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Addressing Climate Change Anomie in Teacher Education

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Addressing Climate Change Anomie in Teacher Education

Abstract

This research project sought to understand how preservice teachers explore their relationship with Science and confidence in teaching about climate change in Science education amid a culture of denial regarding the impact of the climate crisis. Using data from three cohorts of students in an elementary Science methods course, this paper shares the context of climate change acceptance in the province of Alberta, Canada, the fossil fuel economic hub of Canada, and how using Journell's framework for controversial issues alongside a critical energy literacy framework using inquiry, supported preservice teachers to address their hesitancy in Science classrooms to engage with climate change education. Science education also needs to shift as our energy and economies need to shift in response to the climate crisis. Preservice teachers, therefore, need to be supported in this transition by better understanding their relationship with Science and how to respond to the climate crisis within regions that do not necessarily support renewable or sustainable forms of energy, such as Alberta, Canada.

Keywords

climate change, anthropocene, preservice teacher education, science education, critical discourse analysis

Cover Page Footnote

My heartfelt thanks to each and every student for your valuable contributions to this project. Your involvement will have a lasting impact on our field.

Addressing Climate Change Anomie in Teacher Education

Elementary teachers teach across disciplines, including English, Math, Social Studies, and Science. A collective hesitancy to teach Science is common among preservice teachers, often due to a lack of scientific literacy, which grew from their experiences as students in K-12 education (Chen & Moore Mensah, 2018). Students who go on to earn bachelor's degrees in the Science field do feel more comfortable with the Science content. However, they lack the ability to translate Science content pedagogically for children to learn, and conversations about equity in Science education often do not come up, as the focus is on learning the discipline (Appleton, 2013; van Driel, 2021). Content knowledge comes through experiences for preservice teachers, and many students, particularly equity-denied groups, do not see themselves reflected in the content or the room. Women, for example, are often pushed out of the Sciences, which prompted a movement to encourage women and girls in the Science, Technology, Engineering, and Math (STEM) fields with programs targeting K-12 education such as Women in Scholarship, Engineering, Science, and Technology (WISEST), a program at the University of Alberta. Programs like WISEST seek to provide equity for women and other equity-seeking groups to access STEM and remove existing barriers (WISEST, 2023). When our preservice teachers engage in Science education amid these barriers, such as a lack of representation, their confidence and content are limited within an "academic structure and culture" that is gendered, racialized, and traditional (Carr et al., 2019, p. 356).

Various levels of content knowledge impact preservice teachers' confidence in teaching Science and how to teach Science (Appleton, 2013; Chen & Moore Mensah, 2018; van Driel, 2021). The lingering effect of stand-and-deliver teacher-centric pedagogic approaches exacerbates a lack of confidence in teaching Science (Chen & Moore Mensah, 2018). On the other hand, inquiry-based teaching methods enhance learning in Science education by encouraging active participation by students and building skills such as critical thinking, collaboration, and communication. As inquiry aligns with the scientific method, learning through inquiry also allows students and teachers to dive deep into scientific concepts. Inquiry, informed by Dewey (1910; 1938), provokes students to engage in their learning as active participants critically as teachers move away from "transmission-based pedagogies that emphasized acquiring facts at the expense of fostering modes of thinking and attitudes of the mind related to the ways scientific knowledge is created" (Friesen & Scott, 2013). Practicum components of teacher education programs are purposed to provide practical learning experiences and the ability to practice pedagogical methods beyond transmission-based. When preservice teachers have the opportunity to be mentored in Science education classrooms that embrace inquiry, this improves

their confidence (Chen & Moore Mensah, 2018). However, there is no guarantee that all preservice teachers will have these experiences, making it increasingly important that teacher education instructors provide openings to engage in inquiry.

As an instructor working with preservice teachers in Science education, I was struck by the varied experiences each had pedagogically with Science and how that impacted their confidence as future teachers. As climate activism swelled globally amongst youth since Greta Thunberg began her youth climate strikes, school districts began to weigh in on student activism. In Alberta, then Minister of Education Adrianna Lagrange stated in a media response that "our government believes that parents and guardians — not activist school board trustees — can determine whether or not they want their children to miss class" (Issawi & Jeffery, 2019). In response to the Edmonton Public School Board's motion to allow students to attend climate protests with parent permission, her statement does not support youth climate activism. This context of supporting preservice teachers to engage in elementary Science education who come with varied levels of confidence is exacerbated within a province that struggles to join the calls to fight climate change. I engaged in this research project to better understand how I can support preservice teachers in elementary Science education and also how to navigate what may be considered controversial topics in Science education, like climate change. There was not necessarily a research question guiding this project, but a wondering and a desire for me to do better for my students – for them to enter into their profession confidently, able to teach Science and to grapple pedagogically with controversial topics like climate change.

As elementary preservice teachers have to learn how to teach multiple subject areas, this presents a challenge when one area, Science, is already clouded with hesitancy and the lack of critical thinking skills revealed during the COVID-19 pandemic creating divisiveness, moves us to focus on ensuring our teachers are confident with teaching in an inquiry-based Science classroom. And, as the climate crisis continues amidst lingering denial, there is a moral imperative to prepare preservice teachers to be confident in their pedagogic inquiry with the Science curricula. A lack of understanding of global warming, for example, perpetuates climate change denial, and when fossil fuels remain a privileged energy source, more barriers emerge as the context informs the curriculum designed by the governing body. In Alberta, Canada, the fossil fuel industry is the economic driver of the province and Canada. However, when standardized testing remains steadfast in K-12 education, preservice teachers who lack experience with inquiry are, again, hesitant to use this method in their Science classrooms and return to teacher-centric pedagogic methods. In this research project, I wanted to consider how to design a methods course with an approach that supported preservice teachers in building their confidence to teach Science through inquiry

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and address the climate crisis anomie through Science education. Anomie is the "breakdown of social integration and social regulation" (Teymoori et al., 2017, p. 1011), and climate change anomie flourishes when there is a lack of trust and leadership to respond to the breakdown in our collective understandings of climate change – is climate change even real? How can we collectively respond to climate change while still debating its existence? When governments remain steadfast on the benefits of fossil fuels, there is a lack of leadership in response to 'extreme weather,' biodiversity loss, and environmental crises. Our current climate crisis reality is unprecedented, causing uncertainty and a lack of intentional leadership to morally respond, including preparing our youth as a means to give them hope. And for us to prepare youth, we need to prepare preservice teachers. Thus, this paper will share the results of a critical discourse analysis of learning artifacts from three cohorts of students enrolled in an elementary Science method course amid Alberta's climate change context.

I <3 Oil & Gas

Addressing climate change anomie in teacher education seems counterintuitive as summer has turned into fire season amid a climate crisis. However, preservice teachers already experience a lack of confidence, especially within Science education, and amid societies such as Alberta, Canada, where fossil fuels dominate, the anxiety becomes unsurmountable if teachers want to engage in climate change education (Chen & Moore Mensah, 2018). Alberta, Canada, is known for its fossil fuels, particularly oil sands (tar sands) and natural gas. These resources continue to play a crucial role in the province's economy, contributing to its revenue through royalties, taxes, and industry. Despite the Federal Government's push for change to green and sustainable energies and jobs, such as through the Canadian Sustainable Jobs Act – Bill C-50: "An Act respecting accountability, transparency and engagement to support the creation of sustainable jobs for workers and economic growth in a net-zero economy" (Parliament of Canada, 2023) – Alberta is resisting a 'Just Transition' as the province relies heavily on the oil and gas industry (see Figure 1). The revenue generated from these activities directly impacts the government's budget and contributes to public services, infrastructure, and other economic sectors and equalization payments. Equalization payments in Canada are a form of fiscal redistribution designed to ensure that all provinces and territories have access to a relatively equal level of public services, regardless of their fiscal capacity (Feehan, 2020). Alberta, one of Canada's wealthiest provinces due to its significant oil and gas resources, has historically been a net contributor to the federal equalization program – Alberta has typically paid more into the program

through federal taxes than it has received in equalization payments (Feehan, 2020).

Figure 1.
Tweets from former Premier of Alberta Jason Kenny (September 22, 2019) and current Premier Danielle Smith (July 17, 2023).

Note: (Kenny, J. [@jkenny], 2019, September 22; Smith, D. [@ABDanielleSmith], 2023, June 11)

Within this context, where fossil fuels are the economic engine of a province, indeed a nation, responding to climate change is a risk – to preservice teachers who feel unprepared to teach in a Science classroom and to our planet and future generations as the economics of the industry are privileged over the outcomes of climate change. An example of this privilege emerged during the semester of this research project: Kearl Lake is an oil sands project jointly owned by Imperial Oil and Exxon Mobil Canada, operating 70 kilometres north of Fort McMurray Alberta in Treaty 8 Territory; however, it is within 20 kilometres of traditional hunting grounds of the Athabasca Chipewyan First Nation, Mikisew Cree First Nation, and the Fort Chipewyan Métis Association (see Figure 2).

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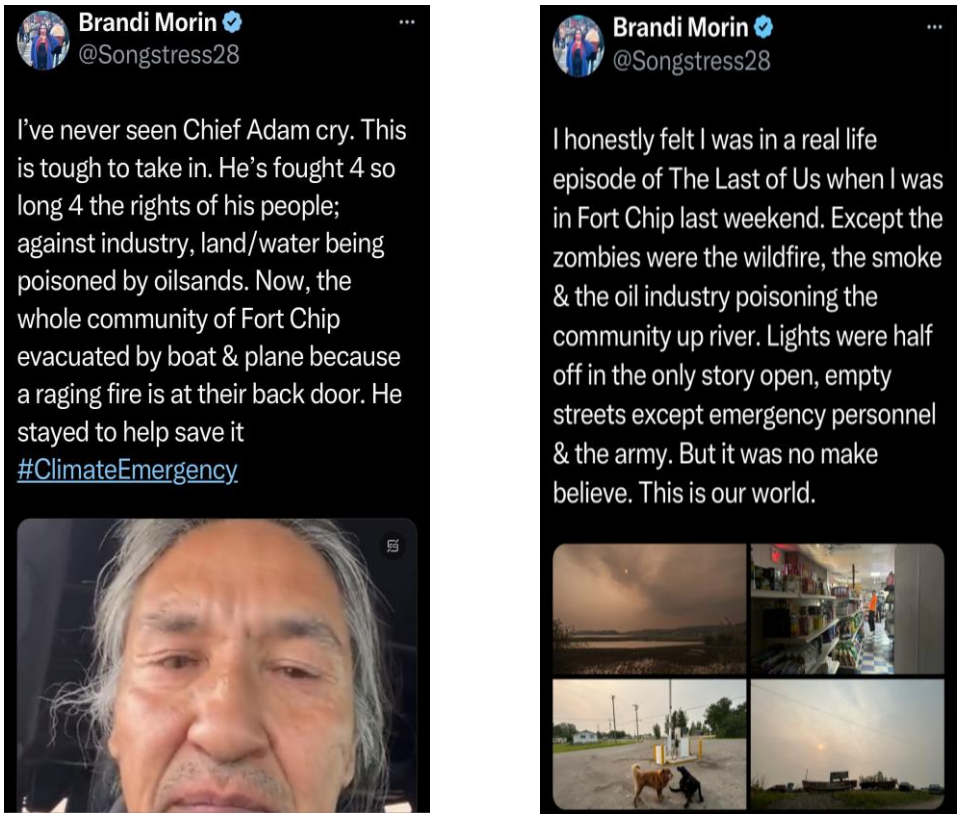
Figure 2.
Map of Treaty 8 Territory, Northern Alberta and location of Kearl Lake and image of a tailings pond.

Note: Image credits: Map (Anderson, D., 2023); Tailings Pond (Lenz, G. in Chow-Fraser & Doll, 2023)

In May of 2022, workers at Kearl Lake discovered a leak in a tailings pond (storage for waste materials), which was not reported for nine months until after a second spill, an "overflow" of 5.3 million litres of tailings was reported. The second spill prompted an Environmental Protection Order "nine months after the initial leak was discovered and continued to leak, meaning anyone could have used the contaminated area without being aware of the risks they were exposing themselves to" (Chow-Fraser & Doll, 2023, n.p.). Nine months of waste from Kearl Lake fed into the ecosystem, including boreal forest, muskeg, wetlands, rivers and lakes, and the traditional hunting grounds of the Athabasca Chipewyan First Nation, Mikisew Cree First Nation, and the Fort Chipewyan Métis Association – and the oldest settlement in Alberta, Fort Chipewyan (Regional Municipality of Wood Buffalo [RMWB], n.d.). Not only have these Northern communities been directly impacted by the Kearl Lake leaks, but historically, they have been (are) subjected to waste from the oil sands, resulting in elevated cancer rates and other health-related problems and environmental upheaval (Parades, 2023; Young, 2014). This year, in the fire season, the entire Fort Chipewyan community was evacuated due to forest fires,

resulting in community members leaving via airplane or boat as there is only winter road access (see Figure 3) (RMWB, 2023).

Figure 3.
Tweets (June 1 and 11, 2023) from journalist Brandi Morin.



Note: (Morin, B. [@Sonstress28], 2023, June 1; June 11)

The lack of desire to address climate change in Alberta is fueled by the economics of the fossil fuel industry, which allowed for leaks to continue without repercussions for months, adding to the years of pollution impacting the environment and the Fort Chipewyan community. This small northern community has been suffering under the weight of the fossil fuel economy, and this is but one example in this province and demonstrates the context in which children and youth are learning about how the government of Alberta privileges the fossil fuel industry over the environment and equity-denied people's basic needs. As the economic hub of the oil and gas industry in Canada, the curriculum for K-12 education is closely tied to the fossil fuel industry and resources to teach about environmental education are often funded by oil and gas

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companies (Lowan-Trudeau & Fowler, 2022). However, as we see the Earth respond to the climate crisis through increases in 'extreme weather' patterns and seasons morph as a result of rising global temperatures, for example, the crisis is also having an impact on children and youth's mental health (Burke et al., 2018; Majeed & Lee, 2017). Not responding to the climate crisis in K-12 classrooms questions the morality of K-12 education in preparing children and youth to respond to the climate crisis and giving them hope; however, preservice teachers need to be prepared and confident (Lawrence et al., 2021).

Research Design: Preparing for Growth

Students enrolled in my elementary Science methods courses in the winter of 2023 were invited to participate in this study, which involved passive data collection – meaning there was no expectation of active participation (Keusch et al., 2019; Maher et al., 2019). Passive data collection reduces the power imbalance, and as informed consent forms were not opened until after the course was completed, I had no idea how many or which students were participating. This form of data collection did not change how students engaged in the course, allowing students to learn without being affected by the research project. Participation in this project included students consenting to their in-course learning tasks being used as data, with 71 students consenting. During the course, students morincompleted four learning tasks, including a reflection on their Science teacher identity, a pedagogic content representation, a group project on designing a unit and lesson plans with a teaching demo, and a portfolio of their learning over the semester. Maher et al. (2019) identified privacy, data storage, and informed consent as key components of a research design involving passive data collection. At the beginning of the semester, I shared information on this research project with students, and informed consents were given to all students, which were then gathered by a colleague and placed in sealed envelopes, stored as per ethical guidelines until the end of the term. Once the course was completed and marks approved, the informed consent forms were opened, signed consents were pulled, and participating students' assignments were gathered from our learning management system for data analysis. A critical discourse analysis of the assignments for themes related to their Science teacher identity, climate change, and pedagogy provided the data for this paper.

Critical discourse analysis (CDA) of student artifacts for this project placed an "emphasis upon existing social realities as humanly produced constraints, which in certain respects unnecessarily reduce human well-being and increase human suffering; upon historical explanation of how and why such social realities have come into being; and upon possibilities for transforming

existing realities in ways that enhance well- being and reduce suffering" (Fairclough, 2023, p. 12). Thus, CDA provides a lens to allow for understanding preservice teachers' relationship with Science and how this relationship may inhibit their confidence in teaching Science from an inquiry approach amid the context of a province still enchanted by fossil fuels. Through the analysis of their assignments, I was able to gain insights into the ways in which my students' relationship with Science evolved through both their K-12 experiences as students and in their practicums. Not only was their apprehension with teaching Science a collective experience, but depending on the type of assignment completed for our class, their climate change anomie also emerged. As Ross (2020) shares, "critical discourse analysis offers a productive approach for understanding the ways in which anthropocentrism is enacted in educational materials, particularly in revealing the elemental ways in which the environment is framed" (p. 356) and not only did the analysis reveal climate change anomie but my analysis also provided me with a means to reflexively engage with my curriculum and pedagogy and reduce my own anthropocentric lens while building trust with my students and demonstrating leadership on climate change education. As movement towards reducing the anthropocene in curriculum grows in early childhood education and teacher education, we cannot overlook the ways in which instructors represent the environment in teacher education programs as it can either reinforce the anthropocene (nature benefits children) rather than an ecocentric approach where humans are "not the sole focus" (Harvey et al., 2022, p. 185).

As participants in this project were engaged in passive data collection, their interaction with the course was unhindered, and a critical discourse analysis provided an authentic read of their responses to the learning tasks – their "existing social realities" (Fairclough 2003; 2023, p. 12). The critical discourse analysis approach to the data revealed how preservice teachers constructed meaning on how they came to understand their relationship with Science and their openness to engage with teaching about climate change in their future practice – when they felt it safe to do so. All participating students' assignments were pulled after the course finished and given a close read to understand how preservice teachers grappled with their confidence in teaching Science and climate change. Analysis began by first a review of all assigned tasks to scan for initial themes as well as looking specifically for when students mentioned climate change/climate crisis. The reread of each assignment by type identified themes within each before I then completed a holistic read across the all the assignment categories. The first analysis of each category of assignment showed nuances such as with respect to how students came to develop a relationship with Science and inquiry and the holistic analysis showed where they were still

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apprehensive about engaging with climate change such as through representing and demonstrating content.

As a means to overcome climate change anomie, critical discourse analysis "does not simply describe existing realities but also evaluates them, assess the extent to which they match up to various values, which are taken (more or less contentiously) to be fundamental for just or decent societies" (Fairclough, 2023, p. 9). While all assigned learning tasks were analyzed, two types of tasks provided meaningful responses for this research project: the reflection on their Science teacher identity and the portfolio. Interestingly, the pedagogic content representation and group project had less engagement with climate change content, consistent with a lack of confidence in teaching Science and controversial topics. From the analysis, two themes emerged, including how preservice teachers developed their hesitancy with teaching Science and climate change and how their confidence improved during the course due to exposure to inquiry-based teaching and the skill to decide when issues are controversial and need to be taught despite conflicted views on climate change.

Seeds for the Garden

The content for the course was consistent with previous courses I taught. The only additions during this research project were selected chapters from the textbook *Teaching in the Anthropocene: Education in the Face of the Climate Crisis*, readings by Dr. Wayne Journell on controversial topics, and reading by Dr. Greg Lowan-Trudeau and myself on critical energy literacy. Journell's framework was used to assist students with deciding on climate change as an open, closed, or tipping issue (Journell, 2018). Open topics remain debatable amid multiple opinions to inform understandings. Issues such as the legalization of recreational drug in some societies are open issues, whereas closed issues have been decided upon by laws and legislation such as marriage equity. Tipping issues can move between open and closed based on societal attitudes or scientific innovations. For example, with the overturning of Roe v. Wade in the United States, abortion has moved from a closed to a tipping issue as women's reproductive rights are now in question again (Action Canada for Sexual Health & Rights, n.d.). Journell's (2018) framework gave students the skills to decide if climate change is an open, closed, or tipping issue. By naming climate change as a closed issue, for example, we collectively accept it as a reality based on evidence from Science, equity-denied groups impacted by climate change, and legislation such as Bill C – 50. Climate change is real – therefore, a closed issue. Naming climate change as a closed issue pushes educators to educate themselves and their students.

My students were divided on their perspectives of oil and gas. However, the classroom environment needs to be a place where ideas can be exchanged without fear of repercussions and a space where the denial of a closed issue is no longer tolerated. As the Kearl Lake example highlights, those impacted by climate change are often equity-denied groups. A Sturgeon Lake First Nation Scholar, Willie Ermine, stresses the importance of an ethical space of engagement, which is crucial when discussing controversial topics. Specifically, Ermine (2007) refers to engagement between Western and Indigenous knowledge, allowing for different worldviews to learn from each other, and he defines ethics as "the capacity to know what harms or enhances the well-being of sentient creatures" (p. 195). Creating an ethical space of engagement in the Science education classroom is crucial for students to grapple with teaching about climate change and models for preservice teachers on how to do so. Climate change denial continues to cause harm to members of the Fort Chipewyan community, and a lack of understanding of how climate change will impact the economy of Alberta maintains climate change anomie.

Once students in my class worked to decide if climate change is an open, closed, or tipping issue, they then engaged in learning about critical energy literacy, which is a theory that prompts learning about the various forms of energy, the role of power and inequality within energies, environmental impact, and global perspectives to encourage informed decision making that aligns with sustainability, social justice and environmental protection (Lowan-Trudeau & Fowler, 2022). Understanding the various forms of energy within the Science classroom offers a means for preservice teachers to teach about climate change and provide their future students with the knowledge to give them hope for their future (Lawrence et al., 2021). For example, a lack of understanding of Bill C–50, a Just Transition, fuels conflict when talking about climate change in Alberta, as this will impact the daily lives of Albertans, including the livelihood of some preservice teachers and their students. Therefore, as preservice teachers grapple with a lack of confidence in teaching Science, they need to be literate in the various energies and the impact of a Just Transition on the lives of Albertans. They also need to know how to represent this content in their classrooms pedagogically, and an inquiry-based pedagogic approach offers a strong means for them to do so in their future classrooms.

Results: A Garden of Controversy

The analysis of the artifacts, focusing on the Science teacher identity reflection and learning portfolio, generated two overarching themes: seeds of hesitancy and growth in confidence. As mentioned, the other two assignments did not provide meaningful insights into the project. However, no data is also data. These two

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assignments are pragmatic and not only explore pedagogic content knowledge in Science but provide an opportunity for preservice teachers to demo their content with the support of their colleagues and instructor. However, this lack reinforced that low confidence, even in a supportive teacher education course, did not encourage preservice teachers to risk engaging with climate change in Science education. In a classroom environment where marks and evaluation are not criteria for success, there may be more willingness to engage with climate change and inquiry in pragmatic assignments. The pressure to perform in high-stakes environments inhibited pedagogic explorations.

The first theme, seeds of hesitancy, arose in the first assignment: a reflection on their Science teacher identity. This written reflection provoked participants to revisit their memories of being a student in K-12 Science classrooms, as a university student, and their reasons for becoming a teacher. Students draw on their experiences and relevant research but are challenged to dive deep and consider how their relationship with Science was developed. The second theme, growth in confidence, was informed by the final assignment, a portfolio of their learning over the semester. Students are asked to respond to prompts and revisit and reflect on previous assignments. For example, they must reread their Science teacher identity reflection and consider whether their relationship with Science has evolved. They must also reflect on working collaboratively in a group and engage in an inquiry project to build skills in inquiry. In the summer and fall of 2022, in Canada, we experienced 'lettuce loss.' Due to a combination of factors, primarily caused by 'extreme weather' decimating the crop in California, which supplies "70% of Canada's lettuce," lettuce was either not on the shelves, on our burgers, or was incredibly expensive, and the lack of ability to harvest our own food was remarkable (Silvestre, 2022, n.p.). To respond to the 'lettuce loss,' this teacher-led inquiry project asked preservice teachers to grow food from food waste over the semester, and they needed to use the scientific method to inform how they approached the inquiry and gathered data. At the end of the term, we produced a garden that included tomatoes, peppers, potatoes, avocado, kiwi, celery, lettuce, onions, mint, scallions, and beans! And we grew confidence!

Theme 1: Seeds of Hesitancy

In the Science teacher identity reflection, students are provoked into revisiting how they came to know Science – what was their relationship with Science as a student in K-12 education, and for some, as university students. Overwhelmingly, participants stated their hesitancy about becoming a Science teacher was due to a lack of engagement in K-12 Science classes. The lack arose partly from teacher-centric focused classrooms with little exposure to inquiry.

Participants spoke about the lack of engagement with inquiry in their K-12 Science classrooms. One stated, "I don't remember much of my Science experience, and I believe that is due to the fact it was taught to me in a very black and white, right and wrong way of thinking." Another stated, "I spent most of primary school disliking it [Science]. My recollection was of a monotone voice at the front of the classroom trying to explain complex topics to a disengaged classroom." The idea of right and wrong, black and white, my way or no way, predominated in teacher-centric classrooms. One participant shared that their experience in high school was "spent writing pages of notes at our desks while our teacher flipped through a PowerPoint at the front of the classrooms. Things were very much black and white. You were either right or wrong." One student also summarized their hesitancy with teaching Science because of teacher-centric pedagogies as "there was no inquiry, questioning, or inspiring curiosity," and another reiterated the either-or mentality, believing that "Science was either right or wrong, there was not much room for interpretation or for various perspectives."

Gendered and racialized representations of Science also hindered engagement. One female student who loved Science in elementary school found that this changed in high school as Science was "for boys or men" and "there was not space for me there," while another female student reflected that "most of my teachers were male and my friends had bad experiences in Science because they weren't confident in the male-dominated field." Another student reflected that "from grade 7 onward, all of my Science teachers were older white, male teachers." A lack of diversity in content also impacted students' ability to connect with Science. Many participants reflected that focusing on Westernized Science inhibited their engagement with understanding different worldviews, reinforcing the right or wrong way to 'do' Science. One participant stated that their "educational journey was constantly composed of one-sided Westernized beliefs about Science," and another said they lacked the opportunity to "explore different perspectives." The lack of diversity in Science content caused many to feel "no connection" to the content, and with a teacher-centric pedagogic approach, participants felt disengaged, some stating they "fell through the cracks." This hardline singular approach to Science resulted in participants believing this grew their hesitancy to teach Science in their careers as they feel responsible for providing different learning experiences to their future students. Participants reflected that "they were not good enough," and despite working hard to learn concepts, they still "struggled" because they felt "no connection" to their learning and were unable to make meaning from concepts, which impacted their academic achievement. Poor grades in Science resulted, reinforcing their perceived inability to teach Science.

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When students reflected on their practicum experiences, there was a small movement towards some confidence. However, this was often from within a teacher-centric model. The majority of students did not have the ability to engage in inquiry or even to teach Science. For those who were able to teach Science, there were still feelings of incompetence as they did not have the ability to "be the teacher" in the room and lead pedagogically. One student stated that they were nervous about teaching Science in their practicum. However, their mentor teacher had "all of the Science content already laid out for the year," and their "job as a preservice teacher was to follow these workbooks." Another practicum experience only allowed for a participant to "observe a couple of Science classes" as "Science was not a priority in their classroom," and another's mentor teacher altered the preservice teacher's lesson plans, resulting in them having to teach in a "more traditional way such as worksheets." Participants who were not given opportunities to teach in a Science classroom or explore non-transmission-based pedagogies continued to feel hesitant about teaching Science in their careers. In addition, the content remains a barrier, one stating that the curriculum is "intimidating," and this moved those who did have the opportunity to teach Science in their practicums to stay with a teacher-centric approach. One participant stated that they "truly struggled" in their practicum and did not deviate from the transmission-based pedagogy they grew up with: "I found myself steering more toward a teacher-centred approach instead of a student-centred one." This was common. When educators lack the confidence to try new pedagogies or engage with content they are unfamiliar with, we return to what we know, and as many participants learned Science from a Western lens with a right or wrong paradigm through transmission-based pedagogies, they returned to their comfort zones. One stated that they "ended up having to resort back to focusing on the Westernized view" rather than include Indigenous and other worldviews of Science and inquiry; another stated that they "immediately gravitated towards a teacher-led instruction style of teaching."

Theme 2: Growth in Confidence

The final assignment in the course is a learning portfolio for preservice teachers to reflect on their learning and the learning outcomes for the course and revisit previous learning tasks – have their perspectives changed? In addition, to allow preservice teachers to participate in an inquiry project, my students responded to the loss of lettuce we experienced by growing food from food waste. Students were to choose any food or seed (not from a package), design an experiment, and monitor growth over the semester. Students stated that their growth in confidence over the term increased, and those who felt confident already stayed consistent. All students increased their confidence by trying

inquiry and student-centred pedagogies. All also stated they had increased their ability to respond to climate change in their lesson planning and found ways to consider how they would justify doing so. One student commented, "during our class discussions and readings, I have been exploring and reflecting on ways I can develop my practice to promote discussions on climate change." Another spoke about the youth climate strikes and that youth need to be supported as they "are passionate about fighting for environmental sustainability," and another shared that "Science has difficult topics about which a teacher has to be informed and prepared for the hard conversations to help students to be able to have/find information." Students overwhelmingly felt the need to engage with climate change in their practice in a student-centric approach to provide meaning for their students.

The most common way participants stated they would engage with climate change would be low-risk through current events, which involves a cross-curricular approach with Social Studies, an area they stated they were confident with. However, I challenged students to find a curricular connection with the Science curriculum. To move beyond glossing over climate change, tying it to our curricular outcomes in Science encourages deep learning and critical thinking. In doing this, students used Journell's framework to decide that climate change was a closed issue and then drew connections to curricular outcomes. Some examples of Science-curricular connections occurred in grade three: dog adoptions during the pandemic, climate change's impact on bird migration patterns, and bison's being returned to Montana. In grade 4, connections included fertilizer overuse; in grade 5, connections to the Kearl Lake oil spill, the city busses transitioning to electric; and in grade 6, deforestation in national parks and protecting the great lakes. One student reflected on Journell's framework as being helpful to them when considering bringing controversial topics into their practice, but they extended their thoughts as they felt "government policy" is "not consistently reliable," as demonstrated above by the Premiers of Alberta who continue to resist embracing sustainable renewable energies. One student felt that the framework helped them to "be prepared to handle pushback," and another stated that while "it can be hard to determine if an issue is open or closed," they believed that "climate change is a closed topic and can be discussed." In addition, the critical energy literacy framework supported deep learning and an opening into inquiry, as noted by one participant who said that the "examination of energy sources was a relevant and meaningful topic that students could connect to their everyday lives." Another stated that this approach would allow students to "examine sustainable and 'green' energy sources" used in their communities. One student stated that the coupling of Journell's framework and critical energy literacy "creates meaningful

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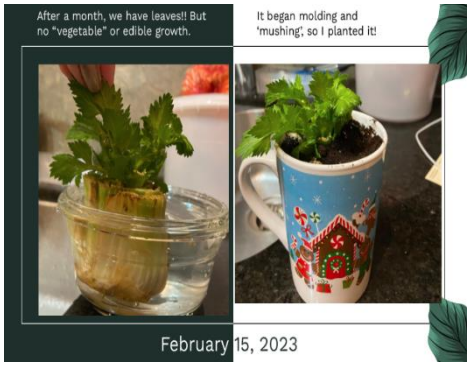
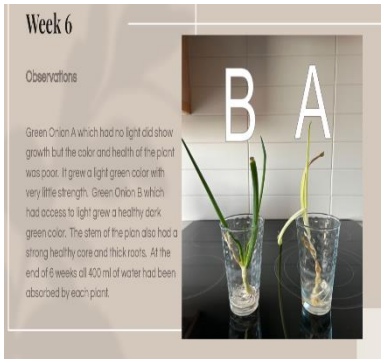
learning opportunities, promotes the development of scientific literacy, and increases students' global awareness."

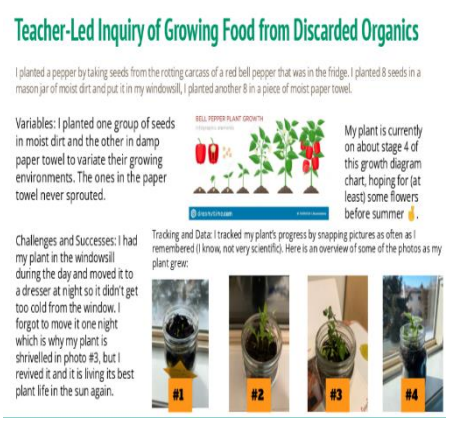
The other area where there was considerable growth in confidence was with a non-transmission pedagogy: inquiry. Based on their reflections from the first assignment, there were varying degrees of experience with inquiry as K-12 students and in their practicums; therefore, they needed to have this experience in their methods course. This project was also connected to a current event, the lettuce loss due to the California crop loss in 2022, but students also had to find curricular connections with the Science curriculum, which there were many across grades K-7. Participants embraced inquiry. One stated they would now "incorporate it [inquiry] into my future classroom with confidence," and another said they "want to have an inquiry-based classroom where students can explore and investigate." Reflecting on their transmission-based experience in K-12, a student stated that they "have learned that I do not have to teach Science the way I was taught, in fact, I shouldn't," another stated that they are "more comfortable adopting a student-centred approach." One student reflected on their practicum experience and said, "If I could go back now, I would approach how I taught Science in my practicum differently. In both practicums, I focused on transferring knowledge and how the students could remember and repeat it."

Not only did the project grow skills in student-centric pedagogy, but it also enhanced our classroom community. As their inquiry into growing food from food waste progressed, students would come into class excited that they had sprouts or roots forming and would share pictures with me and their table mates. Towards the end of the term, students brought tomato plants to share (some are in our garden), potatoes to show their table mates, and salad made from their kitchen counter gardens. Images below in Figure 4 show some of the data gathered during their inquiry project, and our classroom garden produced a bounty of ready-to-eat food and plants for their gardens, including tomatoes, peppers, potatoes, avocado, kiwi, celery, lettuce, onions, mint, scallions, and beans. One student reflected on using this project in their classroom and the various benefits, including teaching children how to grow their food, as "we have lost sight of the growing process, and students will gain a better understanding of what it takes to grow food."

Figure 4.
Data from students' inquiry project.







Findings from The Bounty: A Garden of Confidence

Over the course of the semester, students were able to critically analyze their relationship with Science and how this has impacted their hesitancy about becoming a Science teacher and their climate change anomie. Their ability to participate in an inquiry project helped them grow their confidence in engaging in inquiry in their future practice. They recognized that transmission-based

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pedagogies did not promote their engagement as K-12 students and desired different experiences for their students. Representation of diversity in who is teaching was important for racialized and gendered participants, but all students recognized the importance of different worldviews in Science education. The right or wrong legacy of Western objective Science is not a true representation of Science as great moments in Science were not born from the white 'fathers of Science' but from the Golden Age of Islam and Indigenous Ways of Knowing, for example. Participants were more confident teaching about climate change when there was less focus on Westernized Science, and when participants had land-based learning experiences in their schooling and practicums, they felt even more prepared to create more engaging Science classrooms. When participants did not have the ability to practice, they fell back into teacher-centric approaches and Western views of Science as well as when Science was not a priority for their mentor teachers, participants were denied the opportunity to teach Science or engage in inquiry. The recommended allocations for core instructional time determine the priority of content. In Alberta, core content in grades 1 and 2, English is at 30%, Maths at 15%, and Social Studies and Science are at 10%. Grades 3 to 6 include English at 25%, Maths and Science at 15%, and Social Studies at 10% (Alberta Education, 2023). Participants who did have the support of their practicum teachers to teach Science and try student-centric pedagogies felt increased confidence, whereas those who did not have the opportunity to stretch their skills did not grow their confidence.

While all students felt prepared to respond to climate change in their future classrooms, they did so in a low-risk manner, even within a classroom space that we intentionally established after Willie Ermine's ethical space of engagement, the weight of being in a province which relies on fossil fuels dominated due to the fear of their grades being impacted or other forms of repercussions such as family finding out they were talking about climate change. During their other two assignments, including their teaching demos, there was little engagement with climate change, but in the final assignment, all connected climate change to current events. The cross-curricular connection between Social Studies and Science offered the safest place for participants to talk about climate change. Connecting their 'event' to the Science curricula, using Journell's framework, and engaging in critical energy literacy gave them the confidence to extend beyond the current event space. The presence of oil and gas in participants' family life and our province remained a barrier, and the lack of leadership to engage with Science on climate change is intimidating. While participants drew connections to climate change in current events, no content was tied to the Just Transition. This could have been because participants thought the Just Transition is content not suitable for elementary students. However, the lack is striking. Apprehension with the Just Transition arose in

class discussions, with many feeling that the Just Transition will impact their future students and their families in a negative way because of job losses in the oil and gas industry.

An interesting finding arose as students who had land-based experiences, being on the land through either their home life or K-12 experiences, felt the connections between the land and climate change would give them the confidence to move beyond transmission-based pedagogies. Land-based learning was seen as a natural space to talk about climate change, and this could also support mental health, as learning outside has been shown to increase positive mental health (Mann et al., 2022). However, this project has reminded me to move away from the anthropocene connection, and while yes, being outside improves the health of children and youth, 'going outside' must be done from an ecocentric lens and encourage reciprocity with the land. Ecoanxiety is also rising among students, and schools and teachers need to overcome climate change anomie and support K-12 students in understanding climate change and how we can work to protect our planet. Pedagogies of hope arise when children can have space to talk about their concerns and engage in meaningful learning experiences, such as finding ways to combat climate change and learning through an ecocentric approach (Lawrence et al., 2021). However, for future generations to be educated on climate change, preservice teachers must be prepared to have confidence in Science education and pedagogies that allow for inquiry to flourish.

Concluding My Anomie

This project offered insight into my practice, a reflexive self-study into my gaps in how to support preservice teachers, as well as the need for an approach that shifts from the anthropocene to ecocentric Science education. Engaging in more intentional land-based learning in addition to inquiry seems to have the opportunity to support preservice teachers with more confidence in Science education, but it must be done from an ecocentric approach and with a less 'traditional' Western Science and objective lens. This also opens up an avenue for inquiry with respect to colonial legacies in Western Science and how they reproduce the anthropocene in our K -12 classrooms. The pressure of grades in our classrooms prevented preservice teachers from stretching their growth into engaging in controversial topics and student-centric pedagogies. During the teaching demos, there was engagement in land-based learning, so this provides a window of an opportunity to engage with climate change on the land as a learning opportunity. The ability to remove grading and move to a pass/fail assessment model may also allow preservice teachers to experiment more freely (Burke, 2020).

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A negative from this work did arise in student surveys on instruction, already a contentious practice in higher education (Charbonneau, 2013). A few students stated that my focus on climate change was "ideological," and better time could have been spent on the "methods of teaching Science." Support of instructors taking on climate change in a province like Alberta is also needed if we are to focus on teaching preservice teacher's skills to engage in climate change education and inquiry to promote critical thinking. To do otherwise "diminish[es] the possibilities for the future at every turn" (Kimmerer, 2013, p. 383), and we have a moral imperative to strengthen the skills of our preservice teachers to reduce climate change anomie.

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