education with emerging cultural change related to areas such as degrowth

economics (Hickel, 2021; Nirmal & Rocheleau, 2019), anti-colonialism (Escobar, 2018; Mbembe, 2022), and multi-species justice (Celermajer et al., 2020).

Conclusion

Climate science is clear that without decreased fossil fuel emissions, a future of catastrophic weather events that change the possibilities of human and non-human life is unavoidable. It is urgent that the full impact of the fossil fuel industry is made visible and that alternatives become commonplace, embedded in a post-oil culture. Such efforts are even more imperative now, as the current US administration under Donald Trump intensifies a war on climate science and education to boost extraction, or to "drill, baby, drill." At the time of writing, the United States is scrubbing climate research from government websites and flagging projects funded by federal bodies like the National Science Foundation for violating executive orders issued by President Trump (Johnson et al., 2025). Petroculture is thus being enforced within research at the very moment it is most critical to resist it.

To respond to the current context and ensure the just futures of all life on the planet, the field of education has a key role, starting with establishing a substantial national and international research agenda focused on education and petroculture, petro-capitalism, and petro-policies that will provide ways to decrease our dependence on fossil fuels, mitigate the damage already created by fossil fuel consumption, and provide alternative actions and life worlds.

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