Learning with the Head and the Heart:

Exploring Emotional Experiences in Post-Secondary Environmental Education

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

In a time of widespread climate change and environmental degradation, ensuring the efficacy of environmental education to inform and empower the next generation to make meaningful change is more important than ever. However, existing approaches to environmental education largely fail to acknowledge or consider the impact of emotions on student learning, well-being and pro-environmental behaviour. The purpose of this master's thesis was to explore students' emotional experiences of post-secondary environmental education with the goal of gathering information that could inform curricular and pedagogical recommendations for educators and institutions. My research was guided by three objectives: (1) to capture and articulate a broad range of students' emotions in association with the post-secondary environmental curriculum and/or pedagogical experience; (2) to determine if and how the emotional experience varies within the environment student population based on educational stage (early undergraduate, late undergraduate, master's); and (3) to make student-led recommendations to environmental curriculum and pedagogy to address and support students' emotional experiences. I took a pragmatic, mixed-methods approach to achieve these objectives using online surveys, a participant-driven photo-elicitation activity, and subsequent individual semi-structured interviews. Data were collected from post-secondary students at two Canadian universities and analyzed in R and NVivo.

Survey data showed that students experience a broad range of positive and negative emotions in response to the curricular and pedagogical aspects of their environmental degrees. These emotional experiences varied in frequency, intensity, and persistence with anxiety, sadness, happiness, and inspiration being more frequently, intensely, and persistently experienced. Extensive data from photo-elicitation and subsequent interviews revealed a rich tapestry of emotional responses related to specific curricular and pedagogical sources with anxiety, anger, dread, hopefulness, curiosity, and connection being the most frequently discussed by participants. Negative emotions resulted from learning about climate change and environmental issues, a perceived lack of action from parties in power, and environmental inequities, and from a lack of opportunities to meaningfully engage with the material and each other. Positive emotions resulted from learning about environmental success stories and solutions, and the wonder of the natural world, and from creative teaching approaches, engagement opportunities, and a positive focus.

To improve the emotional experience of environmental education, students recommended the following measures: welcoming emotions in the learning environment; increasing opportunities for real-world action and application; embracing experiential learning and creative pedagogy; building community; and expanding solutions-oriented content. These student-led recommendations were well supported by existing peer-reviewed literature.

My research fills an existing gap in the available literature on student climate emotions and post-secondary EE. While several studies exist at this intersection, my study makes novel contributions in the form of a multi-dimensional measure of emotions in this context, and specific curricular and pedagogical sources of the emotions discussed. My research has the potential to inform curricular and pedagogical recommendations for environmental educators to improve students' emotional experiences in post-secondary environmental education.

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1.0 Introduction

In this introductory chapter, I describe the broader problem context and research questions. Next, in the literature review, I provide a theoretical foundation upon which my research is founded. In the methodology chapter, I outline the philosophical backing, research context, and data collection and analysis methods used for my research. I have opted to include a positionality statement to provide the reader with additional context on how my identity has intersected with and informed the research process. I then report results and interpret them in the discussion section, where limitations and future directions for research are identified. Within the conclusion, I reiterate key points and highlight the contributions and implications of my research.

1.1 Problem Context & Research Rationale

Climate change and its devastating effects are becoming more severe, frequent, and far-reaching, posing a direct threat to survival, livelihood, community, culture, and well-being (Clayton et al., 2017; Guthrie, 2023; Intergovernmental Panel on Climate Change [IPCC], 2018; Ogunbode et al., 2022; Smith et al., 2022; Tschakert et al., 2017). We continue to exceed planetary boundaries, pollute, and degrade habitats, and overconsume finite resources (IPCC, 2021). The health of our planet and its inhabitants is at risk, and as the stakes (and the oceans) rise it becomes imperative that we take swift, effective, and equitable action toward a more sustainable future. The U.S. Environmental Protection Agency (2023) argues that "to pursue sustainability is to create and maintain the conditions under which humans and nature can exist in productive harmony to support present and future generations." An equitable society is one "characterized by justice, equality, impartiality and fairness, including fair and equal distribution of power, economic resources, opportunities, goods and services across the social spectrum" (United Nations, 2009, p. 9). Sustainability and equity challenges are inevitably intertwined, so the solutions must be concurrently pursued (Clark et al., 2011b). These definitions force us to consider the question: what does productive harmony look like and how can we ensure that for generations to come? Given this urgent scenario, our educational institutions' ability to inform and empower new environmental stewards, activists, scientists, policymakers, and citizens to take meaningful action on complex environmental challenges is a top priority (Bryan, 2020; Field et al., 2023; Mulkey, 2017; UN Climate Change Conference, 2021).

Obtaining a post-secondary environmental education (EE) requires students to engage with difficult topics like climate change and environmental issues on a daily basis (Campbell, 2023). Engaging with this type of information is accompanied by complex, sometimes negative emotional experiences (Pihkala, 2022). Research shows us that emotions have powerful influences on learning (Li et al., 2022), well-being (Clayton et al., 2017), and pro-environmental behaviour (Carmi et al., 2015). These three outcomes are major aims of post-secondary institutions and EE programs (Royal Roads University, 2022; University of Waterloo, 2020). Though goals vary between institutions, professors in post-secondary environmental education (EE) -- discussed further in Chapter 2 -- typically teach their students to recognize environmental issues and potential solutions, implement those solutions, and foster pro-environmental behaviours in their own lives, work, and communities (Clark et al., 2011a; Field et al., 2024; Mangas et al., 1997). While disseminating factual information about climate change and environmental issues is sometimes mistakenly conflated with generating pro-environmental behaviour, researchers have shown us that psycho-social factors including emotions have proven to be more troublesome obstacles to pro-environmental behaviour than knowledge deficits (Carmi et al., 2015; Davidson & Kecinski, 2021; Gifford et al., 2018). Yet these psycho-social factors have been largely overlooked in EE where the climate change curriculum potentially evokes strong emotional reactions and contains implicit and powerful normative messages, despite a pedagogical focus on 'delivering the facts' (Truelove et al., 2015; Sylvestre

et al., 2013; Zembylas & Schutz, 2016). However, to empower students to tackle the climate crisis in their personal and working lives, it has been suggested by previous researchers that environmental post-secondary programs should acknowledge and leverage the potentially powerful impact of emotions on learning, pro-environmental behaviour and decision-making for positive outcomes as described below (Field et al., 2024; Lorenzoni & Whitmarsh, 2014; Van Valkengoed & Steg, 2019). This claim is explored further in Chapter Two.

A more nuanced understanding of the emotions students associate with environmental post-secondary curriculum and pedagogy, and the variation in those emotional experiences, could strengthen educational interventions and post-secondary institutional goal achievement (Field et al., 2024). Through my master's thesis, I contribute to the growing research on emotions and EE, informing curricular and pedagogical adaptation and intervention development to meaningfully address emotions (and their subsequent impacts) in post-secondary EE. Further clarity on emotions' role in post-secondary EE can lead to improvements in learning outcomes, pro-environmental behaviour, and the well-being of the next generation of environmental leaders fighting the climate crisis.

1.2 Research Question and Objectives

My research is part of a Social Sciences and Humanities Research Council's Partnership Development Grant (SSHRC-PDG) led by Drs. Sarah Wolfe and Michael-Anne Noble at Royal Roads University and Dr. Christine Barbeau at the University of Waterloo. The research team contributing to this project includes faculty members and students from both universities. As a research team, we are collaborating on multiple interrelated studies to explore emotions' role in learning and decision-making outcomes within post-secondary EE. Based on these findings, we will generate research-based recommendations for the emotional dimensions of EE.

The purpose of my project -- resulting in this master's thesis -- was to explore students' emotional experiences of post-secondary EE with the hopes of gathering information that could inform curricular and pedagogical recommendations for educators and institutions. Specifically, I focused on the following research question and research objectives subsequently referred to in this text as RO1, RO2, and RO3:

Research Question: "*What is the nature of students' emotional experiences of post-secondary environmental curriculum and pedagogy and how might those emotional experiences differ by educational stage?*"

> **RO1:** Capture and articulate a broad range of students' emotions in association with the post-secondary environmental curriculum and/or pedagogical experience.
> **RO2:** Determine if and how the emotional experience varies within the environment student population based on educational stage (early undergraduate, late undergraduate, master's).
> **RO3:** Make student-led recommendations to environmental curriculum and pedagogy to address and support students' emotional experiences.

A review of existing literature follows below to provide a theoretical foundation upon which this research is built and a justification for the above research objectives.

2.0 Literature Review

For this thesis, I draw upon several bodies of literature including environmental psychology and emotions research, and environmental and climate change education research. In this literature review, I explain climate emotions, their multi-dimensional complexity, and their potential impacts. I then describe the emotional experience of environmental education at the post-secondary level and identify important gaps in this body of research.

2.1 The Multi-Dimensional Complexity of Emotions

Emotions research has a long and complex history (Patulny, 2019; Scarantino & de Sousa, 2018). According to Patulny (2019), emotions in late modernity in a Western context can be characterized by their increasingly complex, individualized, commodified, and mediated nature. Emotions are often conceptualized as a "private responsibility," internalizing, psychologizing, and drawing attention away from the social problems they are a response to (Patulny, 2019). Our increasingly capitalistic and commodified world where corporate media is largely inescapable further complicates our emotional experiences (Patulny, 2019). Considering the broader social, cultural and societal context in which our emotions occur can provide thought-provoking insights into our emotional experiences. Building upon Ekman's (1999) work, which argues that a limited number of "basic emotions" are accompanied by culturally shared and distinctive facial expressions, more recent research finds that these basic emotions can "combine in socially constituted ways to form more complex emotions" (Patulny, 2019, p. 15). For example, a 2017 study by Cowen & Keltner identified and located 27 distinct emotional categories within a structure of reported emotional experience using self-report methods. Numerous overlapping and conflicting theories, conceptualizations, and definitions of the term "emotion" and adjacent terms exist making this a rich and complex field of study (Barrett et al., 2016; Scarantino & de Sousa, 2018).

For my research purposes emotion has been defined as "a complex reaction pattern, involving experiential, behavioural, and physiological elements, by which an individual attempts to deal with a personally significant matter or event" (American Psychological Association [APA], 2018a). Emotional responses have three primary components: subjective experiences, physiological changes, and behavioural changes (Stevens, 2020). Through this research, I focused solely on subjective experiences, relying on self-report data collection methods which capture information about participants' internal states (Barrett et al., 2007). While physiological and behavioural elements permit external and arguably more "objective" emotional measures, self-report measures remain an absolute necessity to understand the internal experience of the conscious state, mental representation, and "feeling" so intimately tied to emotional experiences (Barrett et al., 2007). As Pekrun (2019) asserts, "For a nuanced picture of emotions, self-report is indispensable" (p. 1810).

This research will focus on emotions specifically related to curricular and pedagogical aspects of post-secondary EE, which are likely to overlap heavily with 'eco-emotions' or "emotions which are significantly related to ecological issues" (Pihkala, 2022, p. 2). Emerging research at the intersection of environmental issues, climate change, and emotions is informed by the sub-discipline of environmental psychology. For example, Dr. Robert Gifford, a Professor of Psychology at the University of Victoria in British Columbia, has been conducting environmental psychology research for decades. Much of his research explores the psychological barriers to climate change mitigation and adaptation, including emotions (Gifford, 2011). Climate change is a key focus of EE curricula, and therefore 'climate emotions' are also of direct relevance. Climate emotions can be defined as "affective phenomena which are significantly related to the climate crisis" (Pihkala, 2022). This body of research on environmental issues' emotional dimensions

has rapidly expanded in recent decades (Gonzáles-Hidalgo and Zografos, 2020; Ojala et al., 2021; Salas Reyes et al., 2021; Thoma et al., 2021).

Emotions related to environmental issues, and climate change more specifically, are diverse and evolving as are their terms and definitions (Pihkala, 2022). New terminology has been created by researchers in this field to describe these specific environmentally-related emotional experiences including eco-anxiety, eco-grief, and many others (Albrecht et al., 2007; Cunsolo & Ellis, 2018; Lewis, 2018; Pihkala, 2018). Some of these terms were coined not by psychologists, but by environmental scholars who have spent decades working at the intersection of sustainability, climate change and health. For example, Dr. Glenn Albrecht an environmental philosopher and Professor of Sustainability, coined the term 'solastalgia' in 2003, which combines the words 'solace' and 'nostalgia' to describe the emotional "distress caused by the transformation and degradation of one's home environment" (Galway et al., 2019, p. 1). However, many of these terms including most notably solastalgia and eco-anxiety have been acknowledged, accepted, and used by psychology experts and professional organizations like the American Psychology Association in exploring and addressing the mental health impacts of climate change (Clayton et al., 2017). While these terms are relatively new, the idea of being emotionally connected to the environments in which we live is not (Mashford-Pringle & Stewart, 2019).

A recent study of Canadian youth found that fear, sadness, anxiety, helplessness, powerlessness, and anger were reported as the most common emotions related to the climate crisis (Galway & Field, 2023; Pihkala, 2022). Although less prevalent, positive emotions have also been captured in relation to climate change and other environmental issues including motivation, empowerment, hope, pride, togetherness, care, and compassion among others (Pihkala, 2022). To understand and organize the emotional states covered by the interdisciplinary literature on emotions relating to environmental change, Pihkala (2022) created a non-exhaustive and flexible climate emotions taxonomy informed by a thorough overview of recent studies. Dr. Panu Pihkala is an adjunct professor of Environmental Theology in the Faculty of Theology at the University of Helsinki in Finland. He is an interdisciplinary researcher who specializes in the psychological, emotional, and spiritual aspects of climate change and environmental issues and an eco-anxiety expert. The studies selected as key sources by Pihkala (2022) to inform his taxonomy included peer-reviewed research articles which empirically observed and discussed five or more climate emotions, and self-report surveys conducted in the fields of environmental education and environmental psychology exploring many emotions related to climate change. As noted by Pihkala (2022) existing literature on emotions relating to the climate crisis and environmental change includes sources from a diversity of disciplinary and methodological backgrounds whose conceptual understandings and definitions of terms vary. See Table 1 below for an adapted summary of the general categories of climate emotions discussed by Pihkala (2022) which informed the study design and methods used in this research.

Table 1: *Categories of climate emotions from literature (Adapted from Pihkala, 2022).*

Emotional Category	Valence	Examples
Surprise-Related	Positive/ Negative	Amazement, awe, wonder, surprise, disappointment, confusion, feeling disoriented, upset, troubled, disturbed, shock, trauma, feeling isolated, etc.
Threat-Related	Negative	Fear, worry, anxiety, dread, helplessness/powerlessness, feeling overwhelmed, terror, panic, etc.
Sadness-Related	Negative	Sadness, grief, solastalgia, yearning, longing, feeling blue or low, feeling lonely, etc.
Guilt-Related	Negative	Guilt, shame, embarrassment, regret, remorse, feeling inadequate, etc.
Indignation-Related	Negative	Indignation, moral outrage, betrayal, etc.
Disgust-Related	Negative	Disgust, aversion, resentment, etc.
Anger-Related	Negative	Anger, rage, frustration, feeling irritated, etc.
Envy-Related	Negative	Envy, jealousy, admiration, etc.
Hostility-Related	Negative	Hostility, contempt, feeling skepticism or doubt, schadenfreude, boredom, etc.
Motivation-Related	Positive	Motivation, urge to act, determination, etc.
Pleasure-Related	Positive	Pleasure, joy, pride, contentment, happiness, etc.
Hope-Related	Positive	Hope, optimism, empowerment, etc.
Belonging-Related	Positive	Belonging, togetherness, connection, etc.
Caring-Related	Positive	Love, empathy, sympathy, care, compassion, etc.

Categorizing emotions in this way helps us to build comprehension and awareness of our emotional experiences and develop emotional literacy (Pihkala & Kamenetz, 2022). However, while these categories are useful to help us understand the vast spectrum of human emotion, the experience of human emotion is much more complex in practice. Although categorical labels are useful in understanding humans' emotional range, emotional categories are more blurred than they are distinct (Cowen & Keltner, 2017; Tschakert et al., 2023). It is also important to note that emotions, including climate emotions, do not always occur in isolation, but subsequently or concurrently (Lewis, 2016; Pihkala, 2022). While research often frames specific emotions as "positive" or "negative," neither category is explicitly good nor bad, right nor wrong (Ojala, 2023). This conceptualization of emotions as "positive" or "negative" is often referred to as valence (Bellocchi & Turner, 2020). Valence is a complex concept and research shows that although some emotions are typically referred to as pleasant or unpleasant, depending on the context, the same emotion can sometimes be more positive or negative (Bellocchi & Turner, 2020). For example, anger can be considered a pleasant experience when associated with justice achievements, or an unpleasant experience characterized by hate and violence (Bellocchi & Turner, 2020).

All emotions are a part of humans' diverse emotional experiences and are responses to complex personal and societal problems (Ojala, 2023). Western society caters to and rewards positive emotions, often shaming, ridiculing, and dismissing negative emotions as "irrational" or "inappropriate" (Ojala, 2023) and "there is a deep cultural pressure in the West not to be a 'doom and gloom merchant'" (Head, 2016, p. 2). Many social consequences of emotions are determined in part by the perceived appropriateness of the emotion for the situation at hand; "emotional expressions that deviate from implicit or explicit norms and expectations may be perceived as inappropriate" (Van Kleef & Cote, 2022, p. 644). Hochschild (1979; 2012) refers to this concept as "feeling rules," which "provide parameters for the types and intensity of emotional expressions that will be interpreted as appropriate by other participants in a given social encounter" (Cox & Neumann, 2022, p. 252). If social norms within EE contexts ignore or deem negative emotions inappropriate, students may be inadvertently encouraged to

suppress those emotions, which can lead to negative outcomes including the jeopardization of close relationships and missed opportunities to foster motivation and empathy (Beasy et al., 2023; Van Kleef & Cote, 2022).

While negative emotions can be maladaptive in more severe cases and lead to mental health impacts, we frequently overlook their adaptive functions (Brosch, 2021; Clayton et al., 2017). For example, anxiety can play an important role in encouraging information-seeking and problem-solving behaviours, and it can be a motivational force for action (Clayton, 2020; Verlie, 2019). Eco-anxiety can be a healthy, appropriate, and empathetic response to climate change as it "exhibits concern and care for the planet and those suffering" (Pihkala, 2020, p. 12). Similarly, anger is often related to concerns about injustice and inequity (Laws et al., 2014). It is important not to pathologize these emotional reactions which are justified and normal responses to a real, severe, and present existential threat like climate change (Brosch & Sauter, 2023; Thoma et al., 2021). As a result, post-secondary EE should not attempt to remove "negative" emotional experiences but embrace, acknowledge, manage, and leverage them for positive outcomes, such as self-reflection, emotional intelligence, self-efficacy, and constructive action (Boler, 1999, Ojala et al., 2023).

In addition to having a positive or negative valence, there are multiple dimensions to discrete emotional experiences including frequency, intensity, and persistence (Davidson, 1998; Klonsky et al., 2019). Collectively, these dimensions are referred to as "affective chronometry" and combine to create unique emotional experiences (Klonsky et al., 2019; Rothbart & Derryberry, 1981). Without considering affective chronometry, emotional experiences can be perceived as one-dimensional, missing important nuances. For example, imagine a post-secondary environmental student who occasionally feels very intense and persistent anxiety in response to curricula, compared to a student who feels mild anxiety every day in response to curricula. Both students experience anxiety, but their experiences vary in important ways and might benefit from different responses and supports. Capturing the multiple dimensions of students' emotional experiences in post-secondary EE increases the potential for understanding and developing appropriate responses and interventions.

2.2 Emotions in Post-Secondary Environmental Education

Our planet is facing an unprecedented barrage of environmental threats from land use intensification to deforestation to biodiversity loss, but climate change has become the socio-environmental issue of our time. Every biome, ecosystem, and species on Earth has been or will be affected by climate change and its devastating impacts (IPCC, 2018). With extreme precipitation, raging forest fires, and a temperature increase twice that of the global average, Canada is by no means immune to these impacts (Bush & Lemmen, 2019). Climate change degrades more than our physical environments, with negative impacts on community, culture, health, and well-being (Clayton et al., 2017; Ogunbode et al., 2022; Smith et al., 2022; Tschakert et al., 2017). Climate change is also an existential issue, reminding us of life's fragility and our own mortality (Guthrie, 2023; Smith et al., 2022). Given this dire scenario, we must optimize the education and empowerment of future generations of environmental practitioners and citizens to act on these issues effectively (Clayton & Ogunbode,2023; Field et al., 2023; Mulkey, 2017; UN Climate Change Conference, 2021).

For use in this research, environmental education (EE) is defined as "a process in which individuals gain awareness of their environment and acquire knowledge and skills that enable them to act to solve environmental problems" (UNESCO, 2014). This definition assumes that key outcomes of EE include knowledge and skills development related to environmental issues and the ability and expectation to act on those issues. Post-secondary EE program goals often include the advancement of student knowledge on environmental issues and potential solutions, but also the generation of pro-environmental behaviour

among their graduates (Clark et al., 2011a; Field et al., 2024; Mangas et al., 1997). Post-secondary EE works to achieve these goals using curriculum and pedagogy. Curriculum can be defined as "the lessons and academic content taught in a school or in a specific course or program" (Sabbott, 2015). This includes learning objectives, lecture and reading content, assignments, and grading schemes among other aspects (Sabbott, 2015). Curriculum focuses on what students are taught. Climate change and related environmental issues are a key curricular focus in post-secondary EE (Campbell, 2023). Pedagogy can be defined as "the combination of teaching methods (what instructors do), learning activities (what instructors ask their students to do), and learning assessments (the assignments, projects, or tasks that measure student learning)" (*Pedagogy,* n.d.). This includes the strategies, methods, and activities used by the professor to deliver the curriculum. Pedagogy focuses on how students are taught.

Spending several years pursuing an environmental education requires students to study and comprehend environmental issues, including climate change (Campbell, 2023). By necessity, EE curriculum commonly disseminates information about habitat destruction and biodiversity loss, the social impacts of climate change, and bleak future climate projections, painting what researchers have found to be an anxiety-provoking picture (Galway & Field, 2023; Hickman et al., 2021; Ojala et al., 2021; Wallace et al., 2020). Bryan (2020, p. 15) refers to climate education as "a form of difficult knowledge" that can be traumatic and destabilizing for the learner, "not only because of the traumatic content of the knowledge itself but also because the learner's interaction and engagement with this content is deeply unsettling." For both students and professors, frequent and deep engagement with the devastating impacts of climate change and environmental destruction can take an emotional toll that could easily be considered "a prerequisite for an emotional response" (Clayton, 2018, p. 260). Learning about these issues daily is inevitably accompanied by complex, often negative, emotional experiences (Bright & Eames, 2022; Clayton, 2018; Maggi et al., 2023; Rushton et al., 2023). Research has begun to show that environmental educators and researchers studying climate change and environmental issues experience emotional exhaustion and burnout as a result of their profession (Fraser et al., 2013). Head & Harada (2017) found that environmental scientists sometimes engage in practices to distance themselves from the negative emotions they experience in relation to their work. Even for general populations of youth not focusing their academic pursuits on environmental issues, climate emotions can be difficult and largely negative. For example, Maggi et al., (2023, p.8) found that among Canadian youth, the most common climate emotions were "disappointment, frustration, helplessness, fear, sadness, anxiety, shame, disgust and guilt." Given the emerging research on the emotional experiences of engaging with climate change and environmental issues, professionally or otherwise, it is of great importance to better understand the emotional experiences of students in EE programs. As Jaquette Ray (2018, p. 302) explains, "without curricula that attends to affect, students are likely to leave college not as the well-trained, problem-solving leaders that [EE] programs promise on their websites but deflated, aimless, angry, or apathetic."

Emotions are a powerful force that can positively or negatively affect student learning, well-being and pro-environmental behaviour. Insights from the field of neuroscience tell us that student's emotional experiences in the learning environment can have significant impacts on academic outcomes (Li et al., 2020). For example, some positive emotions are considered key components to motivating learning including hope, pride, and happiness, and promote the self-regulation necessary to engage in behaviours that promote academic success (Li et al., 2020). When positive emotions are experienced in the learning environment students engage in habits which can strengthen learning outcomes including self-monitoring, self-evaluating, and planning (Li et al., 2020). Psychological science and neuroscience scholars have found that positive emotions have been shown to strengthen the speed and accuracy of recalled information, while negative emotions, and suppressing emotions altogether, can lead to memory impairment and inaccurate recollection (Brainerd et al., 2008; Lerner et al., 2015). Further,

positive emotions foster information-seeking behaviours and self-efficacy, which is key to motivating action, while negative emotions can have the opposite effect (Li et al., 2020; Maggi et al., 2023; Rowe et al., 2015; Silvia, 2008). If emotions experienced in response to post-secondary EE curricula are primarily negative, what impacts might these emotions have on student's learning outcomes?

Experiencing the impacts of climate change directly, or indirectly can lead to negative physical and mental health effects that impact overall well-being (Clayton et al., 2017). According to the American Psychological Association, well-being is defined as "a state of happiness and contentment, with low levels of distress, overall good physical and mental health and outlook, or good quality of life" (APA, 2018b). The potential mental health impacts of climate change captured in the literature are numerous and include trauma, shock, PTSD, depression, anxiety, suicide, substance abuse, strains on social relationships, loss of personally important places, loss of autonomy, loss of identity, and feelings of helplessness, fatalism, solastalgia, and eco-anxiety (Clayton et al., 2017). A study on Canadian youth by Galway & Field (2023, p. 1) found that "78% [of participants] reported that climate change impacts their overall mental health" and that "37% reported that their feelings about climate change negatively impact daily functioning." Even in the least severe cases where post-secondary students and their loved ones are largely protected from the direct impacts of climate change, learning about and engaging with climate change regularly can be a compounding stressor (Clayton et al., 2017). This is important to note given that many post-secondary students already face high levels of stress in their everyday lives (Forrester, 2021; Linden et al., 2023).

In addition to impacts on learning and well-being, research shows that emotions have a powerful impact on our pro-environmental behaviour. A 2015 study conducted by Carmi et al. tested a model to understand the mediating role of emotions in the relationship between knowledge and environmental behaviour. Both objective and subjective knowledge were measured as predictors of environmental behaviour with environmental emotions studied as a mediating variable (Carmi et al., 2015). They found that subjective knowledge, mediated by environmental emotions had a significant impact on environmental behaviour (Carmi et al., 2015). While cognitive, analytical, and emotional processing are all involved in decision-making, emotions play a dominant role in issues plagued by uncertainty and risk, such as climate change (Weber, 2006).

Students' learning, well-being, and pro-environmental behaviour are key priorities of post-secondary EE programs, and post-secondary institutions more broadly. For example, the vision statement shared in the University of Waterloo's Faculty of Environment's Strategic Plan for 2020-2025 explicitly states that "to use our unique position as a leading teaching and research institute for the environment to create sustainable solutions needed to address the complex challenges facing our world" (University of Waterloo, 2020, p. 2). One of the three major goals outlined in this report is to "demonstrate an ethos of caring in all that we do" under which they promise to "create, model, and support a culture of well-being for students, staff, and faculty" (University of Waterloo, 2020, p. 14). Royal Roads University's Climate Action Plan for 2022-2027 shares a vision of "inspiring people with the courage to transform the world" with goals to "lead and enable" and "build knowledge and capacity" (Royal Roads University, 2022, pp. 24-25). If post-secondary institutions' goals include the optimization of student learning, well-being, and pro-environmental behaviour and if emotions have a powerful influence on those outcomes, then post-secondary institutions should seek to understand, acknowledge, and consider the emotional experiences of their students.

To meaningfully embrace emotions in post-secondary EE, it is important to reflect on and, where necessary, challenge the social norms and perceptions of emotions in academic institutions that may not serve this aim. For example, climate change is often framed as "a matter of knowledge rather than a

matter of concern," divorcing emotion from the learning process despite its powerful influence (Jones & Davison, 2021, p. 192). This radical separation of rationality and emotion distorts our self-understanding and portrays emotive responses as potentially inappropriate and harmful (Beasy et al., 2023; Jones & Davison, 2021; Patulny, 2019). We need to create a new norm in post-secondary EE of addressing, discussing, and embracing students' emotions instead of discussing environmental issues in a strictly scientific, detached way, especially when presenting course content that research shows is likely to elicit emotional reactions. In their review of climate change education pedagogies, Neas (2023) explains how climate change education typically assesses learning through an increase in knowledge on the topic. The predominant pedagogy associated with this form of learning assessment is a "one-way flow of information from expert to layperson" also referred to as 'the information dump' (Neas, 2023, p. 2). While this focus on improving 'climate literacy' is an important marker of an informative EE program, it is sometimes mistakenly assumed that an understanding of climate change will translate into informed action (Neas, 2023). This paradigm is also referred to as the "information-deficit model," the proponents of which assume knowledge to be the limiting factor in informing decision-making and engaging in pro-environmental behaviour (Cook & Overpeck, 2018; Jones & Davison, 2021; Kollmuss & Agyeman, 2002).

While fostering students' knowledge and understanding of climate change and environmental issues is fundamental to the aims of post-secondary EE, to assume that this increase in knowledge alone will lead to an increase in pro-environmental behaviour would be misguided (Carmi et al., 2015). It is important to recognize that these environmental problems and their potential solutions are intertwined with psychological, cultural, economic, and political factors that operate at overlapping scales (Clayton et al., 2017; Toomey, 2023; United Nations, 1987). For example, research shows that emotions pose a greater obstacle to pro-environmental behaviour than a lack of knowledge (Gifford et al., 2018; Mishaud et al., 2023; Van Valkengoed & Steg, 2019). Despite this fact, emotions have historically been largely overlooked in post-secondary EE where some course content, by necessity, contains emotionally charged information (Field et al., 2024; Rushton et al., 2023; Truelove et al., 2015; Sylvestre et al., 2013; Zembylas & Schutz, 2016). Considering the emotional potential within EE curricula, "it is unethical to expect students to devote themselves to saving the planet but then fail to prepare them affectively for this challenge" (Ray, 2018, p. 313).

Adding complexity to the emotional experiences of EE curricula is the fact that, not only is climate change an emotional issue, but it is also an existential issue (Guthrie, 2023; Hauer & Santos-Lozada, 2021; McGregor, 2023; Vandenplas et al., 2023; Wolfe & Tubi, 2019). In the field of psychotherapy, existential issues are defined as "concerns that arise from distress or questions about difficult subjects, such as death, meaning, freedom, and isolation" (Schnipke & MacKay, 2023). Course content on climate change and other environmental issues can cue existential thoughts and feelings about physical survival, mortality, moral duty and responsibility, and spirituality and meaning (Guthrie, 2023; Ojala, 2016; Pihkala, 2020; Smith et al., 2022). Learning about climate change can trigger the uncomfortable exercise of reflecting on humanity's sometimes disastrous and deadly capacities, and our individual implications and contributions to those disasters and deaths (Bryan, 2020; Graham et al., 2020). For example, a 2024 report from the World Economic Forum predicts that "by 2050, climate change is likely to cause an additional 14.5 million deaths" as a result of exacerbated extreme weather, including floods, droughts, and heatwaves, and an increase in vector-borne diseases (World Economic Forum, 2024, p.4). It is not then unsurprising if post-secondary EE students learning about climate change and other environmental issues are experiencing complex and uncomfortable thoughts and feelings about their mortality or that of their loved ones.

While it can be easy to assume students' emotional responses to EE curricula to be largely negative, we do not fully understand the diverse and complex range of students' emotional experiences with their

environmental degrees. As described by Pellitier et al., (2023, p. 1), “Climate emotions permeate student learning and research activities, but their influence is poorly understood and often ignored in higher education.” More specifically, we do not know which emotions are associated with what specific curricular content, the frequency, intensity, and persistence of those emotions, or the ways that those emotional experiences may vary throughout the post-secondary EE experience (Brosch & Sauter, 2023). Though research has shown that students studying environmental issues, including the climate crisis, are experiencing a complex suite of emotions, little information is available to explain what specific content or pedagogies are leading to either positive or negative climate emotions. If environmental educators had a clearer understanding of what content and teaching approaches were likely to elicit specific emotions, they could better prepare to address those emotions in a meaningful and impactful way when delivering course content. Additionally, if specific pedagogical approaches help students to contemplate and understand and manage their emotional reactions or create positive and meaningful emotional experiences, those could be integrated into course design. While we are beginning to build knowledge on what emotions young people are experiencing in relation to environmental issues, we do not know how frequently, intensely, or persistently those emotions are experienced by students. Having this information would provide a more nuanced view of students’ emotional experiences in post-secondary EE and provide the opportunity to tailor approaches in response to those emotions. While student populations are increasingly being studied, we do not know how these emotional experiences may differ throughout the educational experience from early undergraduate through to graduate studies. These knowledge gaps were the focus of my first and second research objectives. To optimize learning outcomes, support student well-being, and achieve action-oriented institutional goals, educators must start by better understanding students’ emotional experiences with curriculum and pedagogy (Carmi et al., 2015; Ettinger & Painter, 2023; Field et al., 2024; Rushton et al., 2023).

Research is beginning to reflect a demand from environmental students to embrace the affective dimensions of climate change and opportunities for meaningful engagement with climate action within their education (Galway & Field, 2023; Grant & Case, 2022; Jones & Davison, 2021; Kluttz, 2020; McGregor, 2023). For example, Kluttz (2020) reviewed primarily North American post-secondary institutions and found that action taken to address post-secondary climate education’s mental health impacts has been overwhelmingly student-led. As a result of the perceived lack of institutional support, student communities across campuses in the U.S. and Canada are creating the resources they deem necessary and valuable in addressing their own climate emotions (Kluttz, 2020). Jones & Davison (2021, p. 197) found that their Australian post-secondary student participants “expressed the wish that they had been provided safe spaces in which to bear and give witness to the emotions evoked in learning about climate change.” The absence of opportunities for students to acknowledge, explore and better understand their climate emotions in their educational environments created “a burden that some participants carried into their early adult lives” (Jones & Davison, 2021, p. 197). Providing opportunities in EE for students to openly share their emotions related to climate change can foster a sense of connection between students and with their classroom instructors, letting them know they are not alone in their experiences (Australian Psychological Society [APS], 2017; Clayton & Ogunbode, 2023; Field et al., 2024). Given this increasing demand within the literature, my third research objective was to provide students an opportunity to share their recommendations for the affective dimensions of environmental education.

Until the affective dimensions of EE curricula and pedagogy are acknowledged and discussed, EE forgoes opportunities to optimize student learning, well-being and pro-environmental behaviour and to foster connection among students (Pooley & O’Connor, 2000; Wallace et al., 2020). Environmental education researchers have argued that it is time to value and leverage emotions in the learning environment, particularly in post-secondary EE programs where emotionally charged content is a frequent visitor to

the classroom (Bright & Eames, 2021; Ojala et al., 2021). As stated by Wallace et al., (2020, p.150) “acknowledging and supporting the existential demands of teaching, and the emotional needs of students, is an essential part of achieving learning outcomes.”

3.0 Methods

This section outlines my philosophical worldviews underpinning this research, my positionality, the research context, and the data collection and analysis methods used.

3.1 Methodology

In the context of this research, I hold a pragmatic philosophical worldview, wherein "researchers emphasize the research problem and use all approaches available to understand the problem" (Creswell, 2014, p. 39). Pragmatic approaches draw from a range of philosophies, refusing to rigidly subscribe to a single philosophical position or method (Creswell, 2014). Pragmatic philosophies are often paired with a mixed-methods approach which combines quantitative and qualitative elements, as is the case in my study (Creswell, 2014). Quantitative survey data enabled me to explore trends across and variations within students' emotional educational experiences and their study stage. The qualitative methods I selected include participant-driven photo-elicitation and semi-structured individual interviews. Photo-elicitation methods combined with interviews are particularly beneficial in exploring largely unobservable, personal, and sometimes awkward topics such as emotional experiences (Harper, 2002; Prosser & Schwartz, 1998; Van Auken et al., 2010).

This methodology allowed for the exploration of students' subjective emotional experiences related to EE curricula and pedagogy, tapping into the strengths of both quantitative and qualitative approaches and drawing on aspects of both post-positivist and social constructivist thought. Aspects of post-positivism including the assumption of a shared objective reality, the simultaneous rebuttal of absolute truth, and the iterative search for evidence using the scientific method informed this research (Creswell, 2014). Social Constructivism also brought valuable insights upon which to found this research. Social Constructivist researchers seek to understand the environments in which people live and work, the subjective meanings people assign to their experiences, the variation and diversity of those experiences, and the social and historical influences of individual processes of meaning-making (Creswell, 2014; Creswell & Poth, 2018). Social Constructivism operates on the assumption that as humans engage with and interpret the world around them, they construct meanings (Creswell, 2014). This process of meaning-making is influenced by our historical and social context and perspectives, "arising in and out of interaction with a human community" (Creswell, 2014; p. 38). With this methodological foundation, I have explored environmental students' unique, subjective, and personal emotional experiences and perceptions.

3.2 Positionality

I reflexively acknowledge and make transparent how my identity intersects with my research topic, process, and participants (Finlay, 2021). I was born and raised in Ontario, Canada to a university-educated family. Many women within my family have pursued higher levels of education and I was encouraged and supported to do the same. These aspects of my positionality have afforded me the privilege of an environmental post-secondary education largely free from systemic barriers.

As a post-secondary environmental student, I am an active participant embedded within the institution and program I am studying. This dynamic is likely to influence interactions with my participants and may lead participants to perceive me as an "insider" or "peer" with shared experiences and common understandings (Holmes, 2020). Having completed an undergraduate degree in environmental studies, I have extensive personal experience with both positive and negative emotional reactions to environmental curricula and pedagogy. Resultingly, I am deeply invested in the research outcomes and

possible applications. I am highly motivated to communicate participants' emotional experiences, insights, and educational recommendations meaningfully, accurately, and justly.

Ultimately, my positionality and personal connection to the research context can provide valuable insights, but they can also lead to biases (Finlay, 2021; Holmes, 2020). While conducting this research, I have sought to iteratively reflect on my positionality and remain conscious of the potential biases it may bring. I have aimed to maintain "empathetic neutrality," striving to "avoid obvious, conscious, or systematic bias and to be as neutral as possible in the collection, interpretation, and presentation of data" while acknowledging that my humanity makes total neutrality impossible, and arguably ill-suited (Holmes, 2020, p.4; Ormston et al., 2014).

3.3 Research Context

My focus population was post-secondary EE students from two Canadian universities: the University of Waterloo in Ontario and Royal Roads University in British Columbia. While many post-secondary programs have some curricular content related to environmental issues, I focused on programs whose core curricular focus was interdisciplinary environmental studies and sciences programs. The University of Waterloo is a large institution with approximately 40,000 students enrolled (Universities Canada, 2022). The University of Waterloo's Faculty of Environment has a population of approximately 2400 students enrolled full-time, with approximately 250 master's students and 2100 undergraduates making up the majority (University of Waterloo, 2023). Royal Roads University has a total student population of approximately 3200 students, with 2600 of those enrolled in a master's level program (Universities Canada, 2022). An unknown subset of these 3200 students is enrolled in EE programs of study; administrative staff at Royal Roads University were contacted to obtain this data but were unable to share this data because the Dean would not agree to release it. I recruited environmental students at both undergraduate and master's levels for research participation. Students were recruited through virtual and in-person presentations in classrooms, emails, posters hung in high-traffic areas on campus, and postings on relevant faculty, department, and student organization websites, virtual learning pages, and social media platforms.

I focused my recruitment efforts on required courses offered in the Fall 2023 term for environmental students in each year of study at both institutions' programs. These recruitment efforts were focused on students in specific interdisciplinary environmental studies and sciences programs but largely excluded programs in other fields that were likely to have some environmentally related curricula such as environmental engineering, biology, or chemistry for example. Required courses are courses that students must take to graduate from their program and are built into the schedule for each year of study. For targeted undergraduate programs, I included at least one course from the first through to the fourth year of study. For targeted master's programs, I included a course from the first and second years (see Appendix A for the list of courses targeted for recruitment).

Targeting undergraduate and master's students accounted for the majority of the environmental student population at these institutions while permitting a comparison of emotional experience between the levels of study. Targeting required courses for recruitment ensured that most students in each cohort were informed about the study and were drawn from courses deemed central and necessary to an EE by the relevant institution. This targeted approach aligned with my master's research timeline and maximized possible participation in most cohorts according to their study and work term schedules.

3.4 Data Collection

In this section, I outline the multiple data collection methods used in this research including student surveys, a participant-driven photo elicitation activity, and subsequent individual semi-structured interviews.

3.4.1 Student Surveys

My intended survey sample was ~400 participants combined from the two universities ranging in educational stages from first through to the last year undergrad and first through to the last year masters. I predicted that collecting 400 surveys from multi-stage environmental students would yield a statistically reliable +5% margin of error or lower, at the 95% confidence level and allow for comparison of emotional experiences and analysis of patterns across and within the data (Bartlett et al., 2001). I created the survey in Qualtrics, and participants completed it online (n = 60). In the first pages of the Qualtrics survey, before accessing or responding to any questions, participants were informed of the study details and ethical considerations, confirmed their eligibility to participate, and provided their informed consent. They were also asked to generate and input a unique participant code based on a set of standard questions. Survey respondents had the option of sharing their email address in a separate linked survey if they wished to be entered into a draw to win one of four $25 Amazon e-gift cards.

Using surveys, I gathered reliable, standardized data from a larger population cost-effectively (Sheppard, 2020). My survey was a lesser time commitment -- of an estimated 15-20 minutes -- than the photo-elicitation activity and subsequent interviews, reducing a barrier to participation for interested students with limited availability. This approach was less prone to interviewer bias as researchers were not required to be present during survey completion (Sheppard, 2020). Conducting the surveys first helped me to recruit interested participants for the subsequent photo-elicitation activity and interviews, using the “foot-in-the-door” technique (Freedman & Fraser, 1966). This social psychological strategy argues that if a large time or resource-intensive ask (photo-elicitation activity and interview participation) is preceded by a smaller, more easily achievable ask (survey completion), participants are more likely to engage in and comply with the more intensive ask (Freedman & Fraser, 1966; Grolleau et al., 2017). Completing the survey first also familiarized participants with the research topic, increasing their potential interest in participating in the study’s next steps. The survey was tested by a small sample of post-secondary EE students before data collection and was revised as required to ensure clarity and comprehension. This test sample was not included in the data. The qualitative approaches included in this mixed methods study compensated for the limitations in depth and diversity of survey responses, which is highly valuable in understanding as personal and complex a topic as emotions (Bates et al., 2017).

In the first section of the survey questions, I collected some demographic and logistical information on participants’ degrees and focused on RO2, gaining some insight into participants’ study stage. These optional questions required minimal thought and effort on the part of students and eased them into the survey. Participants were asked to provide their age, gender, and ethnicity. Although it was optional, most students provided this information. Only two participants selected “prefer not to respond” when providing gender and five participants chose not to disclose their ethnicity. Using a 5-point Likert scale, ranging from almost exclusively ecological to almost exclusively social, students were asked *“What is the focus of your degree?”* The population of focus included students in various EE programs, some of which focused primarily on environmental science and ecology, while others focused primarily on environmental policy and education. These were not considered binary possibilities but a spectrum of program foci and approaches that would be best measured using a 5-point Likert scale (University of Toronto, n.d.). I then asked students to share the specific environmental program they were enrolled in

(whether undergrad or masters) and what year of study they were in (first, second, third, fourth, or fifth+).

In the survey, I provided explicit instructions for participants to answer each question considering their emotions about their educational experience with activities occurring exclusively in their environmental courses. This included curriculum (referred to as course content) and pedagogy (referred to as teaching approaches). I asked participants to exclude certain experiences when answering these survey questions. For example, any elective courses in other programs of study not related to their environmental degree were to be excluded in addition to extracurriculars, residence, the physical campus, etc. A bolded statement requesting that students focus their comments on the course content and teaching approaches, and not comment on the course instructor was included.

RO1 was addressed in the survey by incorporating an adapted version of the Multi-Dimensional Emotions Questionnaire (MEQ), a self-report measure developed by Klonsky et al., (2019) that measures discrete emotions, valence, and dimensions of emotional reactivity which included frequency, intensity, and persistence. This questionnaire was adapted for use in my study to measure the self-perceived frequency, intensity, and persistence of emotions associated with environmental course content (curriculum) and teaching approaches (pedagogy) (Klonsky et al., 2019). In the standard MEQ, ten discrete emotions are measured: five measure positive emotional reactivity (happy, excited, enthusiastic, proud, inspired) and five measure negative emotional reactivity (sad, afraid, angry, ashamed, anxious) (Klonsky et al., 2019). I adapted the MEQ to include eighteen items, which have been selected to capture the diverse range of 'climate emotions' prevalent within the literature, maintaining an even split between positive and negative valence (Klonsky et al., 2019; Pihkala, 2022). The positive emotions included in my survey were happiness, inspiration, pride, determination, hope, connection, compassion, gratitude, and awe. The negative emotions featured in my survey included sadness, anxiety, guilt, grief, anger, betrayal, powerlessness, hopelessness and dread.

I chose these emotions because they frequently appear in the literature around climate emotions (Galway & Field, 2023; Pihkala, 2022; Pihkala, 2024). This methodological choice is underpinned by the assumption that post-secondary EE students are likely to experience these climate emotions as a result of the curriculum and pedagogy built into their studies which heavily discusses climate change (Grant & Case, 2022; Kelly, 2017; Ojala, 2023; Pihkala, 2020).

The positive and negative emotions were interspersed in order. The MEQ used a 5-point Likert-type scale to measure each dimension of the emotional experience (Klonsky et al., 2019). To measure frequency, participants were asked how often they experienced the emotion (Klonsky et al., 2019). To measure intensity, participants were asked how intense the emotional experience was (Klonsky et al., 2019). To measure persistence, participants were asked how long-lasting the emotion was (Klonsky et al., 2019).

Following this multi-dimensional approach for each emotion, participants were asked to share, *"In the last two academic semesters, within your environmental courses, what specific course content or teaching approach sparked this emotion?"* through an open-ended question. Following these adapted MEQ questions, participants were asked *"In your experience with the course content and teaching approaches used within your environmental education: How often are your emotions currently acknowledged?"* and *"How often would you prefer to have your emotions acknowledged?"* While the adapted MEQ may have taken longer to complete than other self-report measures of emotion, the dimensionality provided by this scale is unparalleled (Klonsky et al., 2019). For example, the Positive and Negative Affect Schedule (PANAS) scale measures 20 different emotions, using one Likert-scale question for each, for a total of 20 questions (Tran, 2013).

My adaptation of the MEQ measured 18 different emotions but used three Likert-scale questions for each (to measure frequency, intensity, and persistence), for a total of 54 questions. Other existing emotional self-report measures have notable limitations including, “failure to consider the time course of emotional experience," and "inadequate assessment of discrete emotions” (Klonskly et al., 2019, pp. 2). These limitations can lead to an oversimplification and misrepresentation of complex emotional experiences (Lerner et al., 2015). These limitations were overcome by the MEQ, providing a more nuanced understanding of participants’ emotional experiences.

In the next survey section, I addressed RO3, prompting student recommendations surrounding the emotional aspects of their EE. Two open-ended questions were posed: (1) *“What (if any) course content-based recommendations do you have in relation to the emotional aspects of post-secondary environmental education? (These should focus on WHAT is taught).”* And (2) *“What (if any) teaching approach-based recommendations do you have in relation to the emotional aspects of post-secondary environmental education? (These should focus on HOW it is taught).”* These open-ended questions provided students with the opportunity to give recommendations without being provided specific options that might have skewed their responses.

The final survey section was a recruitment tool for the participant-driven photo-elicitation activity and semi-structured individual interviews. Participants were redirected to a separate survey that asked them about their interest in participating in the photo-elicitation and individual interview. Interested participants were prompted to enter their unique participant code again and to provide an email address through which I could contact them. Regardless of their interest in these additional study components, participants were also provided with the opportunity to enter their email addresses if they wished to be entered into a draw to win one of four $25 gift cards. This ensured that no identifying information was collected directly in association with survey responses, keeping them anonymized. However, the participant code allowed me to refer to the survey information, including the student’s university, program, and year of study to quota sample for the photo-elicitation activity and interviews. In finishing the survey, participants were provided with a page thanking them for their participation and providing them with my contact information had they wished to reach out with any additional questions. See Appendix B for a full survey draft.

3.4.2. Participant-Driven Photo-Elicitation

Photo-elicitation methods were developed in the 1950s by researcher and photographer John Collier (Collier, 1957). Photo-elicitation can be defined as “an interviewing technique in which researchers elicit information from participants by using photographs” (Richard & Lahman, 2015, p. 5). Participant-driven photo-elicitation methods are a sub-category of photo-elicitation methods in which participants (as opposed to researchers) capture the images through a creative photography process (Bates et al., 2017; Van Auken et al., 2010). These photographs are often accompanied by participants’ written descriptions, which provide added context to the photographs and are typically centred around a pre-determined topic provided by the researcher (Bates et al., 2017; Homer, 2021).

Participant-driven photo-elicitation was well-suited to the research objectives and focus. This method provided structure and focus for interviews while offering opportunities to build rapport (Banks, 2001; Richard & Lahman, 2015). The participant-driven photo-elicitation activity acted as a unique source of data, offering a “visual dimension to unobservable thoughts, feelings, experiences, and understandings” (Cleland & MacLeod, 2021; Collier, 1957; Prosser & Schwartz, 1998; Richard & Lahman, 2015, p. 4). Some scholars argue that “images evoke deeper elements of human consciousness than do words” because the brain regions responsible for visual information processing evolved before those responsible for

verbal processing (Harper, 2002, p. 13). This approach offered the unique capacity to manage power dynamics more equitably between the researcher and participant and to promote participant agency and empowerment (Banks, 2001; Banks, 2007; Biggs et al., 2022; Cleland & MacLeod, 2021; Collier & Collier, 1986). Participant-driven photo-elicitation provided participants with the creative freedom and agency to photograph and write about what they chose, capturing and communicating what they believed to be of the greatest importance (Cleland & MacLeod, 2021; Harper, 2002; Homer, 2021). This creative approach helped to alleviate interview fatigue, which maximized the data collected from each interview and aided in answering the complex research questions posed (Harper, 2002). These approaches "yield deeper and more elaborate accounts of participants' lives compared to verbal-only interviews" (Bates et al., 2017, p. 22; Tran Smith et al., 2015).

Examples of photo-elicitation methods combined with interviews to explore emotional themes of environmental issues exist in the literature and provided guidance. This combination of methods has been used to explore the intersection of health, resilience, and nature connection in Indigenous youth in Canada (Hatala et al., 2020), climate change and pregnancy intentions in young Canadian women (Smith et al., 2023), and well-being and nature engagement in Australian young adults (Sofija et al., 2022). Studies by Raccichini et al., (2023) and Testoni et al., (2019) found useful applications of photovoice methods in death education, aiding participants in exploring death-related topics in constructive and empowering ways. Petersen & Martin (2021) used photo-elicitation to explore the specific emotion "kama muta," commonly translated to "feeling moved" in nature-based experiences with university students in Norway. Grant & Case (2022) found that engaging Canadian post-secondary environmental students in an independent photovoice activity followed by focus groups helped them to explore their emotions about climate change and feel validated and empowered. Beyond the studies discussed above, there is substantial literature employing photo-elicitation methods and subsequent interviews to study emotions, education, and environmental issues and their intersections (Phillips et al., 2022; Trott, 2019; Zhang & Hennebry-Leung, 2023).

Many factors should be considered when determining an appropriate sample size for a qualitative study. These include population heterogeneity, the number of criteria used to determine selection, whether those criteria are nested, the number of samples required, the methods of data collection, and the available resources and budget (Ritchie & Lewis, 2003). My research had a relatively homogeneous sample, focused study objectives, and utilized a semi-structured interview guide and partially deductive codebook, which minimized the sample size required to reach saturation. However, interest in sub-group variation based on the study stage and the anticipation of conceptual codes increased the required sample size (Hennink et al., 2017).

My intended sample size for the participant-driven photo-elicitation activity and subsequent interviews was informed by these factors, but I aimed to reach the point of saturation (Hennink et al., 2017). Saturation can be defined as "the point when you have heard the range of ideas and aren't getting new information" (Tashakkori & Teddlie, 2010, p. 183). The point of saturation will be determined using a combined approach of code frequency counting and code meaning assessment (Hennink et al., 2017). These two approaches to determining the point of saturation consider both the point at which no new ideas are being presented and the point at which no new understandings, nuances or insights from those ideas are gained (Hennink et al., 2017). The approximate sample size I aimed for was 25, which should have been sufficient to reach saturation using both of these approaches (Hennink et al., 2017). I used a convenience sampling approach as my research required access to classrooms and online learning sites granted by individual instructors. I targeted my recruitment to required courses across EE cohorts within the undergraduate and master's student populations at the two universities. If more than 25 interested participants were recruited, I planned to use a quota sampling approach to ensure student

representation across study stages and from both institutions in the photo-elicitation activity and interview.

Interested participants (n=25) were sent an email with information on the participant-driven photo-elicitation activity and semi-structured individual interviews. This email included the attached Information for Participants Memo and Photo-Elicitation Activity Instructions and confirmed their continued interest in participating in the study's next steps. These instructions included clear ethical guidelines around photography content to ensure that the respect, privacy, dignity, and consent of potential photography subjects were ensured while maintaining participant safety (Bates et al., 2017). Participants were instructed to use a personal device to capture the photographs or to indicate if they did not have access to a device. Participants were asked to confirm their continued interest and intention to complete the photo-elicitation activity and individual interview by replying to the email. This email reply also provided an opportunity for participants to ask any questions they may have had about the activity or the study in general. Of the 25 interested participants, a total of (n=13) participants took part in the photo-elicitation activity and subsequent interviews.

Participants were provided with two prompting questions to provide some creative direction for what they chose to photograph and write. Each participant captured two photographs, one for each prompting question, and wrote a short accompanying written description for each to provide their interpretation and ascribed meaning of the photos.

The two prompting questions were:

1. *"What has been your emotional experience in environmental post-secondary education? Consider what emotions you have experienced in relation to your degree and the specific course content or teaching approaches that brought about those emotions."*

2. *"What recommendations (if any) would you like to share in relation to the emotional experience of the course content and teaching approaches utilized within your post-secondary environmental education?"*

These questions were designed to address RO1 and RO3. All research objectives were explored in the individual semi-structured interviews that expanded upon the work completed in the participant-driven photo-elicitation exercise. Participants had creative freedom in deciding the content of their photographs and written descriptions but were asked to submit only two photos, one for each prompt, and two accompanying written descriptions of approximately 200 words. While participants were encouraged to actively engage in the process of photography for this activity, they were also provided with the option to use a photograph they had captured previously if they felt it related to and answered the prompting question well. Two weeks after participants were provided with the photography instructions, I reconnected via email to follow up, collect a copy of the completed photographs and written descriptions, and schedule the individual interview. See Appendix C for full participant-led photo-elicitation activity instructions and Appendix G for a selection of participant photographs and written descriptions.

Like all data collection methods, participant-driven photo-elicitation has limitations and potential complications. Compared to other methods it required a larger time investment from participants (Richard & Lahman, 2015). It demanded more participant preparation, education, resources, and training provided by me to ensure that photographs were taken ethically, appropriately, and safely (Richard & Lahman, 2015). As the researcher, I was prepared to provide participants with access to a camera if they did not have such a device and to ensure equitable participation across participants' socio-economic

realities. The results were highly context-specific and personal and thus are not greatly generalizable to other contexts or populations (Creswell, 2014; Homer, 2021). To overcome these limitations, I provided clear written digital instructions along with an invitation to discuss further if needed, instead of requiring compulsory training meetings. This approach minimized the time commitment of both the participant and the researcher. Additionally, giving participants the option to use photos taken previously by them allowed participants to save additional time if they so chose.

3.4.3 Semi-Structured Individual Interviews

Upon completion of the photo-elicitation activity, individual semi-structured interviews were conducted virtually via Zoom. The interviews were audio and video recorded and recordings were immediately uploaded to Otter.ai, a common, paid transcription software used for qualitative interviews, for transcription (Bourgeault & Corrente, 2022; Wollin-Giering et al., 2024). Transcripts were reviewed, edited and anonymized where necessary. Identifiers were stored in a separate password-protected document. Recordings were saved to my personal, password-protected computer and OneDrive and were only accessed by myself. Interviews ranged from forty-five minutes to an hour and a half in length with an average of one hour and four minutes. Although it was not required by either university's ethics process, I reached out to photo-elicitation and interview participants to invite them to review their interview transcripts. Two participants accepted the offer, and reviewed their transcript but did not request revisions.

Interviews followed a semi-structured approach, with a predetermined script, but remaining flexible to the inclusion of additional clarifying and probing questions based on response depth and content (Ruslin et al., 2022). I began the interviews by welcoming and thanking the participant for their time and participation, introducing myself and my role, and reiterating important messages to set the stage for the interview. I confirmed that participants had reviewed the information letter and asked if they had any questions. If necessary, I reviewed that letter with the participant at this time. I then asked for consent to participate and to be audio and video recorded. Additionally, I asked if participants consented to the inclusion of their photographs, written descriptions, and interview contributions in any form of knowledge dissemination that may come from this research. They had the opportunity to have their work remain anonymous or to be attributed if they provided consent to the aforementioned use of their work. Participants were reminded of the voluntary nature of participation in all research phases and that they could withdraw from the study at any time. During the interview, I made written notes of any notable body language, facial expressions or tone not captured within audio transcriptions. A document with free and accessible mental health and well-being resources was shared with participants at the session's end and they were encouraged to access them should any distress arise from discussing their emotions and experiences.

Semi-structured individual interviews provided an opportunity for rapport building and an interactive, conversational approach that encouraged sharing (Ritchie & Lewis, 2003). The balance between structure and fluidity offered by the semi-structured approach was well-suited to a topic as complex, vast, and personal as emotional experiences (Ritchie & Lewis, 2003). Interviews provided opportunities to collect other forms of data including any observed facial expressions or body language, which may be especially relevant when discussing emotions (Sheppard, 2020). This approach permitted participants to share information from their perspective rather than through pre-determined response options on a survey (Ritchie & Lewis, 2003). Open dialogue was particularly appropriate for emotions-related research as "the nature of such phenomena makes it likely that participants will need very delicate and responsive questioning – and time – to explore the issues for themselves" (Ritchie & Lewis, 2003). The sensitive and personal nature of emotional experiences made individual interviews better suited to this research than focus groups, as the powerful effects of "groupthink" may have swayed participants to give more socially

desirable answers in their peers' presence (Bergen & Labonté, 2020; MacDougall & Baum, 1997; O.Nyumba et al., 2018; Ritchie & Lewis, 2003).

The interview guide was designed to best utilize the participant-driven photo-elicitation activity as a natural way to ease into the conversation around the prompting questions which were closely tied to research objectives (Van Auken et al., 2010). The questioning order mimicked the order of the research objectives which built upon each other. Semi-structured interviews provided participants with the opportunity to answer the research questions in ways not captured within their creative, participant-driven photo-elicitation work (Bates et al., 2017). Semi-structured interviews aligned with the social constructivist paradigm underpinning the research design, gaining insights into students' personal, and emotional experiences within their learning environment (Biggs et al., 2022; Finkbeiner, 2018).

Initial questions aimed to gather basic, identifying information about the participant including their preferred name and pronouns, program, year and focus of study. Interviews then progressed through several question sets connected to the participant-driven photo-elicitation activity they completed. To begin, their photo and written description for the first prompting question were shared and they were asked to read their written description aloud. Starting the interviews with the photos as a focal point and having the participants read their written works aloud was a strategy to ease them into the discussion and to ensure that the written works were included in the transcript and could be coded along with the interview. A series of follow-up questions that encouraged additional discussion around the photograph and written description was asked to maximize the data collected about each photograph (Bates et al., 2017; Cleland & MacLeod, 2021). The participant was then asked additional questions related to RO1 and RO2 to gather insights not captured within the participant-driven photo-elicitation activity. This process was repeated with the photograph and written description for the second prompting question, reading the written description aloud, using the same set of follow-up questions for the second photograph, and a unique set of additional questions related to RO3. The interview was concluded with a few final questions to provide participants with the opportunity to reiterate key messages of importance or add anything that was not discussed, but that they wanted to be reflected in the research (Harper, 2002). See Appendix D for the full semi-structured individual interview guide.

Those who participated in the photo-elicitation and individual interview received a $10 Amazon e-gift card via email as a thank-you for their time and effort. After completing the interview, participants received an email that thanked them for their participation, reminded them of the e-gift card that was sent, and that they could reach out should they change their mind about their choice to remain anonymous or be attributed. Due to the personal, creative, and artistic work provided by participants through the participant-driven photo-elicitation activity, providing this opportunity to have their work and art attributed was the most ethical option. Anonymity was maintained for participants who did not want their work attributed.

Using semi-structured interviews had its drawbacks including a greater time commitment for both participants and me (Sheppard, 2020). The photo-elicitation and individual interview results were highly context-specific and personal and thus were not greatly generalizable to other contexts or populations (Creswell, 2014; Homer, 2021). To ensure smooth and clear delivery, the interview was tested on post-secondary environmental students, and alterations and changes were made to the interview guide as needed. Building rapport with students in the initial phase of the interview helped foster open, truthful conversation and hopefully minimized social desirability bias (Bergen & Labonté, 2020). As a fellow EE student, sharing similar experiences and aspects of participants' identities may have aided in rapport-building. Conducting interviews virtually allowed participants to select a time and location that felt safe and appropriate for them. This form of data was highly personal and thus not very generalizable;

however, in combination with survey data and photo-elicitation this mixed-method study achieved both breadth and depth.

The data from three sources (student surveys, the participant-driven photo-elicitation activity, and semi-structured individual interviews) supported the research objectives and contributed understanding to the research question, creating built-in redundancy. This convergent parallel mixed methods approach combined qualitative and quantitative data sources and provided a more comprehensive understanding of the research problem than either dataset would have achieved independently (Creswell, 2014). This approach made later data triangulation possible, increased internal validity and reliability and captured students' emotional experiences of EE more fully (Creswell, 2014; Merriam, 1988; Noble & Heale, 2019). See Appendix F for my research project timeline.

3.5 Data Analysis

Each dataset, despite being focused on the same research question and objectives, was analyzed independently. The general findings from each dataset were triangulated to help determine whether themes and findings aligned and/or differed (Creswell, 2014).

3.5.1 Student Surveys

Survey responses (n=60) were downloaded from Qualtrics, then cleaned and cross-tabulated in Excel. Appropriate column short names were assigned, and a data dictionary was generated accordingly. Numerical values replaced textual Likert scale data. For example, "about once per month or less" was replaced with 1, "about once per week" was replaced with 2 and so on. Descriptive statistics were generated in R, calculating, and visualizing the distributions of the Multi-Dimensional Emotions Questionnaire (MEQ) Likert scale responses for each dimension of each emotion. By analyzing the adapted MEQ survey data I quantitatively addressed RO1 with basic descriptive statistics, providing central tendency and distribution measures for the frequency, persistence, and intensity of eighteen different discrete climate emotions. This allowed for discussion on the multi-dimensional experience of positive and negative emotions in relation to post-secondary EE curriculum and pedagogy. While I hoped to use this data to address RO2 by comparing the results of study stage sub-groups of early undergraduates, late undergraduates and master's students, unfortunately sample sizes were determined insufficient to conduct this additional analysis. Open-ended survey questions were coded for themes using the same process described below for interview data analysis. These open-ended survey questions contributed directly to addressing RO1 and RO3.

3.5.2 Participant-Driven Photo-Elicitation

Because written descriptions from the participant-driven photo-elicitation activity were read aloud in the interviews, they were coded – as described below – and thematically analyzed with the rest of the interview data. This is often referred to as a "dialogic approach" in image content analysis, which "focuses on analyzing the verbal or written reflection on the content of photographs and what they symbolize" (Cleland & MacLeod, 2021, p. 233). In this approach, I focused more on the written descriptions and interview transcripts and how participants discussed the photographs and made meaning from them. This approach directly contributed to the achievement of RO1, as quotes from photo-elicitation written descriptions and interviews helped students to articulate, in their own words, their emotional experiences of EE curriculum and pedagogy. An "archaeological approach," involving basic visual content analysis of the photographs was also used (Cleland & MacLeod, 2021). By using this approach, I sought to extract data from the visual image itself, including the photographer's choices of what subjects, places and themes were captured (Cleland & MacLeod, 2021). The steps outlined by Chapman, et al. (2017) were adapted for photographic data analysis, but with the aid of NVivo instead of

the ATLAS.ti software based on my familiarity and access. These steps included coding photographs, finding relationships, and interpretation (Chapman et al., 2017).

Photograph codes were determined by scanning the images and creating codes based on what was captured (Chapman et al., 2017). These codes might describe the setting, subjects, objects, and concepts visually captured in the image. For example, "park," "child," and "playing," are some code examples. Broader categories were drawn from the patterns or repetitions in content. When finding relationships between codes, code families were created to "organize codes and help researchers think about relationships and preliminary themes" (Chapman et al., 2017, p. 815). Code families included "subjects," "places," "activities," and "metaphors" among others, into which the codes were grouped. Interpretation included frequency counts of codes and discussion around what was captured in relation to both prompting questions and what was notably absent from photographs (Chapman et al., 2017). Photographs were uploaded and stored within NVivo which created an opportunity to compare codes between photographs and interview data.

3.5.3. Semi-Structured Individual Interviews

After the interview transcriptions were completed by Otter.ai, I conducted a manual review to remove filler words and any identifying information, unless attribution had been requested. The interview data were analyzed manually and within the qualitative data analysis software NVivo. Utilizing both manual and computer-assisted approaches to qualitative analysis maximized technological benefits and efficiencies while ensuring that important codes and themes were not missed by the software (Zamawe, 2015). Some advantages of computer-assisted qualitative analysis tools include a common storage site for all relevant data files, ease of access and search capabilities, and systematic data management (Tummons, 2014). NVivo has many useful functions that increase efficiency including the ability to create, search for, and hierarchically organize nodes across multiple documents (Bernauer et al., 2013). It is important to note that despite the benefits, NVivo cannot independently conduct data analysis, it simply helped to facilitate the analysis conducted by the researcher (Tummons, 2014). Transcriptions underwent multiple manual coding rounds, drawing on both deductive and inductive coding techniques. The Query tool in NVivo was used to search the documents for instances of each emotion that emerged in the initial rounds of coding to ensure that no relevant examples were missed.

Deductive, structural coding was utilized to categorize responses broadly as they relate to the three research objectives (Saldaña, 2015). Most of the data were easily categorized this way as a result of the tailored participant-driven photo-elicitation prompting questions and interview questions that connected directly back to the research objectives. This included:

- Structural Coding Category One: *Emotions experienced in relation to curricular and pedagogical aspects of post-secondary EE;*
- Structural Coding Category Two: *Identified curricular and pedagogical sources of emotions experienced in post-secondary EE;*
- Structural Coding Category Three: *Self-reported variation in emotional experience by educational stage; and*
- Structural Coding Category Four: *Student-identified recommendations for the emotional experience of EE.*

The valanced climate emotion categories used in Structural Coding Category One were drawn from Pihkala's 2022 taxonomy and were used as primary deductive codes. Nested within these categories of climate emotions, the eighteen specific climate emotions featured in the survey, also drawn from Pihkala (2022), were explicitly coded within the corresponding category. Synonyms for these emotions and the

other adjacent emotions featured within the climate emotion categories were coded into an implicit sub-code within each category. Codes captured within Structural Coding Category Two were embedded within Structural Coding Category One. Coding data into Structural Coding Categories One and Two directly contributed to answering RO1. Coding data into Structural Coding Categories Three and Four directly contributed to addressing RO2 and RO3 respectively. See Appendix E for the full deductive codebook.

Additional inductive codes were developed in the initial coding stage to capture data not covered by the deductive codebook. Some of these inductive codes were integrated into the Structural Coding Categories where appropriate, for example, other emotions that emerged. Other inductive codes fell outside of the structural coding categories, creating new categories, for example, emotional sentiments such as "ignorance is bliss" that provided additional insights into the emotional experiences of post-secondary EE students. My initial coding strategies focused on identifying keywords of interest in transcripts while maintaining the intended meaning of participants' phrasing (Saldaña, 2015). I iteratively engaged in Braun & Clarke's (2006) six phases of thematic analysis: familiarization with the data, coding, searching for themes, reviewing themes, defining and naming themes, and writing up. Identified themes were organized and utilized to create a clear, comprehensive narrative told by the data (Saldaña, 2015). A limited timeline and budget meant that a second coder was not a possibility for this research. However, engaging in the iterative phases of thematic analysis and referring back to analytic memos throughout the process of data analysis helped me to critically evaluate, adjust, and improve my codes (Braun & Clarke, 2006; Saldaña, 2015).

3.5.4 Data Triangulation

I used three methods to achieve my three research objectives; this methodological variation provided a more comprehensive picture than one individual method could achieve alone (Tashakkori & Teddlie, 2010). This mixed-methods design allowed for the triangulation to determine where they converged, corroborated, or contradicted one another in addressing my research objectives (Williamson, 2005). Findings from the three datasets were integrated at the interpretation and reporting level and were woven together in the communication of the results and discussion as opposed to being presented separately (Alele, & Malau-Aduli, 2023). For example, all three data collection methods addressed RO1 *(Capture and articulate a broad range of students' emotions in association with the post-secondary environmental curriculum and/or pedagogical experience).* The relevant findings for each data method were reported separately in the results. I then compared and contrasted the findings of each method to determine where the survey results and photo-elicitation and interview results communicated similar findings, and where the reported emotional experiences of students differed between the data collection methods. As reported in the results, there is significant overlap between the findings of these data collection methods, but also interesting differences.

4.0 Results

After reporting on the response rates and participant demographics, the results and discussion sections are organized first by research objective and then by data source where necessary. The research methods were tied very closely to the research objectives and, as a result, logically organized this way for reporting the results and discussion.

4.1 Participation Rates

A total of 179 people began my survey. Of those 179, 58 completed 26% of the survey, and an additional 61 people completed less than 26%. These responses were unusably incomplete, leaving 60 complete and viable responses to analyze. While it is hard to say exactly what caused this high attrition rate, the length of the survey design may have discouraged student completion.

A total of thirteen participants took part in the photo-elicitation activity and interviews, leading to the collection of twenty-six photographs and written descriptions and over thirteen hours of interview data. Despite the richness of the qualitative data collected, code meaning saturation was not reached as new ideas and nuances were still being introduced in the final few interviews conducted (Hennink et al., 2017). Of the thirteen participants, ten were master's students and three fell into the early undergraduate study stage (first- or second-year undergraduate). The small sample size and unequal distribution meant that variation in emotional experience between study stages, the focus of RO2, could not be meaningfully analyzed by the qualitative data. Although the findings of my research are insightful, the small sample size limits the generalizability of the findings.

4.2 Participant Demographics

Of the 60 survey respondents, 88% were University of Waterloo students, and 12% were Royal Roads University students. Survey respondents consisted of 30% early undergraduates, 37% late undergraduates, and 33% master's students. See Figure 1. Photo-elicitation and interview participants were also heavily composed of University of Waterloo students (69%) and fewer Royal Roads students (31%). These participants were predominantly masters' students (77%) with the remaining students in early undergrad (23%). See Figure 2.

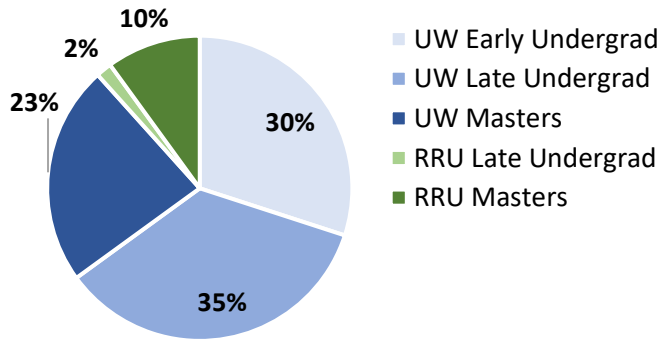

Figure 1: *Survey participant institution and study stage. N=60*

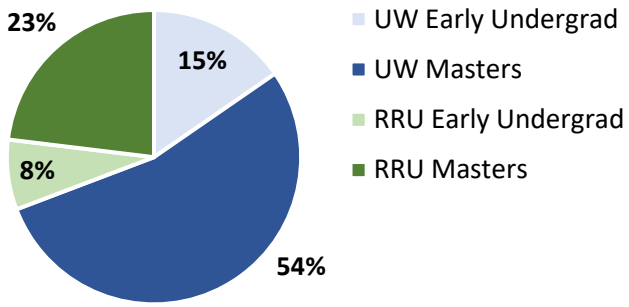

Figure 2: *Photo-elicitation and interview participant institution and study stage. N=13*

Of the 60 survey respondents, 72% were female-identifying, 21% were male-identifying, 3% were gender non-conforming, and 3% preferred not to respond. A diversity of ethnicities was reported including most prominently Caucasian (62%), Chinese (12%), Indian (8%), and South Asian (8%) among others. The age of survey respondents varied with 28% under 20, 40% between the ages of 20-24, 19% between the ages of 25-29, and 13% 30 or older.

4.3 Students' Emotional Experiences of EE

The first research objective was to *"capture and articulate a broad range of students' emotions in association with the post-secondary environmental curriculum and/or pedagogical experience."* I addressed this objective through descriptive statistics captured by the student survey and qualitative data captured in open-ended questions in the student survey, the photo-elicitation activity, and the subsequent individual interviews.

4.3.1 Descriptive Statistics

Descriptive statistics were calculated in Excel with the raw MEQ data, reported on a 5-point Likert scale. The frequency, intensity, and persistence of the nine positive and nine negative emotions included were measured. Participants were asked to select the Likert scale option that best described their experience of each specific emotion related to the course content and teaching approaches used within their environmental post-secondary education in the last two academic semesters. The minimum, maximum, quartiles, median, mean, and interquartile range were calculated for each dimension of the eighteen emotions measured in the student survey. Violin plots were generated in R to report these descriptive statistics and compare each dimension of the nine positive and nine negative emotions. The violin plots utilized kernel density estimation, a common non-parametric approach to estimating the underlying probability density of a dataset (Chen, 2017). These violin plots were used exclusively to visualize the distribution of the data, and not for computational purposes. While selecting the smoothing bandwidth for kernel density estimation requires mathematical justifications when the statistical outputs are being used to draw conclusions about the data, here the outputs were only used for visualization and thus bandwidth selection was based on aesthetic effectiveness (Chen, 2017). This was particularly important as Likert scales provide discrete data that create 'bumps' at integer values and fall to zero in between. Smoothing was thus important to highlight the trend in distribution rather than the discreteness of the distribution. For a full markdown of the R code used to generate these violin plots, see Appendix H.

4.3.1.1 Frequency of Emotions

I begin by reporting on the frequency of the positive emotions measured in the survey in Figure 3.

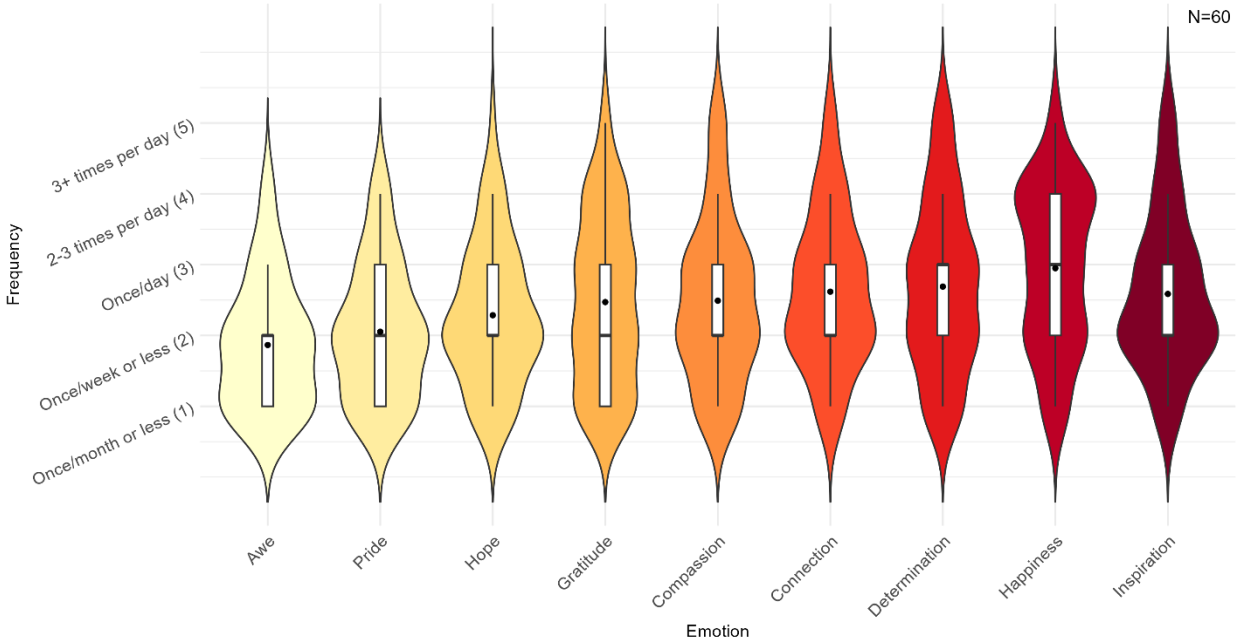

Figure 3: *Reported frequency of survey participants' positive emotions. N = 60*

The majority of the positive emotions shared a median frequency of “once per week or less,” with several emotions, including inspiration, determination, hope, connection, and compassion, sharing the same compressed interquartile range, with the central 50% of responses selecting either “once per week or less” or “once per day.” The frequency of pride and gratitude had a larger variation in response with the central 50% of responses falling between once per month or less and once per day. Awe was the least often experienced positive emotion with 75% of responses reporting it “once per week or less” and “once per month or less.” Happiness had a larger variation in response and the highest median with the central 50% of respondents reportedly experiencing the emotion between “once per week or less” and “two to three times each day.”

In comparison, Figure 4 shows that negative emotions were reportedly experienced less frequently overall, but with a larger variation in responses.

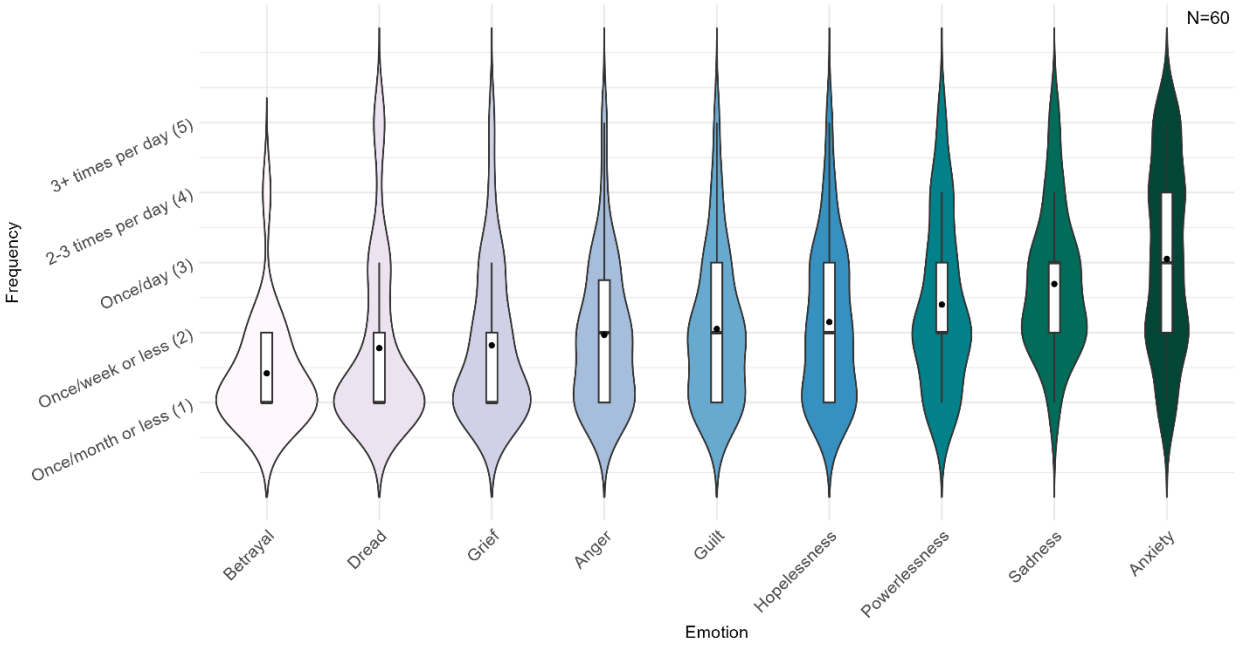

Figure 4: *Reported frequency of survey participants' negative emotions. N=60*

Betrayal, dread and grief were experienced the least frequently with 50% of respondents reporting these emotions occurring “once per month or less.” Anger, guilt, and hopelessness shared a median response of “once per week or less” and more variation in response with the central 50% of responses falling between “once per month or less” and “once per day.” Sadness and powerlessness were experienced slightly more frequently, and anxiety was experienced the most frequently with the central 50% of participants experiencing anxiety between “once a week or less” and “two to three times each day.”

4.3.1.2 Intensity of Emotions

Figure 5 shows the median intensity of all positive emotions measured sits at “moderate” with the spread of responses varying by emotion.

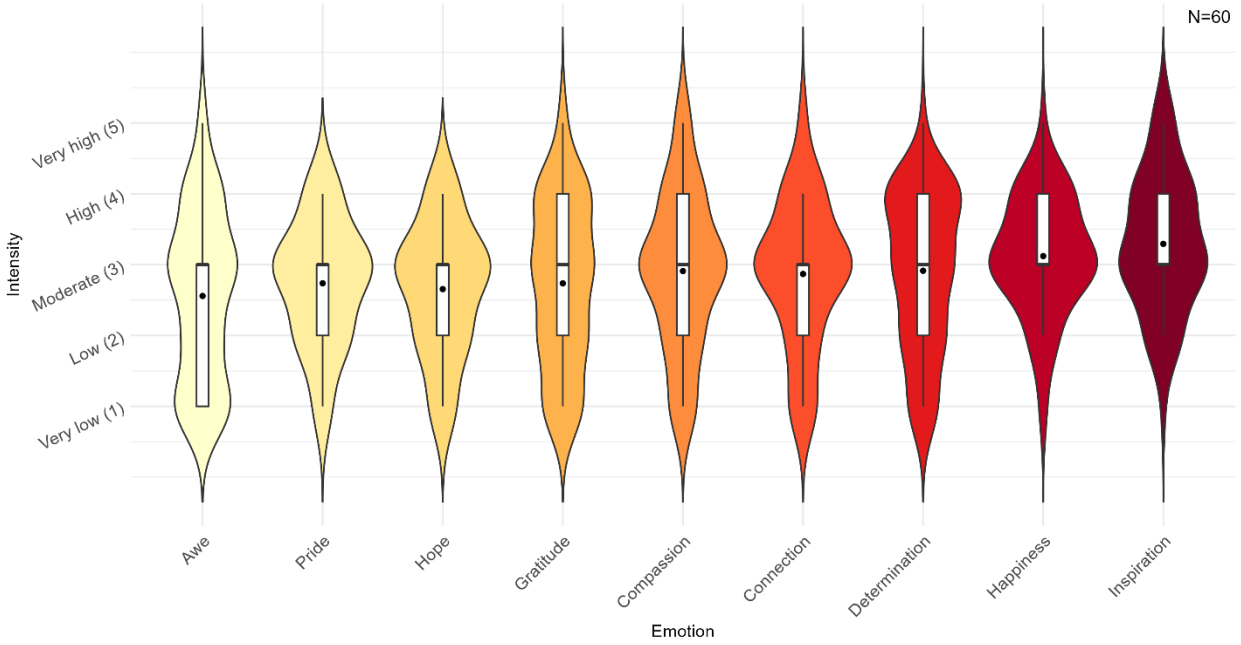

Figure 5: *Reported intensity of survey participants' positive emotions. N=60*

Awe is reportedly the least intensely experienced positive emotion, with 75% of respondents reporting the intensity between “very low” and “moderate.” Pride, hope, and connection are experienced at “low” to “moderate” levels of intensity by the central 50% of participants. Determination, compassion, and gratitude show a larger variation in response with the central 50% of participants experiencing these emotions at “low” to “high” levels. Happiness and inspiration are reportedly the most intense of the positive emotions with an interquartile range of “moderate” to “high.”

Similar to the frequency, the intensity of negative emotions captured in Figure 6 has a larger variation in response.

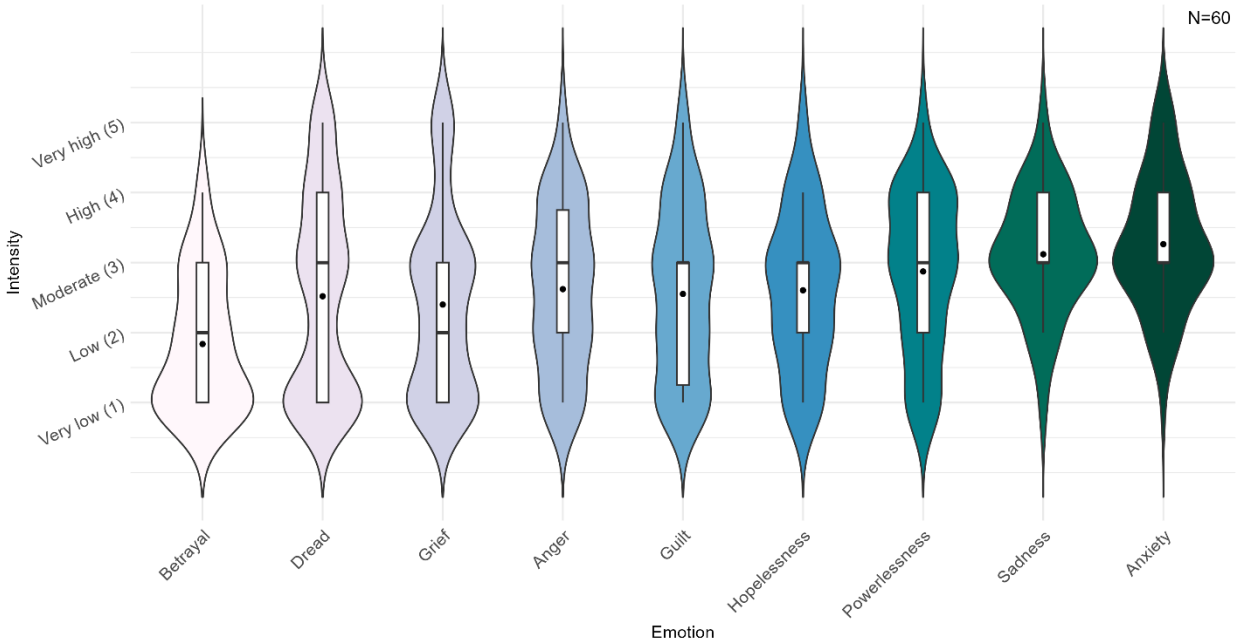

Figure 6: *Reported intensity of survey participants' negative emotions. N=60*

The least intense negative emotions include betrayal and grief with a median of “low.” Dread has the largest variation in response with the central 50% of responses falling between “very low” and “high.” Anger and powerlessness shared a median of “moderate” with the central 50% of responses falling between “low” and “high.” With a very similar variation in response as the two most intensely experienced positive emotions, the two most intensely experienced negative emotions, sadness and anxiety, share a median of “moderate” with the central 50% reporting these emotions between “moderate” and “high” intensity.

4.3.1.3 Persistence of Emotions

As shown in Figure 7, the majority of positive emotions measured shared a median persistence of 1-10 minutes.

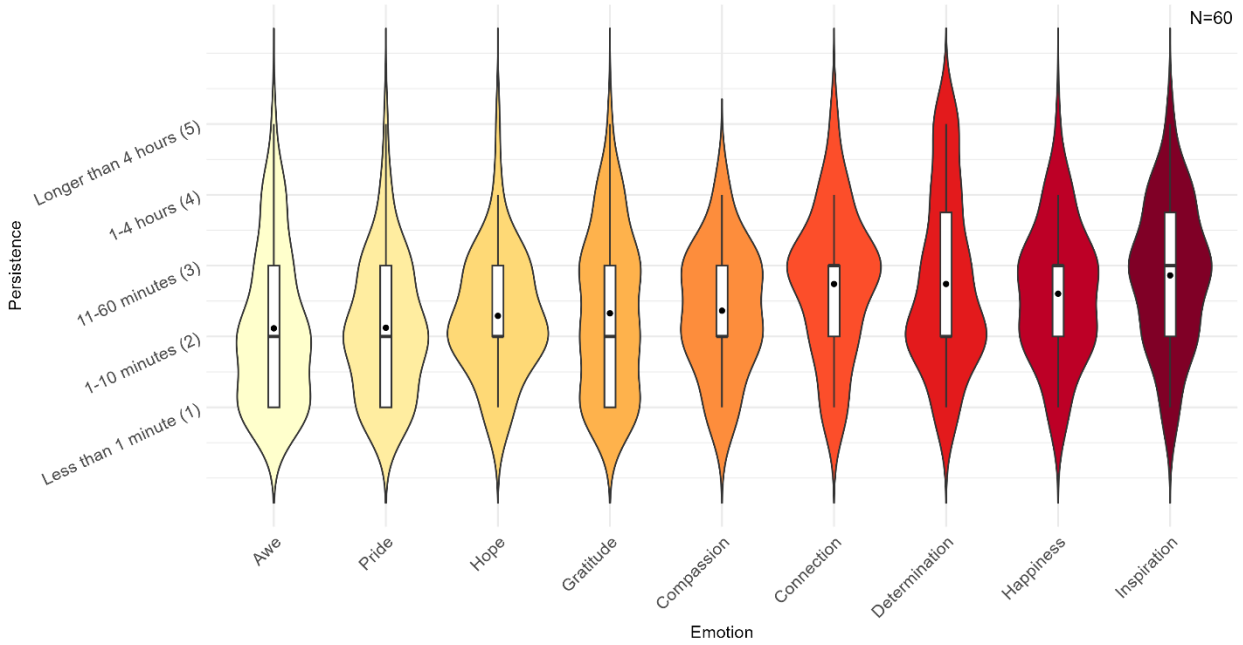

Figure 7: *Reported persistence of survey participants' positive emotions. N=60*

Hope and compassion had a median persistence of “1-10 minutes” and little variation in response, with an inter-quartile range of “1-10 minutes” and “11-60 minutes.” Awe, pride, and gratitude also shared a median of “1-10 minutes” but a larger variation in response with 50% of the participants reporting these emotional experiences from “less than 1 minute” to “11-60 minutes.” Determination had a median response of “1-10 minutes” but a large interquartile range between “1-10 minutes” and “1-4 hours.” The most persistent positive emotions experienced include connection, happiness, and inspiration sharing a median of “11-60 minutes.” While connection and happiness had little variation in response with the central 50% of respondents reporting the emotion lasting between “1-10 minutes” and “11-60 minutes,” inspiration saw a larger spread with the central 50% of responses falling between “1-10 minutes” and “1-4 hours.”

Figure 8 below shows the persistence of negative emotions.

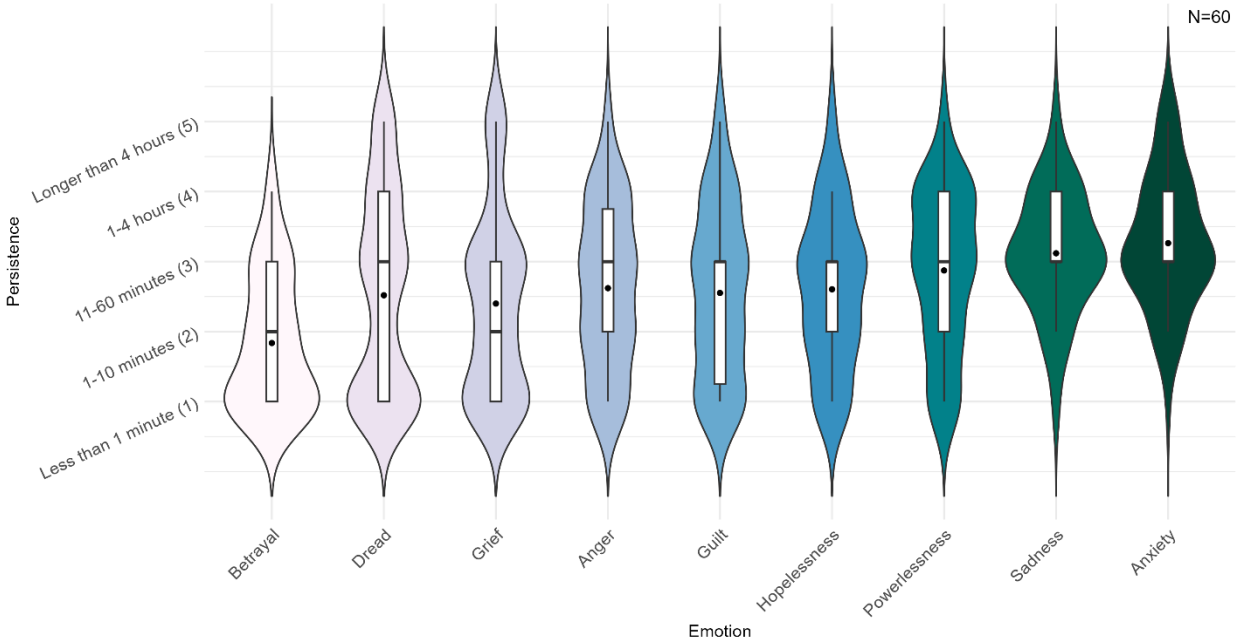

Figure 8: *Reported persistence of survey participants' negative emotions. N=60*

The majority of negative emotions shared a higher median response of “11-60 minutes” and saw a larger variation in response than the persistence of positive emotions. Betrayal and grief were the least persistent with a median of “less than 1 minute” and an interquartile range from “less than 1 minute” to “1-10 minutes.” Similar to its variation in intensity, dread saw the largest variation in response with the central 50% of responses falling between “less than 1 minute” and “1-4 hours. Powerlessness, sadness, and anxiety were the most persistent with a median response of “11-60 minutes.” Powerlessness was more variable with the central 50% of participant responses ranging from “1-10 minutes” to “1-4 hours” while sadness and anxiety were less variable with an interquartile range from “11-60 minutes” and “1-4 hours.”

4.3.1.4 Emotional Acknowledgement Preference

Towards the end of the survey, participants were asked two questions about their preferences for the acknowledgement of their emotions in post-secondary EE. First, they were asked "*How often are your emotions currently acknowledged?*" and second "*How often would you prefer to have your emotions acknowledged?*"

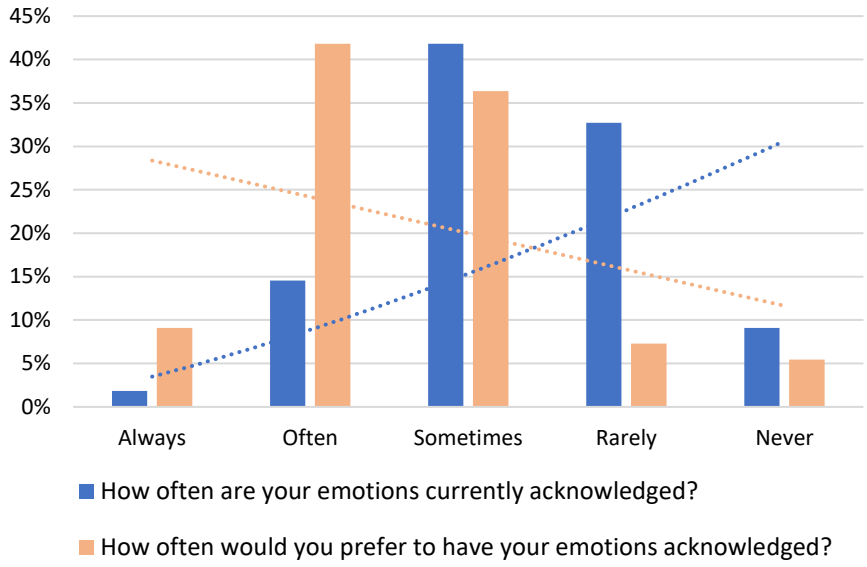

Figure 9: *Survey participants' current perception of emotional acknowledgement in EE and their reported preference for emotional acknowledgement*

Figure 9 shows that overall, the majority of participants would like their emotions to be acknowledged more often within their EE than currently acknowledged. Suppose we know that students are experiencing impactful emotions in association with their degrees and that students would like for their emotions to be acknowledged more in their EE. In that case, we can begin to consider how to most effectively do so.

4.3.2 Qualitative Findings

Qualitative data were collected from three sources: the open-ended questions in the survey, written descriptions from the photo-elicitation activity, and transcripts of the subsequent individual interviews. A total of 69 documents were uploaded into NVivo and sorted based on file type (interviews, photo-elicitation files, and survey responses). These documents were then coded inductively and deductively based on the structural codes in the deductive codebook.

Photo-elicitation written descriptions and subsequent interview transcripts were deductively coded into the first structural coding category *"Emotions experienced in relation to curricular and pedagogical aspects of post-secondary EE."* Both explicit and implicit mentions of these emotions were coded. Mentions were considered explicit if the word being coded or another word sharing the same root was captured in the text. For example, when coding for "*anxiety*," mentions of the word itself or "*anxious*" were considered explicit. Mentions were considered implicit when a synonym of the code word was used. For example, implicit mentions of "anxiety" included "fear," "worry," and "concern." Table 2 below showcases the percent of the 13 photo-elicitation and interview participants who mentioned each

emotion, and the total number of explicit, implicit, and overall mentions coded. Bolded values highlight the five emotions with the most total mentions and that were discussed by the largest percentage of participants.

Table 2: *Structural Coding Category 1 - Emotions experienced in relation to curricular and pedagogical aspects of post-secondary EE. N=13*

Negative Emotions					
Category of Emotion	Code	% of Participants N=13	Explicit Mentions	Implicit Mentions	Total Mentions
Threat-Related	Anxiety	***85%***	24	15	***39***
	Dread	***77%***	13	12	***25***
	Powerlessness	62%	11	9	20
	Overwhelm	***69%***	17	3	20
Sadness-Related	Sadness	***69%***	15	9	***24***
	Hopelessness	46%	17	4	***21***
	Isolation	31%	1	8	9
	Grief	31%	8	5	6
Anger-Related	Anger	***69%***	13	18	***31***
Guilt-Related	Guilt	54%	8	5	13
Indignation-Related	Betrayal	23%	3	3	6
Positive Emotions					
Category of Emotion	Code	% of Participants N=13	Explicit Mentions	Implicit Mentions	Total Mentions
Hope-Related	Hopefulness	***85%***	25	1	***26***
	Inspiration	***54%***	9	2	11
	Empowerment	38%	7	3	10
Pleasure-Related	Gratitude	46%	4	10	***14***
	Happiness	31%	6	4	10
	Pride	31%	5	0	5
	Relief	31%	7	1	8
Surprise-Related	Awe	38%	2	7	9
Motivation-Related	Determination	***69%***	5	13	***18***
	Curiosity	***69%***	13	2	***26***
Belonging-Related	Connection	***77%***	13	13	***26***
Caring-Related	Compassion	38%	3	3	6

The most frequently occurring negative emotions captured in the qualitative data included anxiety, dread, overwhelm, sadness and anger, among others. The most frequently occurring positive emotions captured in the qualitative data included hopefulness, connection, determination, curiosity and inspiration. Negative emotions were discussed more frequently overall with a total of 214 codes captured for the top eleven negative emotions, while the top twelve positive emotions captured included only 169 codes. The majority of the most frequently discussed emotions were included in the initial deductive codebook informed by Pihkala (2022), while others were coded inductively. Those coded inductively include overwhelm, isolation, empowerment, relief, and curiosity.

The relative frequency of the top eleven positive and negative emotions can be visually assessed with Figures 10 and 11, word clouds included below. These were generated using wordclouds.com which allows you to enter words and a corresponding weighting which determined the size of each word represented. I used the total mentions for each emotion featured in the table above as the weighting score.

Figure 10: *Word cloud of positive emotions, word size is weighted based on the number of mentions in photo-elicitation and interview data.*

Figure 11: *Word cloud of negative emotions, word size is weighted based on the number of mentions in photo-elicitation and interview data.*

Although coded separately, it is important to note that in the qualitative data, emotions were frequently discussed as being experienced concurrently, or sequentially. Participants often brought up multiple positive or negative emotions when discussing particular educational stimuli or experiences. They also described the experience of oscillating back and forth between positive and negative emotions. When an excerpt of a transcript contained multiple emotions, the excerpt was coded into each emotion included. Although some emotions were discussed more frequently than others, the emotions mentioned were all weighted equally and coded using the same process.

For example, the following excerpt was coded to anxiety, sadness, hopelessness, and powerlessness:

> I know ignoring it [eco-anxiety] isn't an emotion, but I feel like part of me definitely tries to ignore it. Because it makes me feel sad. It makes me feel hopeless. Like I don't feel hope that we can change that trajectory that we're on. I think people are very stuck in their ways, especially in North America where we consume so much. And yeah, so I feel very, very, very hopeless and powerless. (P2)

4.3.2.1 Participant Photographs

A total of 26 photographs and written descriptions were captured by 13 participants. A selection of these photographs and accompanying written descriptions can be seen in Appendix H. I used an archaeological approach to code the content visually captured in the photographs which are summarized in Table 3 (Cleland & MacLeod, 2021). I reviewed the written descriptions that accompanied the photographs while

completing the visual analysis to confirm and support the codes that are captured visually but are not interpretable without the accompanying text. For example, although "connection to place," was a theme that was captured in the photographs, without the accompanying written descriptions we would not know that the participant felt a connection to the location captured. Similarly, "use of metaphor," and "climate change or environmental degradation" were themes present in the photographs that require additional context provided by the written description to accurately identify. In addition to using the written descriptions to assist in the visual coding of the photographs, the written descriptions were also coded and analyzed in the individual interview transcripts.

Table 3: *Themes and codes captured within participant photographs. N=26*

Themes and Codes	**% of Photos** N=26
Subjects	
• Nature:	85%
○ Trees and plants	73%
○ Water	42%
○ Sky	46%
○ Other species	8%
• People	12%
• Lights	4%
• Text	4%
Places	
• Urban/built environment	27%
• Campus	19%
• Intersection of built environment and nature	54%
• Natural environment	31%
Activities	
• Gardening and harvesting	12%
• Walking	15%
• Taking public transit	4%
• Playing soccer	4%
Other Themes	
• Connection to place	62%
• Use of metaphor	54%
• Climate change or environmental degradation	46%

Most of the photographs included an element of place, with 27% showing a heavily built or urban environment, 54% showing an environment that had elements of both a built and natural environment, and 31% that included only natural elements. See Figure 12 for examples of the different environments captured in photographs. While there is implicit subjectivity in differentiating environments according to these categories, I classified natural environments as being outdoor settings composed primarily of natural elements and living things. Built environments were composed primarily of human-made elements like buildings, pavement, and human-made objects.

Figure 12: *Example of a natural environment, built environment, and an environment with both natural and built elements (from left to right respectively).*

Most photographs (85%) captured included some element of nature as a subject while only 12% of photos included human subjects. Some of the photos captured an activity such as walking and gardening. Some photographs (19%) featured locations on post-secondary campuses. The majority of photographs (62%) captured by participants communicated an emotional connection or fondness for the place that was captured in their photograph. Over half of the photographs and written descriptions (54%) used a metaphor to describe and contextualize their emotional experiences within the photograph. For example, one participant used a photo of cracks forming on an ice-covered river to represent and communicate their emotional experiences in EE (P4). Another took a photo of a cave and used that as a metaphor to discuss their emotions (P5). Just under half of the photographs and written descriptions (46%) captured or communicated some aspect of climate change or environmental degradation.

4.1.2.2 Curricular and Pedagogical Sources of Student Emotions

I used open-ended survey questions following the MEQ Likert scale measures for each emotion to ask participants, *"In the last two academic semesters, within your environmental courses, what specific course content or teaching approach sparked this emotion?"* This data along with interview data discussing specific examples were coded into structural coding category 2 *"Frequently identified curricular and pedagogical sources of positive and negative emotions experienced in post-secondary EE."* Table 4 below shows curricular and pedagogical sources of the most frequently experienced negative emotions.

Table 4: *Curricular and pedagogical sources of negative emotions in post-secondary EE.*

Curricular Sources of Negative Emotions	**Emotions Elicited**	**Total Mentions** N=60
Environmental Issues: Climate change, biodiversity loss, pollution, etc.	Anger, anxiety, dread, grief, guilt, hopelessness, isolation, overwhelm, powerlessness, sadness	104
Inaction & Underlying Cause: Lack of government and industry action, power imbalances, capitalism, industry lobbying, etc.	Anger, anxiety, betrayal, dread, grief, hopelessness, overwhelm, powerlessness, sadness	64
Personal Actions & Contributions: Carbon footprint, personal consumption, etc. (When perceived to be insufficient or harmful)	Anger, anxiety, guilt, hopelessness, powerlessness, sadness	29
Environmental Inequities: Environmental racism, injustice, colonization, etc.	Anger, anxiety, betrayal, grief, hopelessness, powerlessness, sadness	28
Complexity in Addressing Environmental Issues: Trade-offs, unintended consequences of solutions, "band-aid" solutions, etc.	Anger, hopelessness, overwhelm	10
Pedagogical Sources of Negative Emotions	**Emotions Elicited**	**Total Mentions N=60**
Lack of Engagement Opportunities: No peer-to-peer engagement, no opportunities to engage with the material, lecture-based approach, etc.	Anger, isolation, powerlessness, sadness	9
Low-Order Thinking: Memorizing and repeating concepts, no high-level thinking skills used, etc.	Anger, anxiety, guilt, powerlessness	5

Curricular content focused on environmental issues including climate change, pollution, environmental degradation, and biodiversity loss was mentioned in direct relation to negative emotions 104 times within open-ended survey questions, photo-elicitation written descriptions and subsequent interviews. Not only was curricular content the most frequently discussed source of negative emotions, but also it elicited the widest range of different negative emotions including anger, anxiety, dread, grief, guilt hopelessness, isolation, overwhelm, powerlessness, and sadness. Learning about climate change, and the ecological and social impacts of climate change was a common source of many negative emotions experienced within EE, as captured in Figure 13:

Figure 13*: Participant photograph by Katherine Matos.*

> The photograph depicts a boat that is lost in a dark and foggy sea. On board, there is a plant that has limited time left to survive, unless it reaches land soon. Unfortunately, the boat does not have a clear direction and is in unstable conditions to keep floating for much longer. This situation seems quite hopeless. This image represents how I feel after some courses, especially the ones where we discuss how the ecosystem has been degraded due to human activities or topics like climate change. (Katherine Matos)

Inaction on these environmental issues was the next most frequent source of negative emotions with 64 mentions across coded documents. This lack of meaningful action on environmental issues was perceived to be caused by underlying concerns about a societal power imbalance, with greed, consumerism, capitalism, and profits being prioritized over sustainability and equity. For example, one participant felt hopelessness when contemplating "*the lack of action from the actors with the greatest potential for impact*" (anonymous survey response). Another participant expressed that "*learning that governments and other stakeholders with the power to make a difference have chosen not to act in ways that could save the planet is a powerful feeling of betrayal"* (anonymous survey response).

Learning about this failure to act and the underlying systemic drivers perpetuating that inaction led to emotional experiences of anxiety, powerlessness, overwhelm, sadness, hopelessness, grief, anger, dread, and betrayal for students. Learning about the inequities and disparities of environmental issues was mentioned 28 times and led to feelings of anger, anxiety, betrayal, grief, hopelessness, powerlessness, and sadness. This included learning about instances of environmental racism, injustices, disproportional impacts of climate change, and the ongoing impacts of colonization.

Participants also expressed negative emotions when learning about the impact of their own actions and contributions, which were perceived as insufficient at best, and harmful at worst. One participant described the perceived insufficiency of their individual actions by saying, *"I understand the scale of the issue and I don't think the impact of my work will be substantial or timely enough to actually make a difference"* (anonymous survey response). Another participant voiced the substantial potential harm of their actions that was brought to their attention during a classroom exercise of carbon footprint calculating: *"I just think that it was a lot to put on a young person, to have this guilt that to live the way you live you would need two and a half Earths"* (P6). Learning about personal contributions to environmental issues and individual actions led students to experience anger, anxiety, guilt, hopelessness, powerlessness, and sadness.

Grappling with the complexity of environmental issues, the complexity of implementing context-dependent solutions, and considering unintended consequences and trade-offs of those solutions led to negative emotions including overwhelm, hopelessness and anger:

> This degree has kind of crushed my spirit and my desire to fix these problems, because I've learned that there is no 'one-size-fits-all' solution, and solutions that work in some areas, don't work in all areas, and that's just kind of demoralizing. (P5)

While teaching post-secondary students about current environmental issues is arguably necessary to an informed environmental education, this curricular content is undoubtedly accompanied by difficult negative emotions. Pedagogical sources of negative emotions were much less prevalent than curricular sources but insightful, nonetheless. Participants shared that a lack of engagement opportunities was accompanied by feelings of anger, isolation, powerlessness, and sadness. A teaching philosophy based on a uni-directional flow of information, lecture-style teaching, and the resulting lack of opportunities to meaningfully engage with the material and with each other led to these negative emotions for one participant:

> A philosophy of knowledge was expressed where the instructor was the all-knowing container of knowledge, and we were just lucky to be receiving that knowledge from them. That definitely provoked feelings of powerlessness, frustration, and anger. (P4)

In addition to a teacher-centred approach, three participants experienced negative emotions as a result of the pedagogical focus on lower-order thinking such as the memorization, and repetition of concepts. They felt as though they were not given as many opportunities to enrich their learning and engage in critical thought as they had hoped for. One participant described the feeling of frustration that this focus on low-order thinking brought about:

> I had a whole tutorial [covering] the pros and cons of cap and trade versus carbon tax. It felt like my only purpose was just to compare and contrast these concepts or give definitions and

> compare and contrast definitions. But I felt a sense of uselessness because I'm not reducing any CO2 emissions here. (Kylee Bridger)

One participant explicitly mentioned Bloom's taxonomy in their explanation of this experience. They felt they were only reaching the lower-order thinking skills (remembering and understanding) and failing to achieve higher-order thinking skills (analyzing, evaluating, creating) in their environmental courses, which led to negative emotions:

> I get this anxiety because I'm like, 'Do I really understand this?' If I have to take a test on it, am I learning it, or am I just memorizing it? Oftentimes if it's lecture-based, I have this anxiety and guilt that I'm trying to get an education and we're only just hitting the bottom. We're memorizing, identifying, and listing things. I'd love to have comprehension. (Mary Ingribelli)

In addition to negative emotions, EE curriculum and pedagogy were also a source of positive emotions. These curricular and pedagogical sources are summarized in Table 5 below.

Table 5: *Curricular and pedagogical sources of positive emotions in post-secondary EE.*

Curricular Sources of Positive Emotions	Emotions Elicited	Total Mentions
Environmental Solutions & Success Stories: solutions implementation, conservation, nature-based solutions, etc.	Awe, compassion, connection, determination, empowerment, gratitude, happiness, hope, inspiration, pride, relief	65
Environmental Issues: Climate change, biodiversity loss, pollution, etc.	Compassion, determination, gratitude	22
The Wonder of the Natural World: Interconnections between species and ecosystems, the power of water, the formation of the natural world, etc.	Awe, connection, gratitude, happiness	10
Personal Actions & Contributions: Carbon footprint, personal consumption, research work, etc. (When perceived to be environmentally beneficial)	Determination, hope, inspiration, pride	7
Developing Skills & Competencies: GIS skills, presentation skills, environmental assessment, plant ID, etc.	Empowerment, happiness, pride, curiosity	6
Curricular Sources of Positive Emotions	**Emotions Elicited**	**Total Mentions**
Opportunities for Engagement: Peer-to-peer discussion and learning, opportunities to apply learning and engage with material, etc.	Awe, connection, determination, happiness, hope, inspiration	37
Positive Pedagogical Focus: Professors with a positive outlook, focusing on positive case studies, imagining sustainable futures, thinking about the positive impacts of research, etc.	Determination, empowerment, gratitude, happiness, hope, inspiration, pride	20
Creative Pedagogy: storytelling, field trips, guest speakers, scenarios, creative assignments, etc.	Awe, connection, curiosity, gratitude, happiness, hope, inspiration	14
Higher-Level Learning: Analysis, application, creation levels of learning, surpassing memorization and repetition, etc.	Empowerment, happiness	2

While learning about environmental issues was clearly associated with a broad range of negative emotions, it was also associated with positive emotions on 22 occasions. These circumstances under which these positive emotions occurred included: compassion for the species, ecosystems and people suffering; gratitude to be largely free from the worst of those impacts; and determination to address these issues.

The most common curricular source of positive emotions was environmental solutions and 'success stories.' These included sustainability strategies and solutions, collective climate action, and progress toward environmental goals. Some of these successes focused on environmental activism, social justice, Indigenous leadership, knowledge, and reconciliation:

> I appreciate what we've learned about nature so far and how many people have been fighting for ecological protection decades before I was born. I have the chance to stand on the shoulders of giants. (anonymous survey response)

Learning about real examples of successful action being taken to address environmental issues and protect the natural world was associated with awe, compassion, connection, determination, empowerment, gratitude, happiness, hope, inspiration, pride, and relief. One explained how:

> Having courses that teach about solutions, the implementation of solutions, and how to fix the problem at hand, is incredibly valuable in ensuring students can feel a sense of community and togetherness and feel hopeful towards a better future. (P3)

In addition to environmental success stories, learning about the natural world was mentioned in association with positive emotions ten times. Learning about the interconnection of species and ecosystems fostered gratitude, happiness, gratitude, awe, and connection:

> I know that the trees are talking to each other underground and that there is this whole ecosystem with the river in the forest and it's something that we get to enjoy. I have this appreciation for nature from my EE. (P2)

In addition to the positive power of nature, students experienced positive emotions connected to their own skill and competency development and academic achievements in EE. For example, developing new skills, furthering research projects and assignments successfully, and thinking about future career opportunities all led to positive emotional experiences including pride, happiness, empowerment, and curiosity. One participant reflected on his journey through his undergraduate degree and into his master's:

> There is a sense of pride looking back from where I started to where I am now. I can see that I've grown and improved upon all of these skills. I'm also excited for what's going to happen in the future. I have opportunities that I didn't know I was going to have earlier, so there's that pride and excitement. (Owen Nowitsky)

Participants felt determination, hope, inspiration and pride when they perceived their personal actions to be environmentally beneficial, as opposed to useless or destructive. While there were 29 instances of feeling negative emotions when contemplating personal actions, there were also seven instances of positive emotions. For example, a participant noted in an anonymous survey response that, "*the work*

I'm doing is fulfilling to me, and knowing that it will be a part of the solution to this issue contributes greatly [to feelings of hope]."

Some pedagogical sources of positive emotions were also shared. Opportunities for engagement were mentioned 37 times and led to feelings of awe, connection, determination, happiness, hope, and inspiration. Students enjoyed peer-to-peer discussions and learning, and opportunities to apply their learning and engage with material.

A positive pedagogical focus was mentioned 20 times and included professors approaching the material with a positive outlook, focusing on positive case studies, imagining sustainable futures, and actively exploring the positive impacts of research projects. These strategies elicited feelings of determination, empowerment, gratitude, happiness, hope, inspiration, and pride.

Creative pedagogy both in delivering information and assessing knowledge was associated with feelings of awe, connection, curiosity, gratitude, happiness, hope and inspiration and was mentioned 14 times. This included storytelling approaches and creative assignments, field trips, labs, fieldwork, guest speakers, inspiring documentaries, and innovative educational tools such as Google Earth Pro.

4.1.2.3 Emotional Sentiments

Several emotional sentiments emerged from the data during inductive coding that provided context and nuance to students' broader emotional experiences in EE. A sentiment, different than an emotion, can be defined as "a settled opinion reflective of one's feelings" (Merriam-Webster, n.d.). These sentiments, shared by several participants, describe the nature of the emotional experience as a student in post-secondary EE and are explored in greater detail below.

A Harsh but Necessary Truth

Participants acknowledged that EE, by necessity, teaches them about many complex and emotionally heavy topics like climate change and environmental degradation. Although they recognize that these topics are emotionally challenging, participants accept the emotional weight of course content, considering it highly important. One participant acknowledged that while EE is sometimes stressful, "*it comes with the territory*" (P1). Another participant recognized that:

> Sometimes negative feelings can make people feel overwhelmed and feel as though they don't even know where to start to address climate inaction. However, it is still of the utmost importance to relay information in an accurate and science-based manner. Sure, this may be depressing at times, but reality often is in the environment field. (anonymous survey response)

Participant Richa Mishra summarized this sentiment by saying *"If I hadn't had the hard bits, I wouldn't have learned as much as I have, so I wouldn't want to trade it for happiness."*

Blissful Ignorance No More

While participants largely agreed that the EE curriculum can create challenging emotional experiences within their education, they also identified several ways in which the emotional nature of their studies impacts their lives beyond the classroom. Several students shared that once you have acquired an EE, your ability to observe and detect environmental issues in the broader world is heightened. They

reported that both within and beyond the context of their courses, they could not help but notice the issues and patterns they have learned about in their daily lives.

One participant acknowledged this sentiment in their newfound skill to identify invasive species everywhere they went, including this amur honeysuckle captured in their photo, Figure 14:

Figure 14: *Participant photograph by P1.*

> I have found that the more we learn about plant identification, the more I see invasive species when I am outside, and it can be hard sometimes, especially as they are the most easily identifiable. I think this transcends a lot into my courses beyond plant ID. Once we learn about certain patterns in class, I see them much more in real life. In my experience, these have been mostly negative. Aside from invasive species, I also notice environmental politics a lot more in the news, and those decisions have a lot more weight or significance now that I understand the concepts. (P1)

Another participant expressed this sentiment by noting the dark truth of climate change unfolding behind the guise of an unseasonably warm and seemingly beautiful winter day in Manitoba, captured in her photograph, Figure 15:

Figure 15*: Participant photograph by P2.*

> I can agree that, you know, the weather is beautiful. But I know because of my environmental education that it's really, really bad. And it's something that hurts me deep down, knowing that it's something that we can't change. If I went to pass someone on the street, if they're not someone who's learned about the environment, they don't really understand that we're seeing climate change right in front of us. (P2)

She went on further to describe how this heightened perception can reach the point of painful sensitivity, stripping students of the "blissful ignorance" of navigating the world without climate change and environmental degradation mentally and emotionally present in every experience and those yet to come:

> This is something that I didn't anticipate through my education, almost like 'ignorance is bliss,' right? Others are able to go out and enjoy the environment without thinking, 'Oh, my children won't be able to enjoy this.' (P2)

At times, the emotional weight of this scientific knowledge intersected with spirituality and existential concerns in thought-provoking ways:

> I believe that I have lived many lives and will probably live many more. There's nothing I can show to evidence this, but it's just my feeling. And that has been one of the reasons why I chose EE as a professional endeavour. I feel like this is probably the most important thing that I can do in my life. I feel worried that the world that I'm supposed to die here and come back here and be reborn here, but if this ends, where am I gonna go? (Richa Mishra)

With Knowledge Comes Responsibility

Participants recognized that although emotionally trying at times, they hold the privileged position of being able to obtain the knowledge and experiential benefits that a post-secondary EE can offer. This privilege was accompanied by a sense of responsibility to make a positive change in the world and address the complex societal and environmental issues that they spent years learning about. Participant Kylee Bridger described this by saying, "*I feel like I have a duty to mitigate climate change,"* she went on to say, *"If my life's goal is to be more sustainable, then I can say I am helping."*

One participant described this sentiment as a "double-edged sword:"

> We have all this knowledge and we're gifted to understand what will happen. But there's also the action that comes after that, and it's a lot of actionable items that are on that list, to get to an equitable world. (Owen Nowitsky)

Another participant expressed a desire to see this responsibility to act integrated into the curriculum:

> We really need to just step up and do it. We need to be supported to do that, pushed to do that. Not just learn to be a Grade A student. It's like 'No, what are you doing outside of school to make a difference? How are you being a good citizen?' (Mary Ingribelli)

While students seem willing, even motivated to bear the responsibility to take action on climate change and the environmental ills our planet is facing, it is by no means perceived to be an easy task. One participant compared this sentiment to *"being tasked with solving the world's problems and searching for answers and guidance in a dark cave"* (Figure 16, P5).

Figure 16: *Participant photograph by P5.*

4.4 Student Recommendations for the Emotional Experience of EE

The third research objective was to *"make student-led recommendations to environmental curriculum and pedagogy to address and support students' emotional experiences."* Structural coding category 3, tied to RO3, focused on *"student-identified recommendations for the emotional experience of EE."* These data were collected from both open-ended questions in the survey, photo-elicitation written descriptions, and interview transcripts. Participants shared a diversity of possible solutions that they believed would improve the emotional experience of EE. The top six most frequently discussed solutions are featured in Table 6 and explored in further detail in the sub-sections below.

Table 6: *Structural Coding Category 3 - Student-identified recommendations for the emotional experience of EE. N=60*

Code	% of Participants	Total Mentions
Welcome Emotions in the Learning Environment: • Having their emotions acknowledged and validated • Learning more about the role of emotions in environmental work • Learning how to channel their emotions into meaningful action and positive outcomes	45%	67
Real-World Application & Action: • Opportunities to engage in climate action and pro-environmental behaviour within their courses • Opportunities to connect with local environmental organizations • More "real-world" case studies and solutions	28%	38
Solutions-Oriented Content: • More course content on existing environmental solutions that address the root of the climate crisis • More detail on the implementation of feasible solutions Opportunities to envision a sustainable future	18%	16
Experiential Learning: • More outdoor, hands-on, land-based learning • Opportunities to see concepts first-hand	15%	26
Build Community: • More opportunities to connect and collaborate with peers Fostering a culture of vulnerability and openness	13%	20
Creative Pedagogy: • Creative teaching approaches beyond the lecture • Creative assignments beyond the test and essay	12%	15

4.4.1 Welcome Emotions in the Learning Environment (45%)

The most widely discussed recommendation for the emotional aspects of EE was to welcome emotions into the learning environment. Participants have expressed the necessity of engaging with emotionally challenging information and additionally are advocating for the creation of a classroom culture where emotions are validated, explored, reflected on, and discussed.

> I think a lot of folks come in with a personal connection to the material and I don't know that that's necessarily the case for a lot of other post-secondary topics. This is life and death, to me, it's what I live for, and so the idea of losing it is really emotional. It doesn't make sense to me that we sit in the classroom and talk about it, and that there isn't any space for those emotions to come out. I think it's a lost opportunity to (1) Connect with the material in a way that's going to enhance our learning because emotions can deepen our connection to the material. But (2) it's a lost opportunity to connect with each other and to build community. (P4).

Students want their professors to acknowledge the emotionality of studying environmental topics. One participant expressed this by saying *"I kind of just wanted a prof to say, 'This is really hard. These impacts*

are horrible, but this is the road we're on'" (P6). Further, they expressed a desire to have a space to express the full range of emotions that EE can elicit:

> I think students should be taught that it's okay to feel strong emotions in the classroom, especially in EE where we face difficult topics. I don't think the answer is to avoid difficult topics. I think the answer is to create a safe, supportive, and vulnerable space where we can be open about the way that these topics make us feel. This might mean regular reminders that emotions are welcome in the space, more intentional community-building activities, and the sharing of resources and strategies for processing these emotions. (anonymous survey response)

Participants expressed an interest in learning more about the role of emotions and psychology in sustainability and environmental action, noting that this knowledge could be beneficial not only for themselves personally but applied in their working lives. They identified emotions as a potential motivator for action and expressed interest in learning how to channel their emotions into meaningful environmental action, generating positive outcomes for themselves, and their communities:

> I have found it incredibly useful to learn how to use my emotions to fuel my desire to achieve a more sustainable world or society. I do not mean to allow your emotions to take over in all scenarios, but you can use negative emotions such as sadness and guilt to influence positive change in the world. It is much easier said than done, but it's a skill that was worthwhile for me to learn. Allow yourself a space to feel those emotions but not overpower your will and desire to be a part of the positive change that the world needs. (P3).

Welcoming emotions in the learning environment can create opportunities for students to connect to themselves, the material, and each other in new and enriching ways. As participants noted, emotions don't have to prevent meaningful action, they can encourage it. However, for emotions to drive action in EE, students also need to be given opportunities to act.

4.4.2 Real-World Application & Action (28%)

Participants expressed a clear interest in having more opportunities to engage in climate action and pro-environmental behaviour within their EE. One participant said, *"I wish more university assignments were designed to evoke real change within the community or campus,"* and another participant recommended, *"more applicative work so we can feel we are taking action and contributing to change, theory is not enough, we need to act" (anonymous survey responses).* For example, students wanted to learn more about 'real-world' case studies of environmental issues and actions happening in their communities. One participant explained *how "bringing past and present practical cases will benefit students in a way that will allow them to apply the theoretical knowledge they are learning to real-world issues in an efficient way"* (Batu Batbayar). Students saw value in increasing opportunities to connect with local environmental organizations to take action and make real change:

> We did have a course where we did our report for a real case and had a meeting with stakeholders. That was great because the people working on the problem are interested in the work you're doing. So, you feel like your work is meaningful and you're spending your time in a meaningful way. It's not just leading to paperwork. (Katherine Matos)

Participants explained that opportunities for real-world action would bridge the gap between theory and practice, increasing their sense of agency:

> We talk about these things, but we're never told what to do once we're outside of the classroom. We don't really interact with people outside of the classroom. They are providing us with information, but I think information and agency are very different. (P2)

Integrating opportunities to take action within the context of their EE is something that students would like to see more of, and that they believe, would improve their emotional experience. Taking action can extend their learning beyond the classroom and into the real world, which can also be done with experiential learning and creative pedagogy.

4.4.3 Experiential Learning (15%)

Many students want more outdoor, hands-on, and land-based learning to be integrated into their courses because *"the environmental education you get is not just in textbooks, it's also what you see 'out there'"* (Neha Kapoor). Participants saw immense value in learning about and seeing environmental concepts firsthand, bringing what can feel largely theoretical in textbooks and lecture slides, into the real world:

> The most impactful experiences I have had throughout my post-secondary EE have been grounded in land-based learning—from interning on a regenerative cattle farm to my experience in Costa Rica interviewing farmers who are passionate about conducting agriculture in new (and old) sustainable ways. I have found that the parts of my environmental education that have taken place in a classroom have felt largely theoretical—not always, but often. Seeing environmental issues with my own eyes and meeting people impacted by certain stressors made my learning tangible and made the lessons feel more pressing than before. (Figure 17, P6).

Figure 17: *Participant photograph by P6.*

These land-based learning experiences can happen closer to home as well:

> I had walked through this nature park a few times; however, I never had a full appreciation for what it had to offer. After my experience with an environmental policy and legislation course, I suddenly observed so many distinct aspects of this park that raised questions about enforcement, awareness and knowledge of protected areas, species, fish sanctuaries, etc. My first thought was that a walk through a nature preserve would be an ideal class setting. To be able to see an area and learn about applicable environmental laws around it would add so much more connection to the learning. (Figure 18, Mary Ingribelli)

***Figure 18**: Participant photograph by Mary Ingribelli.*

Not only did students acknowledge the learning benefits of experiential approaches in outdoor environments, but they also realized that these are opportunities to foster connection, appreciation, and positive relations with the natural world:

> My appreciation for the environment is something that's been instilled in me from a young age. And I'm very privileged to have that. But I think lots of people lack positive interactions with the natural world. And I think that's something that can be facilitated through school. (P3)

These experiential learning opportunities deepened the learning experience and also students' connections with and appreciation for the land and species they had been studying in classrooms. Experiential learning practices bridge the gap between theory and practice, allowing students to apply their learning in the real world.

4.4.4 Creative Pedagogy (12%)

Participants also expressed interest in creative teaching approaches beyond the lecture including case studies, art, storytelling, documentaries, field trips, and guest speakers. One participant explained how creative pedagogy furthered her understanding of difficult course concepts that were introduced in a lecture-based setting:

> At the end of the course, we had a little field trip where we went to the Reep House for Sustainable Living and then it all clicked and I left that feeling inspired and empowered. Like, 'Okay, I get it now. I've seen it in action, it totally makes sense to me.' So, yeah, that makes me think maybe it's not about the content, maybe it is about the way it's being taught. (P4)

Students also expressed appreciation for creative assignments which improved their emotional experiences in EE. One participant described this by saying, *"I had more desire to learn and more enjoyment in learning because I wasn't just writing papers"* (P5). Examples of creative assignments discussed by students included generating social media posts, board game design, music video creation, and engaging in informed debates on environmental issues or solutions. Student-centred learning was recommended, with lots of opportunities for discussion and peer interaction:

> By putting the student at the center of their learning, there is this feeling that 'Okay, I actually am able to do hard things and figure things out.' In this specific case of agency towards the environment, I think that emotion could then lead to more engagement with pro-environmental behaviours or a stronger sense that students are capable of understanding environmental issues and acting on them. (P4)

4.4.5 Building Community (13%)

Building community was the fifth student recommendation for EE. Students wanted more opportunities to connect and collaborate with peers in their courses. One participant said, *"I think there should be more small group work and discussions. A teacher-centred lecture format is not conducive to vulnerability and connection" (anonymous survey response).*

Students believe that fostering a culture of vulnerability, openness, and mutual respect would encourage students to develop connections and working relationships that would positively impact their emotional experience in EE:

> I was able to open up to my classmates more. That had a very positive impact on not only my learning but also my personal development as well. So being open and vulnerable in a way to people that you can trust can help you break down the feelings you might have. I feel like that's very helpful. (P3)

Building community and creating additional opportunities for peer-to-peer interaction in EE was seen as beneficial for learning, as additional insights were gleaned from diverse perspectives:

> The people in my class came from all different backgrounds. There were people in oil and gas, people in consulting, people in the fashion industry, people in waste management, all these different sectors. The discussions were so positive. It was great to meet people from all these backgrounds who want to learn the same things. All these ideas were shared. I think the discussion part of it was my favourite thing to do. (Neha Kapoor)

Learning about environmental issues in community instead of in isolation can foster hope and make students feel they can overcome these challenges together. One participant explained how this sense of hope came from connecting with his classmates:

> This world is not as bad as I expected. All these people truly care, can do something about it, and know something about sustainability. I felt this sense of belonging. We are like-minded people who want to do something and contribute to this goal. (Batu Batbayar)

Community building within courses was viewed as a more meaningful way of actively supporting student mental health than some of the current strategies used to share existing resources:

> I think that informal peer-to-peer discussions should be encouraged more. Stronger interpersonal connections could make a lot of course content easier to digest, and I would prefer it to the helpline linked at the top of every LEARN page. (anonymous survey response)

In addition to fostering interpersonal connections and relationships between peers to foster positive emotional experiences in EE, we can equip them with as much solutions-oriented content as is available.

4.4.6 Solutions-Oriented Content (18%)

Finally, while students acknowledge the importance of an EE that thoroughly explains the environmental issues we face today, they are also interested in learning more about existing environmental solutions that address both the symptoms and the root of the climate crisis. One participant shared that *"focusing on better management techniques and things that people are doing to combat the bad stuff that is happening is really helpful"* (P1). They also want more content that outlines the feasibility of these solutions and thoroughly explains potential courses for implementation. Students also mentioned that having opportunities to *envision "what the world would look like if we get things right"* and consider how they might get there is a powerful and positive experience (anonymous survey response).

4.5 Results Summary

Post-secondary EE students experienced a broad range of emotions in relation to the curricular and pedagogical aspects of their degrees. The surveys found that negative emotions were less frequent overall than positive and saw a larger variation in frequency. Anxiety was the most frequently experienced negative emotion and happiness was the most frequently experienced positive emotion. Negative emotions had a larger variation in intensity with sadness and anxiety the most intensely experienced negative emotions. The median intensity of all positive emotions was "moderate", and happiness and inspiration were the most intense positive emotions. Negative emotions had a larger variation in persistence than positive emotions. Powerlessness, sadness, and anxiety were the most persistent negative emotions while connection, inspiration, and happiness were the most persistent

positive emotions. Overall, students wanted their emotions to be acknowledged more in EE than they felt they were being acknowledged currently.

The photo-elicitation and interview data found that anxiety, dread, overwhelm, sadness, and anger were the most frequently discussed negative emotions, while hopefulness, inspiration, determination, curiosity, and connection were the most frequently experienced positive emotions. The most common curricular sources of negative emotions included environmental issues, inaction and underlying causes, environmental inequities, personal actions, and complexity. A lack of engagement opportunities and low-order thinking were two pedagogical sources of negative emotions. Curricular sources of positive emotions included environmental solutions and success stories, environmental issues, the wonder of the natural world, personal actions, and developing skills and competencies. Pedagogical sources of positive emotions included opportunities for engagement, a positive pedagogical focus, creative pedagogy, and high-level learning. Students perceived difficult emotions in their EE as a *"harsh but necessary truth,"* claiming they have access to *"blissful ignorance no more"* and that *"with knowledge comes responsibility."* Students had several recommendations for the emotional aspects of their EE including welcoming emotions in the learning environment, real-world application and action, solutions-oriented content, experiential learning, building community, and creative pedagogy.

5.0 Discussion & Conclusions

5.1 Student Emotional Experiences of EE

In this section I discuss my data interpretation for RO1, to *"capture and articulate a broad range of students' emotions in association with the post-secondary environmental curricular and/or pedagogical experience."* This includes the descriptive statistics captured in the student survey, and qualitative data captured in open-ended questions in the student survey, the photo-elicitation activity, and the subsequent individual interviews. The results of these data collection methods are compared and contrasted with each other and existing literature. Possible theoretical interpretations of the results are included.

5.1.1 Positive Emotions

The descriptive statistics from the MEQ Likert scale data showed that happiness was the most frequent, happiness and inspiration were the most intense, and happiness, inspiration and connection were the most persistent of the positive emotions associated with EE. In comparison, the qualitative data showed that the most frequently discussed positive emotions include curiosity, hopefulness, connection, and gratitude. These were followed by inspiration empowerment, and happiness. Curiosity and empowerment, though not measured by the survey, were inductively coded in the qualitative data. Curiosity is considered in the literature to be a common epistemic, academic emotion that is "fundamental to the learning process" and thus may be less of a reflection of the specific course content, and more a reflection of the learning environment in general (O'Toole & O'Flaherty, 2022, p. 3; Pekrun, 2019). A 2020 study by Graham et al., showed that common positive responses to post-secondary EE courses included feeling "empowered," and "like trying to make a difference" (p. 190). Pihkala's 2022 initial taxonomy of climate emotions included a wide variety of positive emotions, including those captured here, but did note that there is a distinct lack of research on happiness, joy and pride concerning climate change.

5.1.2 Negative Emotions

While both data sources showed sadness and anxiety as frequent and intense emotional experiences for students in EE, there was less of a clear alignment on anger, hopelessness, powerlessness, and dread. These results align with Galway & Field's (2023) national survey of Canadian youth, in which researchers concluded that young people are experiencing "a diversity of climate emotions at high rates" with the most common emotions being "afraid (66%), sad (65%), anxious (63%), helpless (58%), and powerless (56%)" (p. 3). Similarly, Verlie et al., (2021) published a study on Australian educators, primarily at the post-secondary level, who "reported that their students commonly experienced feeling overwhelmed, hopeless, anxious, angry, sad and frustrated when engaging with ecological crises" (p. 132). Wallace et al., (2020) discussed the alarm, anxiety, and despair experienced by students in post-secondary EE that they argue are underpinned by sorrow, fear, and powerlessness. Some of these negative emotions including anger, anxiety, hopelessness, and sadness are also not uncommon in learning environments more generally, regardless of the specific course content (Kordts-Freudinger, 2017).

5.1.3 The Prevalence of Negative Emotions

While students were asked to report on an equal number of explicit negative and positive emotions in an interspersed order in the survey, in the photo-elicitation prompts and the subsequent interviews they

had the freedom to steer the conversation and discuss the emotions they found most compelling. I coded the qualitative data for both explicit and implicit emotions. Negative emotions were more heavily discussed by participants and more frequently coded than positive emotions. Similarly, Rushton et al., (2023) conducted focus groups with youth asking them *"What comes to mind when they hear the words climate change?"* They found that positive emotions accounted for less than 10% of emotion references in their data (Rushton et al., 2023). These findings may be an example of the 'negativity bias,' which can be defined as "the propensity to attend to, learn from, and use negative information far more than positive information" (Vaish et al., 2008, p.383). Additionally, research shows that memories associated with negative emotions are recalled with greater detail and accuracy than those associated with positive emotions (Kensinger, 2009). It is possible that when students were asked to share the emotions they associate with the content of their EE, the negative emotions were more salient. Exacerbating the negativity bias could be the availability effect, defined as "the process of judging frequency by the ease with which instances come to mind" (Kahneman, 2013). Students who have extensive knowledge of and frequent interaction with information about the climate crisis and other environmental issues, are more likely to have readily accessible examples of these issues in their minds. If those examples are associated with negative emotions (as the results of my study suggest), they may believe those emotional experiences to be more frequent (Kiran, 2022).

5.1.4 The Prevalence of Basic Emotions

It is worth noting that some of the more prominent emotions from both datasets including sadness, happiness, anxiety, anger, dread (similar to fear), and curiosity (similar to interest), which are included in several lists of basic emotions (Ortony, 2022, Table 1). If emotions can be mentally organized into hierarchies, basic emotions reside on the "basic level, that is typically the most salient, cognitively accessible level" and are linguistically used more frequently and learned at earlier life stages than words at other hierarchical levels (Ortony, 2022, p. 44). Furthermore, the concept of emotional differentiation or granularity explains how people distinguish between emotions at varying levels of specificity, with some people being less likely to use high-level emotional words to describe their experiences (Erbas et al., 2015; Vedernikova et al., 2021). These theoretical concepts can add context as to why the basic emotions may feature more prominently in my results.

5.1.5 Curricular & Pedagogical Sources of Student Emotions

Available research supports the curricular and pedagogical sources of negative emotions identified in my study. Existing literature shows that learning about climate change and environmental issues can lead to negative emotions like worry, overwhelm, hopelessness, anxiety, anger, sadness, frustration, and even despair (Clayton, 2018; Sund & Ohman, 2014; Verlie et al., 2021; Wallace et al., 2020). For example, Jones & Davison (2021) found that EE students experienced overwhelm when grappling with the complexity and significance of climate change, finding climate change a difficult topic to fully comprehend. The same study shared how learning about inaction from parties in power was a source of student frustration, anger, and betrayal (Jones & Davison, 2021). In Grant & Case's (2022) study of post-secondary EE, students experienced guilt in reflecting on their personal pro-environmental behaviour and climate action, which were perceived to be inadequate. They also discovered that EE students experience negative emotions including guilt and despair when learning about the persistent inequities and violence faced by Indigenous communities (Grant & Case, 2022). Pedagogically speaking, Campbell (2023) determined that students learning about climate change were "fed up with" the "information dump" approach to education (p. 6). Participants in my study described negative emotional experiences

in relation to a “teacher-centred approach” which can be contrasted by a “student-centred approach” where knowledge is understood as “constructed by students in a collaborative and supportive academic culture” (Myers & Beringer, 2010, p. 54).

Available research also supports the curricular and pedagogical sources of positive emotions identified in my study. Learning about environmental ‘success stories’ or solutions to climate change and other environmental problems brought about positive emotions. Edwards et al., (2023) discussed the importance of balancing EE curricular focus between the issues and the available solutions to foster a sense of hope. Similarly, Field et al., (2024) recognized a shift in EE towards more climate solutions content. In a recent study by Galway & Field (2023) Canadian youth reported that by teaching about solutions, educational institutions could improve their mental and emotional well-being. A large body of literature on awe supports the finding that learning about and experiencing the wonder of the natural world led to positive emotional experiences for students in my study (Bai et al., 2021; Lucht & Van Schie, 2024; Sperry, 2023). Participants associated positive emotions with creative pedagogical approaches to EE, which can also be used to aid in emotional expression and increase emotional literacy and engagement (Field et al., 2024; Heinemeyer et al., 2024). Grant & Case (2022) found that creative activities including photography can be valuable tools in exploring the emotional dimensions of climate change in the EE classroom. In sharing pedagogical sources of positive emotions within their EE, students also described several aspects of “student-centred learning” including engaging “students in active-learning experiences,” and creating “opportunities for student-faculty and student-student interactions” (Myers & Beringer, 2010, p. 54). Student-centred approaches can foster positive emotional experiences in educational settings (Naude et al., 2014).

5.1.6 Demographic Variables

While demographic information including gender and ethnicity was collected from participants to understand and report on the demographics of the sample captured, differences in emotional experiences based on these variables were not analyzed. Available research shows that women typically have higher levels of environmental concern and negative climate emotions than men, who report higher levels of optimism about climate change (Clayton et al., 2023; Galway & Beery, 2022; Heeren, 2022). A 2010 study by Arnocky & Stroink found that gender differences in environmental concern and action in their undergraduate participant sample were fully mediated by emotional empathy. Given the predominantly female-identifying sample in my study, it is possible that some of the findings including the dominance of negative emotions, might be partially attributable to gender, and emotional empathy. It is important to note that the physical and mental health impacts of climate change are disproportionately experienced by women, which may also be influencing this difference in emotional responses (Stone et al., 2022). A 2024 study by Sasser & Klancher Merchant, found that participants of colour were “significantly more likely than white respondents to report feeling traumatized by climate change, which correlates with other research demonstrating the disproportionate climate impacts across all communities of colour” (p. 9).

5.1.6 Emotional Sentiments

5.1.6.1 A Harsh but Necessary Truth

In my study, engaging with emotionally challenging information was seen as necessary to obtaining a high-quality EE. Field et al., (2024) identified a heightened sense of alarm in EE students, even expecting an “emotional toll” as students “come to understand the gravity and urgency of the climate crisis” (p. 8).

Much like students in post-secondary EE, climate scientists spend a lot of time engaging with material that can raise a lot of negative emotions (Clayton, 2018). As participants noted, learning about climate change and environmental issues can feel like a "harsh but necessary truth," but the answer is not to adjust the curriculum to exclude any emotionally challenging content, to pathologize emotional reactions, or to sweep those negative emotional reactions under the rug (Ojala, 2023; Ray, 2018). Just as students in my study acknowledged difficult emotions as necessary, the environmental education researchers argue that "we should not shelter our students from failure and suffering" or avoid difficult emotional content (Ray, 2018, p. 307). Existing literature recommends that an alternative approach is to "help young people face difficult emotions, critically evaluate them, and do something constructive with them" (Ojala, 2023, p. 4). If we embrace the emotionality of EE curricula, we can create valuable opportunities for the deeper learning and discussion required to address the economic and socio-cultural systems underpinning many of the environmental issues we face (Ojala, 2021; Ray, 2018).

5.1.6.2 Blissful Ignorance No More

Participants found that their knowledge and awareness about climate change and other environmental issues could not be confined to the classroom, but overflowed into other areas of their lives. In their study, Grant & Case (2022) determined that "studying climate change makes its consequences an inescapable reality" as it becomes increasingly easy for students to identify climate impacts in the places they live and work (p. 9). Similarly, Jones & Davison (2021) uncovered that students encountered "knowledge and claims about climate change in all aspects of their lives, from social media to the supermarket to the workplace to political discourse" (p. 198).

5.1.6.3 With Knowledge Comes Responsibility

Many of the environmental issues we face today are a product of a capitalist economic system that requires unsustainable trajectories of growth and production incompatible with the finite limits of our Earth's ecological systems (Stuart et al., 2020). To address the root cause of the environmental issues we face, action at all levels will be required, including systemic reform which must be demanded and driven by the collective (Stuart et al., 2020). Despite this, participants reported a sense of responsibility to address the environmental issues they have spent years learning about in their post-secondary EE. Graham et al., (2020) identified a similar theme in their data collected from students in EE; "Students felt like they were not necessarily responsible for initiating the world's environmental issues but felt disproportionately responsible for solving these problems" (p. 198). Jones & Davison (2021) captured a similar experience, where students learning about climate change felt an added responsibility to communicate the urgency and severity of the situation to their friends and family members. In discussing the idea of responsibility in relation to issues like climate change, Field et al., (2024) note that in many formal educational contexts, an inappropriate focus is placed on the actions of the individual without adequate exploration of the collective and systematic changes required. While this sense of responsibility may be useful to encourage action and pro-environmental behaviour, to create change at the scale and speed necessary to mitigate the worst effects of climate change, students in EE must see environmental issues and their solutions not as a matter of the individual, but as a matter of the collective (Summers-Effler, 2002).

5.2 Student Recommendations for the Emotional Experiences of EE

In this section I discuss the interpretation of data collected to address RO3, to *"make student-led recommendations to environmental curriculum and pedagogy to address and support students'*

emotional experiences." This includes qualitative data captured in open-ended questions in the student survey, the photo-elicitation activity, and the subsequent individual interviews. These results are compared to existing literature and possible theoretical interpretations are provided.

Interestingly, the recommendations students shared for the emotional aspects of their EE are largely supported by the peer-reviewed literature. The Climate Change Empowerment Handbook developed by the Australian Psychological Society (APS) shares several insights from psychological work and poses recommendations to effectively engage in climate action (APS, 2017). Among others these include, acknowledging feelings, inspiring positive visions of sustainable futures, taking personal and collective action, and engaging with nature, all of which were recommendations also shared by students (APS, 2017). Each of the six most frequently discussed recommendations from the qualitative data and their overlap with peer-reviewed literature are included below. These recommendations and concrete examples for integration into post-secondary EE, are summarized in Table 7.

Table 7: *Recommendations for the emotional experience of post-secondary EE and concrete examples for educators to implement.*

Participants' Recommendation	**Concrete Examples for Educators to Implement in EE**
Welcome Emotions in the Learning Environment	• Acknowledge potential emotional reactions to course content. • Create opportunities for reflection and discussion of emotional reactions. • Poll or mind mapping student emotions in class. • Discuss adaptive functions of emotions. • Discuss resilience and healthy coping strategies. • Professors share their own experiences with emotions and coping. • Incorporate educational content on climate emotions.
Real World Application & Action	• Share information about campus clubs, associations, and local community organizations that do climate action work. • Bring local activists and environmental practitioners into the classroom. • Incorporate opportunities for pro-environmental behaviour and climate action into course design through assignments.
Experiential Learning	• Take classes outdoors to learn concepts firsthand. • Design assignments that encourage or require students to explore, observe or analyze their local environments.
Creative Pedagogy	• Diversify beyond lecture-based delivery with field trips, documentaries, multi-media, discussion-based activities, guest lectures, panels, and more. • Incorporate arts-based approaches into assignments that foster creativity, imagination, and reflection: poetry, storytelling, photography, graphic design, or artwork.
Build Community	• Create more opportunities for peer-to-peer discussion and collaboration in class and through assignments. • Connect students with relevant organizations and groups on the broader campus and local community.
Solutions-Oriented Content	• Balance content on environmental issues with solutions-focused content including "real world" examples of successful environmental interventions.

This table is not an exhaustive list but seeks to offer educators a few diverse strategies to improve students' emotional experiences in EE. The time and resource investments required to implement these

strategies vary and are context-dependent based on existing curriculum, pedagogical approaches, and educator backgrounds. Some recommendations will be more easily integrated into a given EE course than others depending on these factors. It is not likely reasonable or advantageous for educators to implement all the above approaches into every single course. However, an appropriate aim would be to find one or two strategies to implement that are well-suited to course outcomes, and the educator's teaching style and comfort level. For example, field courses and courses with outdoor lab components are more likely to be able to easily integrate nature-based experiential learning opportunities. Even if educators are facing limited time, resources, or flexibility in curriculum, less intensive, discussion-based interventions can be a meaningful first step.

5.2.1 Welcome Emotions in the Learning Environment

The survey results established that most participants would like their emotions to be acknowledged more frequently than they perceive them to be acknowledged currently in EE. This finding was echoed in the qualitative data, as students desired to see emotions welcomed, acknowledged, and validated in EE. They also wanted to learn more about how to channel those emotions into meaningful action and positive outcomes. Similarly, Galway & Field (2023) determined that 80% of young Canadians believe that social and emotional dimensions of climate change should be included in education. Not only students, but environmental educators are beginning to acknowledge the potential of emotionally-aware educational practices. Both Edwards et al., (2023) and Field et al., (2024) found that environmental educators see the value in emotional acknowledgement, normalization, and empathy in EE, with an "aim to create safe learning spaces for climate emotions to be voiced, expressed, or processed" (Field et al., 2024, p. 8). Researchers have shown that welcoming emotions in the learning environment can positively impact student learning and well-being, and lead to the development of emotional self-regulation, and differentiation skills (Aps, 2017; Cox & Neumann, 2022; Erbas et al., 2015; Ojala, 2023; Vedernikova et al., 2021; Wallace et al., 2020). The expansion of these skills would help students to become more aware of their emotions, increasing their ability to manage them in healthy and productive ways (APS, 2017). If time and space to critically reflect on challenging emotions in EE are provided, educators create opportunities to empower and motivate students, and even activate joyful emotions (Lehtonen et al., 2019; Naess, 2008; Ojala, 2023).

In practice, welcoming emotions in the learning environment could take many diverse forms, ranging from more to less time and resource-intensive. Some practices can be done intra-personally, while others are completed interpersonally (Lehtonen et al., 2019). An easy place for environmental educators to begin is by acknowledging the emotional weight of the course content either before or after presenting it and inviting students to reflect on, and discuss their emotional reactions to it. For example, after giving a lecture on climate trends or biodiversity loss, a professor might acknowledge that learning about these topics can bring about all kinds of emotions, and at times, be difficult to grapple with. They could engage in a reflective exercise, asking students to work independently, or together to create mind maps of the emotions they experienced as a result of the environmental issue of focus, later discussing their experiences in creating the mind map (Pihkala, 2021). A similar exercise could be completed quickly as a class using an online polling tool or word cloud generator.

Even if the emotions revealed in these exercises are primarily negative, this presents an opportunity for environmental educators to acknowledge the emotional challenges that engaging in EE presents, and to introduce the adaptive functions of emotions to students, validating and normalizing emotional reactions (Ojala, 2023). For example, in the context of climate change anxiety is a moral emotion,

exhibiting care for the planet and those suffering (Pihkala, 2020). Anger can result from perceived injustices and concern for equity and fairness, which are inevitably intertwined with environmental issues (Laws et al., 2014). Grief requires a sense of connection, attachment, or fondness for the subject of loss, in this case the Earth (Heidari & Kumar, 2021). These are all appropriate and justified emotional reactions to climate change and other curricular focuses of EE (Ojala, 2023). In addition to helping students to identify and discuss their emotions in relation to EE course content, posing additional questions can help to foster emotional resilience. For example, asking students to consider how they "cultivate courage" and healthy coping in their own lives, and professors sharing their own coping strategies can close conversations on a positive note (Atkinson & Ray, 2024). It remains unclear precisely how often emotions should be acknowledged in EE to optimize students' emotional experiences. The answer is likely student- and context-specific, depending on the exact curricular content of the course and the strategies and depth at which emotions are acknowledged and explored.

In addition to welcoming student emotions in the learning environment, the literature highlights the "need for educators to critically engage with their own emotions if they are to contribute to fostering productive coping mechanisms among learners" (Edwards, 2023, p. 3). This finding is supported by (Cox & Neumann, 2022) and (Ojala, 2023). Although challenging, environmental educators must broaden their horizons beyond the delivery of factual information to include "emotionally responsive pedagogies" and foster emotional engagement (Rushton, 2023, p. 8). Students also expressed interest in learning more about the role of emotions in environmental work, in hopes that they could apply this knowledge in their working lives and increase the efficacy of their environmental work. Despite their embeddedness in institutions that overlook and even negatively frame emotions, students see the potential educational value in embracing them in both pedagogy and curriculum (Head & Harada, 2017). While emotional and embodied knowledge has historically been neglected, there is a demand from students and support from peer-reviewed literature to welcome emotions into the learning environment (Lehtonen et al., 2019; Selby, 2010).

5.2.2 Real-World Application & Action

Participants in my study demanded and desired more opportunities within EE to take action to mitigate and address the issues they learn about. Similarly, Jones & Davison (2021) determined that their EE student participants "found that the classroom offered no avenue for change" (p. 195). The literature describes how this recommendation can improve the emotional experiences of students in EE. Engaging in climate action can be a powerful strategy to cope with challenging climate emotions and rejuvenate emotional energy (APS, 2017; Summers-Efller, 2002, p. 44). Creating opportunities for students to take climate action in the context of their EE can help to dissipate feelings of distress, helplessness, and anxiety (APS, 2017; Field et al., 2024; Haltinner & Sarathchandrea, 2018; Jones & Davison, 2021). EE has historically focused more on "private sphere environmentalism at the expense of preparing students for public action" (Chawla & Cushing, 2007, p. 448). Students shared a specific desire to have more opportunities for pro-environmental behaviour and climate action that extend beyond their personal lives as individuals and enter the public sphere, connecting them with local organizations engaging in environmental work. These opportunities for public engagement are especially important in the context of climate change, where larger systemic issues are at play. Public engagement and group activism create conditions where "personal problems are revealed as social patterns, and the blame for energy loss is placed on the environment instead of the self" (Summers-Effler, 2002, p. 51). This aspect of public action

might help students explore and better address their feelings of guilt, anger, and betrayal while preventing burnout from extensive climate activism and environmental work.

Environmental education programs in post-secondary institutions should provide students with opportunities to engage in climate action to invest in student well-being, but also because they have a societal responsibility to do so (Leal Filho et al., 2021). The recent push for a Canadian "Youth Climate Corps" showcases the need for youth opportunities to take climate action (Sarfraz, 2023). A national Youth Climate Corps program would "provide job opportunities for young people that are focused on addressing the climate crisis, while also giving them the skills and experience they need to succeed in their careers" (The David Suzuki Institute, 2023). A national program supported by the Canadian government could create an excellent bridge for youth from all backgrounds to transition into environmental work. However, post-secondary EE should be fulfilling that purpose for their students, and extending the "core function of teaching academics to support real-world problem solving, social innovation and societal transformation" (Leal Filho et al., 2021; Leimbach & Milstein, 2022, p. 415). Integrating opportunities for climate action and pro-environmental behaviour into EE curriculum and pedagogy can also contribute to institutional goals. For example, the University of Waterloo's *Faculty of Environment Strategic Plan* shares a vision "to be a leading teaching and research institute for the environment and sustainability; a place where people come together to advance understanding of and to mobilize solutions for sustainability" (University of Waterloo, 2020, p. 3). Solutions cannot be mobilized without integrated opportunities for action. This action-oriented approach to EE is good pedagogical practice, reinforcing conceptual learning with applied learning opportunities (Wright, 2006). As Leimbach & Milstein (2022, p. 419) explain, "Climate education strategies are effective when they move beyond the transmission of climate science, and incorporate activities and educational interventions designed to engage learners in meaningful ways."

5.2.3 Experiential Learning

Students shared a desire for more outdoor, hands-on, land-based learning within EE and research supports the many diverse benefits of this recommendation. There is a large body of peer-reviewed literature that presents the mental health benefits of spending time in nature (Hartig et al., 2014). A few of these benefits include lower stress levels, increased attention capacity, improved cognition, and a boost in positive affect (Bratman et al., 2015; Kaplan, 2001). In addition, spending time learning in natural settings can foster an emotional connection between students and their local environments which can lead to an orientation of respect and care for the Earth (Chawla, 2020). In addition, Mashford-Pringle & Stewart (2019) highlight the opportunities for reconciliation and traditional ecological knowledge within land-based learning, providing students with insight into how the land's physical, emotional and spiritual well-being is connected to their own. Research also shows that teaching and learning in nature at post-secondary levels can improve outcomes for life-long learning, environmental literacy, and nature connection while providing skill-development opportunities, and fostering a sense of comfortability in these settings (Asfeldt et al., 2022; Edwards, 2023). While it is unrealistic to expect every EE course to have the logistical capacity to incorporate experiential learning into their weekly course content delivery, this approach can also be achieved through independent course assignments. Designing assignments that encourage or require students to explore, observe, and analyze their local environment can be a less intensive strategy to incorporate experiential learning into post-secondary EE.

5.2.4 Creative Pedagogy

Participants expressed a desire to diversify the teaching approaches used in their EE, integrating more creativity and variation beyond lecture-based delivery. Research shows that in addition to traditional science-based approaches, there is great potential for arts-based, creative approaches to play a meaningful role in EE to deepen engagement in emotional, experiential, and imaginative ways (Lehtonen et al., 2019; Cole, 2023). In combatting climate change and environmental issues, creative approaches can "transform apathy and grief into joy and empowerment and bridge the gap between theory and practice" (Lehtonen et al., 2019, p. 11).

This is not to say that traditional science-based approaches to EE are not a necessity in post-secondary settings, but rather, that in combination with creative methods of delivery and knowledge assessment, we can improve students' engagement with and understanding of the material, and their emotional experiences. Heinemeyer et al., (2024) recognize that arts-led approaches, storytelling in particular, are well-suited to engage with the uncertainty and complexity of learning about climate change. Nxumalo & Montes (2023) identify creative and artistic climate education pedagogies as opportunities for anti-colonial approaches that "nurture reciprocal relations with the more than human world" (p. 42). Educators can integrate creative pedagogy in a variety of ways based on the time, and resources available to them. This could start with steps as small as diversifying course material beyond solely lecture-style delivery to include multimedia, discussion-based activities, or expert panels. Creative pedagogy can be integrated into assessments as well. These might include assignments integrating poetry, storytelling, photography, graphic design, or artwork (Atkinson & Ray, 2024). Students could be asked to envision and design a sustainable future or alternative related to the environmental topic of focus (McGrath & Schapira, n.d.). As explained by Cole (2023), "If progress is to be made, climate scholars cannot dismiss the humanities as a set of disciplines categorically separate from, or subordinate to, the quantitative sciences" (p. 2800).

5.2.5 Build Community

Participants recommended more opportunities to build community both with their peers and beyond their educational institution. Within post-secondary institutions, research is clear that students with a strong sense of belonging in their educational communities have better outcomes for motivation, self-confidence, engagement and achievement (Pedler et al., 2020). This sense of belonging can be fostered through community building within and outside of the classroom, through class discussions, group projects, and meaningful engagement with the broader local community including NGOs, environmental organizations, campus clubs and student associations (Mitchell, 2019; Summers-Effler, 2002). Community-building opportunities can overlap with opportunities for real-world action and application in the form of volunteering, local activism, and community organizing, maximizing benefits for students (Kleres & Wettergren, 2017; Pihkala, 2020; Verlie, 2020).

5.2.6 Solutions-Oriented Content

Participants shared a desire for the curriculum to be more balanced in terms of thoroughly explaining the environmental challenges and sharing the existing environmental solutions, feasibility, and steps for implementation. Similarly, Jordan (2023) found that when undergraduate EE students were asked what they would most like to be taught in their courses, 50% of students responded with "concrete actions to address climate change" (p. 3). The literature shows that focusing on climate solutions and climate action in EE can help to productively manage challenging climate emotions and instil a sense of agency in

students (Edwards, 2023; Field et al., 2024; Galway & Field, 2023). Edwards et al., (2023) discuss this as a balancing act, wanting to ensure that the severity of environmental problems is not diminished or inaccurately portrayed while fostering hope through the discussion and promotion of specific actions. Students also wanted opportunities to envision a sustainable future within their courses. Interestingly, the Climate Change Empowerment Handbook recommends engaging in positive visionary activities to imagine a sustainable future and then ground it in available solutions to help us progress towards that vision (APS, 2017).

Ensuring a balanced approach to EE with an increased emphasis on solutions may help to mitigate the potential effects of pseudoinefficacy, a decision-making bias based on the false perception that individual actions do not make a meaningful difference in solving a larger problem (Zhao & Luo, 2021). This bias has clear potential implications for students' perceptions of the contribution of individual actions to climate mitigation in the face of government and industry inaction and malfeasance, all prevalent concerns communicated by students in the results of my research (Zhao & Luo, 2021).

All of these student-posed recommendations are valuable considerations to improve the emotional experience of post-secondary EE. However, based on the findings of my study and the available literature, I believe that welcoming emotions in the learning environment and integrating opportunities for real-world application and action in EE are the most relevant and necessary. Addressing the emotional experiences of EE curricula and pedagogy and welcoming emotions in the learning environment creates opportunities to enhance student learning, well-being, and pro-environmental behaviour. Creating real-world application and action opportunities would support the transcendence of students' learning beyond the classroom and foster a sense of agency and capability to make meaningful changes in the world around them.

5.2.7 Possible Institutional Resistance to Emotionally Aware EE Practices

While research is showing that many environmental educators are acknowledging the need and advocating for emotionally aware and considerate EE (Field et al., 2024), pushback is inevitable from some educators and/or administrators in environmental institutions. While this specific area is not well studied, it is reasonable to assume that the recommendations posed by students in my research may be met by disinterest, and pushback by some staff and faculty. Faced with an already significant barrage of research, teaching, and administrative duties, it is understandable that some educators may see these recommendations as yet another demand that they must meet with already limited time and resources. Others may not understand the value or importance of addressing emotions in EE or may be uncomfortable with reflecting on their own emotional experiences in their environmental work. These possible attitudinal barriers to recommendations implementation require further investigation but are not insurmountable roadblocks. The solutions posed by participants above are diverse and many can be implemented with a small amount of time and resources, and with minimal curricular adjustment. Further, these recommendations can be packaged and presented differently to educators who remain uncomfortable or unwilling to address and discuss emotions. These recommendations were posed by students to improve their emotional experiences in EE; however, they can also be presented to educators as pedagogical best practices to optimize student learning and pro-environmental behaviour. Whether presented in relation to emotional outcomes or not, the implementation of these recommendations should lead to an improvement in the emotional experiences of EE students.

5.3 Limitations

This research was conducted within a master's graduate studies program at the University of Waterloo which was accompanied by time and resource constraints that inevitably shaped the research process. I was operating within a two-year degree and as an individual researcher with the support of my committee and lab community. The research was scoped and designed according to these parameters and logistics limitations.

Participants were drawn from both the University of Waterloo in Ontario and Royal Roads University in British Columbia. Although my recruitment strategies targeted students in each year of study at both institutions, they were not randomly sampled or proportional to the broader population and were largely convenience-based as I reached out to specific instructors to gain access to students in their classes (Cox, 2015). It would have proven impossible to use quota sampling to strive for a sample proportional to the broader population as this enrollment data was unfortunately not made available to me by RRU staff.

I am a full-time master's student at the University of Waterloo which likely influenced the efficacy of recruitment of participants from the respective institutions. I had the opportunity to schedule in-person classroom recruitment visits at the University of Waterloo, while no in-person recruitment visits were conducted for classes at Royal Roads University. This discrepancy in recruitment strategies may have led to a bias towards participant recruitment from the University of Waterloo.

University of Waterloo students, specifically at the master's level may have been familiar with me, my program, my advisors, and/or my lab which may have biased participation. Recruitment occurred primarily during the Fall 2023 academic semester at the University of Waterloo. Many of the courses targeted for recruitment at Royal Roads University are offered online, or with condensed in-person components, and do not operate on the same four-month semester-based schedules, which further complicated recruitment at this institution and may have hindered participation.

While descriptive statistics were generated, the overall survey sample size (n=60) and size of the sub-group from Royal Roads University (n=7) was deemed insufficient to use inferential statistics to explore differences between sub-groups (study stage, institution) which was the aim of RO2. As a result, no statistically significant conclusions were drawn (Cox, 2015). In order to obtain sufficient sample size and statistical power to analyze study stage as a variable, a pre-established participant pool would be incredibly helpful.

As discussed in the literature review, emotions consist of subjective experiences, physiological changes, and behavioural changes (Stevens, 2020). While physiological or behavioural measures could have been used to measure students' emotions, these methods would have been more resource, and time-intensive to apply than self-report measures. Self-report measures were also more well-suited to the research questions posed which were interested in capturing a diverse range of subjective emotional experiences (Barrett et al., 2007; Pekrun, 2019). Limitations of self-report measures include the possibility of inaccurate recall, memory biases, social desirability bias, and identity-related self-reflection biases (Brenner & DeLamater, 2017; Gonyea, 2005; Pekrun, 2019). Self-report measures are also unable to capture emotional experiences as they unfold in real-time (Pekrun, 2019).

Although students were asked to reflect on their emotional experiences related specifically to environmental course content and teaching approaches, other related factors may have influenced their emotional reflections. For example, students reflected on experiences spending extracurricular time in nature and how the knowledge acquired in their EE courses led to additional emotional experiences in those scenarios outside of class time. Additionally, it is important to consider the potential influence of

external sources of environmental information including news and social media (Andersen et al., 2024). Climate events and environmental disasters such as forest fires, heatwaves, floods, and the 28th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP28) occurring during the time of data collection may have influenced students' responses. While a variety of emotions were captured within this research, the absence or intentional suppression of emotions was not. Feeling numb or avoiding emotions would have been valuable to capture in this research, but was not implemented into the study design.

5.4 Directions for Future Research

Further research on the emotional experiences of EE using a diversity of methodological approaches would strengthen our comprehensive understanding. To address the limitations of self-reporting outlined above, other methods of emotion measurement should be used to gather additional data on students' emotional experiences of EE including behavioural and physiological measures (Pekrun, 2019).

Several research gaps remain, including the relative impacts of study stage and institutional context on environmental students' emotional experiences (Pekrun, 2019). Creating a clearer picture of how the emotional experience of EE changes throughout a degree would contribute to tailored supports and approaches. Better understanding the emotional experiences of students in EE across institutions within and beyond Canada would help to clarify how the socio-cultural context in which post-secondary institutions are embedded impacts student emotions. It would also be valuable to study differences in emotional experiences of EE students based on demographic variables such as gender and ethnicity. To study all of these variables appropriately, longitudinal and experimental approaches are required (Pekrun, 2019). Existing studies on emotions in higher education lack large, representative, random samples which are typically more resource-intensive to collect; to address this challenge, Pekrun et al., (2019) recommend "conducting multi-lab studies involving several research groups across institutions" (p. 1810). In addition to better understanding the emotional experiences of environmental students, we need more research on the coping strategies used by students to manage their climate emotions in EE (Galway & Field, 2023).

The development, testing, and dissemination of tools, activities, and best practices for environmental educators to meaningfully address and productively manage emotions in their classrooms is a very important area for future research. Existing literature shows that "many climate change educators feel that they need more support and resources to be able to engage people with such a complex topic" (Verlie et al., 2021). The creation and testing of feasible curricular and pedagogical best practices and interactive tools and resources for environmental educators to implement in their classrooms with varying levels of effort, resources, and time would be incredibly valuable. It is important to then test the efficacy and impact of these interventions in post-secondary EE to ensure that the intended outcomes for students' emotional experiences are met and optimized. Future research should also capture educator perceptions of these best practices to flag and address potential barriers, including possible resistance, to implementation. In addition to expanding peer-reviewed literature in this study area, it is equally important to consider the best strategies for sharing these tools with educators within and eventually beyond post-secondary environmental education to maximize applicability and accessibility.

5.5 Contributions

5.5.1 Student's Emotional Experiences of EE Curriculum and Pedagogy

My research fills an existing gap in the available literature on student climate emotions and post-secondary EE. While several studies exist at this intersection, my study makes novel contributions in the form of a multi-dimensional measure of emotions in this context, and specific curricular and pedagogical sources of the emotions discussed. While existing literature in this area is dominated by negative emotional experiences, my study design ensured that measures of nine negative and nine positive climate emotions were captured and that curricular and pedagogical sources of both negative and positive emotions were discussed. Filling these research gaps presents a valuable opportunity for post-secondary institutions and EE programs more specifically, to better understand the emotional experiences of their students. Students' emotional experiences within their EE have great potential to impact their learning, well-being and pro-environmental behaviour, all of which are established priorities and deliverables of post-secondary EE. With additional insights into student's emotional experience of specific curricula and pedagogy, environmental educators can better anticipate, plan for, and appropriately respond to student emotions in the context of their EE courses.

5.5.2 Students' Recommendations for Emotional Aspects of EE

While existing literature captures some elements of post-secondary students' emotional experiences in EE, and some of their desires and opinions in relation to curricula, my study captures detailed recommendations from students on the emotional aspects of their degrees. It is absolutely vital to consider what is feasible and realistic for environmental educators to implement; however, it is also of the utmost importance to consider the needs and preferences of students as paying customers of post-secondary institutions. By identifying students' recommendations and validating them against peer-reviewed literature, we can begin to design and compile a set of informed recommendations, tools, and practices for educators in EE to meaningfully address emotions in their classrooms. Researchers have shown a demand for resources to help environmental educators navigate the emotional complexities of teaching EE (Pellitier et al., 2023). Along with the research projects of several colleagues in the Society, Environment, and Emotions Lab, my research will inform a set of research-based recommendations for the emotional dimensions of EE that we will be developing.

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Appendix A: Participant Recruitment Targets

University of Waterloo - Undergraduate			
Course Name	**Programs Targeted**	**Course Code**	**Enrollment**
Foundations: Environment, Resources and Sustainability	Environment, Resources & Sustainability	ERS 100	77
Environmental Policy, Politics, and Governance	Environment, Resources & Sustainability	ERS 201	67
Sustainability Thought, Practice, and Prospects	Environment, Resources & Sustainability	ERS 301	77
Social-Ecological Approaches to Sustainability	Environment, Resources & Sustainability	ERS 400	73
Environmental Applications of Data Management and Statistics	Environment, Resources & Sustainability; Geography & Environmental Management; Geomatics; Climate & Environmental Change	ENVS 178	265
The Future of our Oceans	Environment, Resources & Sustainability	ERS 275	50
Urban Water and Wastewater Systems: Integrated Planning and Management	Environment, Resources & Sustainability	ERS 316	75
Photography for Sustainability	Environment, Resources & Sustainability	ERS 318	17
Introduction to Environment & Business	Environment & Business	ENBUS 102	118
Research Design	Environment & Business	ENBUS 306	88
Engaging Stakeholders	Environment & Business	ENBUS 410	44
Climate Change Fundamentals	Geography & Environmental Management; Climate Change	GEOG 207	190
University of Waterloo - Graduate			
Course Name	**Programs Targeted**	**Course Code**	**Enrollment**
Foundations for Sustainability Management	Master of Environmental Studies in Sustainability Management	SUSM 602	19
Sustainability Foundations	Master of Environmental Studies in Social and Ecological Sustainability	ERS 680	12
Foundations in Environmental Science	Master of Environmental Studies in Geography; Master of Science in Geography	GEOG 640	12
Royal Roads University - Undergraduate			
Course Name	**Programs Targeted**	**Course Code**	**Enrollment**
Sustainable Development: Ideas and Applications	Bachelor of Arts in Environmental Practice; Bachelor of Science in Environmental Practice	ENVP 303	15
Royal Roads University - Graduate			
Course Name	**Programs Targeted**	**Course Code**	**Enrollment**
Research & Analysis	Master of Arts in Environmental Management; Master of Arts in Environmental Education and Communication	ENVR 550	N/A

Appendix B: Qualtrics Survey

SECTION 1: Study Information

Ethics Clearance:
This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board and passed by the Royal Roads University Research Ethics Board (REB #45534). If you have questions for the Board, contact the Office of Research Ethics, toll-free at 1-833-643-2379 (Canada and USA), 1-519-888-4440, or reb@uwaterloo.ca.

Contact:
If you have questions about the study or the procedures, please contact Beth Grant (Student Investigator) at wegrant@uwaterloo.ca or Christine Barbeau (Principal Investigator) at (cbarbeau@uwaterloo.ca).

What is the study about?

My aim in conducting this research is to investigate the nature and variation of emotional experiences that Canadian university students associate with the course content and teaching approaches utilized within their environmental education and to determine student-led recommendations for the emotional dimensions of their degrees. Please see my **Information for Participants Memo** for more information.

Methods and Procedures:
I will draw participants from Canadian post-secondary institutions, in interdisciplinary environmental studies and sciences programs at the undergraduate and master's levels of study.

Participation in this study will involve several components. First, you have been invited to participate in this 20-minute online survey where you will be asked questions about the emotions you have experienced concerning your environmental post-secondary education and recommendations you may have. Upon completion of this survey, you will be asked about your interest in participating in the next phases of the study. You will also be given the option of being entered into a draw for one of four $25 Amazon e-gift cards. The amount received is taxable. It is your responsibility to report this amount for income tax purposes.

Twenty-five participants will be randomly selected to participate in an independent participant-led photo-elicitation activity (approximately 1 hour) and an individual semi-structured interview (approximately 1 hour). Participant-led photo-elicitation requires participants to capture photographs and write short descriptions for their images based on given prompting questions related to the goals of this research. You will be given a period of two weeks to capture two photographs and write short descriptions around the topic of your emotions related to your environmental education and recommendations you may have.

Next, you will be contacted to schedule an individual semi-structured interview where you will be invited to share and discuss your photographs and written works with the student researcher. Interviews will be conducted online via Zoom. Audio and video from the interviews will be recorded with your permission.

Not everyone who indicates interest in participating in the participant-led photo-elicitation activity and interview portion of the study will be selected to participate. Those who do participate in the photo-elicitation and individual interview will receive a $10 Amazon e-gift card as a thank you for their time and

effort. The amount received is taxable. It is your responsibility to report this amount for income tax purposes.

The findings from these study methods will be used for academic publication in a master's thesis and may be used for publications in academic journals, presentations at academic conferences, blog posts, social media posts, and other forms of knowledge dissemination. With your consent photographs, written descriptions and/or interview contributions may be used in study results to demonstrate research findings. These contributions will remain anonymous unless the opportunity for attribution provided to all participants is requested. The findings from the study will be made available to research participants and other interested parties through a summary report that will be shared upon completion of the study.

SECTION 2: Ethical Considerations

Confidentiality:
Your identity as a participant in this study is confidential. Identifying information will be removed and stored separately from collected data and your name will not appear in any paper or publication resulting from this study (unless the opportunity for attribution is requested). Participants will provide consent as to how photographs collected in the photo-elicitation activity will be used in all forms of knowledge dissemination that may come from this research. Collected data will be securely stored on a password-protected computer for a minimum of one year. Participants are free to withdraw from the study before the results are submitted for publication. It will not be possible to withdraw your data once the results have been submitted for publication.

Risks:
Participants will be asked to provide information on their educational experiences and reflect on their emotions individually and/or with the researcher. Given the emotional focus of the study, it is possible that you may find questions upsetting or uncomfortable to consider. The questions are in no way intended to cause upset or discomfort and if upset or discomfort occurs, it is likely to be mild and brief. In addition, please note that privacy cannot be guaranteed whenever information is collected online. There is always a risk that a third party may intercept your responses (e.g., government agencies, hackers). You will be completing the study by an online survey operated by Qualtrics. Qualtrics has implemented technical, administrative, and physical safeguards to protect the information provided via the Services from loss, misuse, and unauthorized access, disclosure, alteration, or destruction. However, no Internet transmission is ever fully secure or error-free. Please Note: We do not collect or use internet protocol (IP) addresses or other information which could link your participation to your computer or electronic device.

Voluntary Participation:
Participation in this study is voluntary. You may decline to answer any question(s) you prefer not to answer by leaving your response blank or by requesting to skip the question. Further, you may decide to end/leave the study sessions at any time by simply closing the survey or by advising the researcher of this decision. The commitment of the researchers is to inform all participants of their right to decline to participate without penalty and withdraw from the study at any time before results are published without penalty or consequence.

SECTION 3:

Eligibility to Participate:

Please check all boxes below to confirm your eligibility to participate in this study. If you do not meet the below eligibility requirements, please close your browser now.

- I am an undergraduate or master's student enrolled at the University of Waterloo or Royal Roads University.
- I am enrolled in an interdisciplinary environmental studies or sciences program of study.

Informed Consent:

Please confirm that you have been fully informed about the study and wish to provide your consent to participate in this survey of your own free will by checking the box below. Please note that by continuing on with the survey you are providing implied consent. (If you are interested in participating in additional components of this study you will be provided with an additional consent form at a later date).
• I have read the prior information about the survey and voluntary participation, and I consent to participate in the survey component of this study.

Informed Consent to Use De-Identified Quotations:

This survey contains open-ended questions for which you may choose to provide quotations. By checking the box below, you are providing consent to include your de-identified quotations in the dataset and potentially use them in any form of knowledge dissemination that may come from this research.

- I consent to the inclusion of my de-identified quotations featured in this survey in the dataset and subsequent forms of knowledge dissemination that may come from this research.

SECTION 4:

Unique Participant Code Creation
Please input a unique, consistent and memorable code based on the below questions. This code will allow linkage of your responses with other data while keeping identifying information separate, should you participate in subsequent portions of the study. Please write this code down for future reference.
• What day of the month is your birthday? Ex. 07
• What are the first three letters of your best friend's first name? Ex. Ali
• What is the first letter of the street you currently live on? Ex. M
o For this example the unique code would be: 07AliM
Enter Code Here: _____

SECTION 5:

In this section, I will be asking you some questions about the educational stage and focus of your environmental post-secondary education.

What post-secondary institution are you currently attending?

- University of Waterloo
- Royal Roads University

What is the name of the program you are currently enrolled in? _____

What year of study are you in currently?
- Year 1 Undergraduate
- Year 2 Undergraduate
- Year 3 Undergraduate
- Year 4 Undergraduate
- Year 5 Undergraduate +
- Year 1 Master's
- Year 2 Master's +

Using the scale shown below, please select the option that best describes your environmental post-secondary education.

What is the focus of your environmental degree?				
Nearly exclusively ecologically-focused	Mostly ecologically-focused	Equal parts social and ecological	Mostly socially-focused	Nearly exclusively socially-focused

SECTION 6:

In this section, I will be asking you some demographic questions, so we can see if there are any differences in survey responses across different groups of people.

What is your age? _____

What is your gender?
• Woman / Transwoman
• Man / Transman
• Gender queer / Gender non-conforming / Gender non-binary
• Two-Spirited
• I prefer not to respond
In regards to gender, I prefer to self-identify: _____

What is your self-defined ethnicity? _____

SECTION 7:

In this section, I will be asking you some questions about your emotional experiences concerning your environmental post-secondary education. Please answer the following questions about your emotions in relation to your educational experience only as it relates to activity occurring within your environmental courses. This will include course content (curriculum) and teaching approaches (pedagogy).

Course content can be defined as "plans in written form of varying scope and that delineate the desired learning experiences" within a "unit, a course, a sequence of courses or a school's entire program of studies" (Oliva, 2009, pp. 7). This includes things like learning goals, lecture and reading content, assignments, and grading schemes. In other words, this focuses on **WHAT** is taught.

Teaching approaches can be defined as "the methods and practice of teaching and learning" which is "about facilitating processes of individuals' learning experiences in meaningful ways" (Matthews et al., 2018, pp. xvi). This includes the strategies, methods, and activities used by the professors to deliver the curriculum. In other words, this focuses on **HOW** the course is delivered. This may include your lectures, seminars, labs, tutorials, reading lists, syllabi, assignments, in-class activities, and discussions.

This should **NOT** include judgments about the professors themselves; we're interested in your emotional reactions to the course content, not the course personality/professor. When answering the following survey questions please do **NOT** consider other elements of your student experience such as non-environmental courses you may have taken, extracurriculars, community, residence, the physical campus, etc. when answering these survey questions.

Please read each item carefully, and using the scale below, **select the options that best describe your experience of each specific emotion related to the course content and teaching approaches used within your environmental post-secondary education in the last two academic semesters**. The scale below will ask about three different dimensions of your emotional experience: frequency, intensity, and persistence. We want to know how often you experience the emotion, how intense the emotional experience is, and how long-lasting it is.

Happiness: (A state of well-being and contentment; a pleasurable or satisfying experience)					
How often?	About once per month or less	About once per week	About once each day	2 or 3 times each day	More than 3 times each day
How intense?	Very low	Low	Moderate	High	Very high
How long-lasting?	Less than 1 minute	1-10 minutes	11-60 minutes	1-4 hours	Longer than 4 hours

In the last two academic semesters, within your environmental courses, what specific course content or teaching approach sparked this emotion?

_____

This Likert scale and open-ended question format repeated for the following emotions in the following order: happiness, sadness, inspiration, anxiety, pride, guilt, determination, anger, hope, grief, connection, betrayal, compassion, powerlessness, gratitude, hopelessness, awe, and existential dread.

In your experience with the course content and teaching aspects of your environmental education: How often are your emotions currently acknowledged?

- Never
- Rarely
- Sometimes
- Often
- Always

In your experience with the course content and teaching aspects of your environmental education: How often would you prefer to have your emotions acknowledged?

- Never
- Rarely
- Sometimes
- Often
- Always

SECTION 8:

In this section, I will ask you about recommendations you have in relation to the emotional experience of post-secondary environmental education course content and teaching approaches.

What (if any) course content-based recommendations do you have in relation to the emotional aspects of post-secondary environmental education? (These should focus on WHAT is taught).

_____

What (if any) teaching approach-based recommendations do you have in relation to the emotional aspects of post-secondary environmental education? (These should focus on HOW it is taught).

_____

SECTION 9:

Would you like to know more?

The next phase of the study involves a creative, independent photography activity in which participants capture photographs that illustrate their emotional experiences in relation to course content and teaching approaches within environmental post-secondary education and recommendations for those aspects of environmental education.

Using these captured images, participants will explore and discuss their emotional educational experiences and recommendations in individual interviews with the student investigator.

SECTION 10:

Thank you for your time and participation!

I would like to thank you for your participation in this study. As a reminder, the purpose of this research is to investigate the nature and variation of emotional experiences that Canadian university students associate with the course content (curriculum) and teaching approaches (pedagogy) within environmental studies and to determine student-led recommendations for the emotional dimensions of their degrees.

The data collected through the surveys, participant-led photo-elicitation activity and interviews will contribute to a better understanding of the emotional experience of environmental education and student-led recommendations for the improvement of these experiences in the post-secondary setting.

If you need emotional or mental health support please consult these Mental Health Resources available to you.

If you expressed interest in participating in the photo-elicitation and individual interview components of this study and are randomly selected to participate, you will be contacted by the student researcher at the email provided with further instructions.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board and passed by the RRU Research Ethics Board (REB #45534). If you have questions for the Board, contact the Office of Research Ethics, toll-free at 1-833-643-2379 (Canada and USA), 1-519-888-4440, or reb@uwaterloo.ca.

We remind you of your continued right to withdraw from the study any time prior to publication. Photo-elicitation and interview participants are free to withdraw from the study before results are submitted for publication. It will not be possible to withdraw your data once the results have been submitted for publication. Once all the data are collected and analyzed for this project, I plan on sharing this information with the research community through seminars, conferences, presentations, and journal articles. The completion of the study is anticipated by early September 2024.

For all other questions or if you are interested in receiving more information regarding the results of this study, or would like a summary of the results, feel free to reach out to me at the contact information indicated below.

Sincerely,

Beth Grant,
Student Investigator
University of Waterloo
Bachelor of Environmental Studies

(Participants were then redirected to a separate survey that asked them about their interest in participating in the photo-elicitation and individual interview portions of the study. If interested, participants were prompted to enter their unique participant code again and an email address through which I could contact them. Regardless of their interest in these additional study components,

participants were also provided with the opportunity to enter their email addresses if they wished to be entered into a draw to win 1 of 4 $25 gift cards. This separate survey ensured that no identifying information was collected directly in association with survey responses, keeping them anonymized. However, the participant code allowed me to refer back to information including the university, type of program and year of study to allow for quota sampling to occur for the photo-elicitation and interview components of the study.

Appendix C: Participant-Driven Photo-Elicitation Activity Instructions

These instructions were sent in an attachment via email to selected, interested participants.

What is Participant-Driven Photo-Elicitation?

Participant-Driven Photo-Elicitation is a participatory research method in which study participants are actively involved in data collection through creative photography. Photographs and written descriptions captured by participants will be shared and discussed with participants in individual semi-structured interviews that follow the completion of this activity. In this study, we want to engage you in a participant-driven photo-elicitation activity to gain insight into your emotional experiences in post-secondary environmental education and to determine what, if any, educational recommendations you may have.

For this activity, please focus on your emotional experiences related only to activity within your environmental courses' course content (curriculum) and teaching approaches (pedagogy). Course content can be defined as "plans in written form of varying scope and that delineate the desired learning experiences" within a "unit, a course, a sequence of courses or a school's entire program of studies" (Oliva, 2009, pp. 7). This includes things like learning goals, lecture and reading content, assignments, and grading schemes. In other words, this focuses on WHAT is taught. Teaching approaches can be defined as "the methods and practice of teaching and learning" which is "about facilitating processes of individuals' learning experiences in meaningful ways" (Matthews et al., 2018, pp. xvi). This includes the strategies, methods, and activities used by the professors to deliver the course content. In other words, this focuses on HOW the course is delivered. This may include your lectures, seminars, labs, tutorials, reading lists, syllabi, assignments, in-class activities and discussions, etc.

This should **NOT** include judgments about the professors themselves; we're interested in your emotional reactions to the course content, not the course personality/professor. When completing this activity please do **NOT** focus on other elements of your student experience such as non-environmental courses you may have taken, extracurriculars, community, residence, the physical campus, etc.

What Does This Participant-Driven Photo-Elicitation Activity Involve?

Your participation in this study will involve capturing two photographs inspired by our two prompting questions below and writing a short description of approximately 200 words to accompany each photograph.

The two prompting questions which can provide creative inspiration for the content of your photograph are as follows:

"What has been your emotional experience in environmental post-secondary education? Consider what emotions you have experienced in relation to your degree and the specific course content or teaching approaches that brought about those emotions."

"What recommendations (if any) would you like to share in relation to the emotional experience of the course content and teaching approaches utilized within your post-secondary environmental education?"

Use these prompts to guide your photography, but keep in mind that there is no right or wrong way to interpret these prompting questions, and this is a creative process so everyone will have unique

responses. Photos should depict your experience and thoughts regarding the prompting questions. Feel free to take several creative photos for each prompt but know that you will need to choose just one photo for each prompt, for a total of two photographs. **If you'd prefer, you can use a photograph previously captured by yourself for use in this study**, so long as it abides by our ethical requirements discussed below.

There are no requirements regarding the content of your photographs, though we do have some rules that we ask you to follow during this portion of this study to maintain safety and ethicality. We ask that you **DO NOT capture any identifiable features of other people in your photographs.** This includes faces, tattoos, birthmarks, etc. We ask that you **DO NOT capture any personal information in your photographs** (addresses, student numbers, financial information, etc.) Your photographs can capture people without identifiable features (people facing away from the camera, people off in the distance, a crowd, etc.) In some cases, it may be most appropriate to obtain verbal consent from people captured in your photographs. Please consult the ethical considerations section below for more information.

Written descriptions that accompany each photo can take whatever form you would like, whether a simple descriptive paragraph or a more poetic piece. The purpose of the description is to help the student researcher understand the photograph's content and the thought and experience behind it. Please remember to keep these descriptions within or close to the 200-word mark.

Please reach out to the student investigator if access to a camera is a concern or limitation to your participation or if you have any questions about the activity.

Ethical Considerations

This study allows you to be part of the data collection process. By taking the photograph and writing about it you have the power to frame the issue; with this opportunity comes responsibility as well. It is of utmost importance to ensure that the safety and consent of all involved are always maintained. This not only includes you, but any people whom you may want to photograph. Photographs can be powerful and may be intrusive of someone's private space or experience, be embarrassing or portray someone falsely, and if taken without permission, can make someone feel unsafe. **For these reasons it is very important that you follow the ethical guidelines listed below:**

1. You as a photographer are responsible to obtain the appropriate level of consent when capturing photographs containing other people. The breakdown of appropriate consent based on the content of the photograph is listed below:
    a. Consent is not required when the image only contains:
        i. A large public area with people you can not make out in the photo (E.g., a large crowd);
        ii. Public figures in public (E.g., a politician on a podium); or
        iii. Public places, objects, or environments without people in them.
    b. VERBAL consent is required when the image contains:
        i. Non-recognizable individuals - from all individuals in all settings when possible (E.g., ask a group of people standing in front of a bus stop if it's ok you take their picture even though you won't be able to see their face or identify them)
2. Always keep safety in mind! Do not put yourself or others in any danger and abide by all laws while capturing photographs for this study. For example, do not trespass on private property to capture a photograph. Do not do anything that risks your health and safety or the health and safety of another person to capture a photo. Also, consider protecting yourself and the people captured in your

photographs from emotional harm, harm to reputation, and financial harm in addition to physical well-being. Please use common sense to ensure safety is always maintained.

3. Always consider the well-being of anyone you photograph. Think about the potential impact of the photo being published and viewed by the public. Even if consent has been obtained, think about how you would feel if a similar photo of you was published. If there is any chance you might feel embarrassed or regret it later, consider a different approach to ensure the well-being of all persons.
4. Ensure that the content of the photograph is appropriate. Please do not capture or share any imagery of drug or alcohol use, nudity, sexuality, violence, or hate. Photos with any inappropriate content will not be approved for use in this study.

How to Gain Verbal Consent of People Captured in a Photograph:

1. Assess: Be sure to assess the situation before you enter into it. Can you approach the person safely? Do they appear to be in a stable and approachable state of mind?
2. Explain: Explain a little bit about the study. You can use the brief script below:
    - "Hi there. My name is _____ and I am participating in a research study at the University of Waterloo. The purpose of this research is to better understand students' emotional experiences in relation to their environmental university education. This study seeks to engage and empower participants to illustrate the emotional experiences of their environmental education using creative photography and interviews to discuss their creative work. As a part of the methods of this research, participants are tasked with taking two photographs that capture the emotions they have experienced during their environmental education. I was hoping to take a photo of _____ for use in the study. Would you be comfortable being captured in the photo? No identifiable features will be captured in the photograph."
3. Ask for Consent: Ask for their consent before taking the photo when possible.

Photography Tips

- Be aware of what you are capturing in your photo. What do you want to be the focus? Does that focus point stand out? What message are you trying to get across? Is the photograph you have captured telling the same narrative you see?
- Consider colour. Would your photograph be more powerful in full colour? Black and white? Some combination? Do you want certain colours to be featured to express your message?
- Consider the perspective. Would your photograph be more powerful or interesting from a different angle?

Appendix D: Interview Guide

Introductory Material

Welcome! Thank you for your time and participation in this study. My name is Beth, the student researcher on this project, and I will be conducting your interview today.

Before we get started, I would like to reiterate some information and gain your informed consent:

- Have you had a chance to read the information letter?
    - [If yes, proceed. If not, review the contents of the letter with the participant.]
- Do you have any questions?
- As a reminder, participation is voluntary, and you may end the interview session by advising me of your decision at any time. If you have questions for the Research Ethics Board, contact information for the Office of Research Ethics is listed on the information letter that you received prior to this session. For all other questions about the study, you may contact me at wegrant@uwaterloo.ca**.**

Name of Interviewee:

Date and Time of Interview:

Do you consent to participate in the interview?

[ ] YES [ ] NO

Do you give permission for your interview to be audio and video-recorded with the understanding that the student researcher and co-principal investigators will be the only ones with access to those files?

[ ] YES [ ] NO

The findings from this study will be used for academic publication in a master's thesis and may be used for publications in academic journals, presentations at academic conferences, blog posts, social media posts, and other forms of knowledge dissemination. With your consent, photographs, written descriptions and/or interview contributions may be used in study results to demonstrate research findings. If consent is provided, participants have the choice to remain anonymous or to have their work attributed. Having your work attributed means that your preferred name would be included in final reports, presentations, publications, and other forms of knowledge dissemination to come from this research alongside any or all of the following categories: your photographs, your written descriptions that accompanied those photographs and your individual interview contributions. This opportunity for attribution is entirely voluntary and in no way required. I simply wished to offer you the option of having your hard work and creativity acknowledged in any knowledge dissemination that may come from this research. If you prefer, you can choose to have your contributions remain anonymous.

I agree to the inclusion of my photographs taken for this study in any publication or knowledge dissemination that comes from this research.

[ ] YES, I agree to the anonymous inclusion of my photographs.

[ ] YES, I agree to the attributed inclusion of my photographs.

[ ] No, I do not agree to the inclusion of my photographs.

I agree to the use of quotations from my written photo descriptions in any publication or knowledge dissemination that comes from this research.

[ ] YES, I agree to the anonymous inclusion of quotations from my written photo descriptions.

[ ] YES, I agree to the attributed inclusion of quotations from my written photo descriptions.

[ ] No, I do not agree to the inclusion of quotations from my written photo descriptions.

I agree to the use of quotations from my individual interview, in any publication or knowledge dissemination that comes from this research.

[ ] YES, I agree to the anonymous inclusion of quotations from my individual interview.

[ ] YES, I agree to the attributed inclusion of quotations from my individual interview.

[ ] No, I do not agree to the inclusion of quotations from my individual interview.

[If attributed was selected for any of the above questions, the following question must be asked].

What name would you like to be used for the attribution of your work? _____

[Clarify spelling with the participant.]

Excellent, now I have a few reminders:

- If at any point you have any questions or concerns, please feel free to interrupt and ask so I can clarify or provide more information.
- An hour and a half have been scheduled for this interview. It might be slightly shorter or full-time depending on how much you wish to share.
- For this interview, please focus on your emotional experiences related primarily to activity within your environmental courses' course content (curriculum) and teaching approaches (pedagogy).
    - Curriculum, referred to in this interview as course content, can be defined as "plans in written form of varying scope and that delineate the desired learning experiences" within a "unit, a course, a sequence of courses or a school's entire program of studies" (Oliva, 2009, pp. 7). This includes things like learning goals, lecture and reading content, assignments, and grading schemes. This may also include the content of your own research projects. In other words, this focuses on WHAT is taught.

- Pedagogy, referred to in this interview as teaching approaches, can be defined as “the methods and practice of teaching and learning” which is “about facilitating processes of individuals’ learning experiences in meaningful ways” (Matthews et al., 2018, pp. xvi). This includes the strategies, methods, and activities used by the professors to deliver the course content. In other words, this focuses on HOW the course is delivered. Please reflect on the content and delivery of your environmental courses. This may include your lectures, seminars, labs, tutorials, reading lists, syllabi, assignments, in-class activities and discussions, etc.
- This should **NOT** include judgments about the professors themselves; we’re interested in your emotional reactions to the course content, not the professor's personalities. When completing this activity please do **NOT** focus on other elements of your student experience such as non-environmental courses you may have taken, extracurriculars, residence, the physical campus, etc.

Are there any questions before we get started?

[If permission was given, I started the recording here.

Interview Questions

1. What is your preferred name? First and last. _____
2. What are your preferred pronouns? _____
3. What is the name of the post-secondary institution you currently attend? _____
4. What is the name of the program you are enrolled in? _____
5. What year of study are you in currently? _____
6. Are you currently enrolled at the undergraduate or master’s level? _____
7. Would you consider your education to be more socially or ecologically focused? _____

[If the interview subject is enrolled at the master’s level of study, ask question 8].

8. What program did you complete your undergraduate degree in? _____

Before this interview, you completed a participant-driven photo-elicitation activity in which you captured two photographs and accompanying written descriptions based on the two prompting questions provided. We will now review your photograph and written description for the first prompting question:

"What has been your emotional experience in environmental post-secondary education? Consider what emotions you have experienced in relation to your degree and the specific course content or teaching approaches that brought about those emotions."

I will now ask that you please read aloud your written description. We will then work through some related discussion questions. [The photo and written description will then be screen shared and the participant will read their written description out loud].

9. What is happening in your photo?
10. What inspired you to select this photo?
11. What significance does this image have to you?

Next are a few related questions that will allow us to discuss other elements of your experience not necessarily captured within the context of your photograph and written description.

12. What emotions do you most strongly associate with the course content and teaching approaches utilized within your post-secondary environmental education?
13. What specific educational experiences have led to those emotions?
14. What emotions have been largely absent from your post-secondary environmental education?
15. Have your emotional experiences of environmental post-secondary education changed throughout your degree? If so, how?

We will now review your photograph and written description for the second prompting question:

"What recommendations would you like to share in relation to the emotional experience of the course content and teaching approaches utilized within your post-secondary environmental education?"

I will now ask that you please read aloud your written description. We will then work through some related discussion questions. [The photo and written description will then be screen shared and the participant will read their written description out loud].

16. What is happening in your photo?
17. What inspired you to select this photo?
18. What significance does it have to you?

Next are a few related questions that will allow us to discuss other elements of your experience not necessarily captured within the context of your photograph and written description.

19. Are there any other recommendations you would like to discuss that were not captured in your photograph or written description?
20. Which of these recommendations do you think would have the biggest positive impact on the emotional experience of environmental education in the post-secondary context?
21. In your experience with the course content and teaching aspects of your environmental education: How often are your emotions currently acknowledged?
22. In your experience with the course content and teaching aspects of your environmental education: How often would you prefer to have your emotions acknowledged?

I have a few final general questions before we wrap up this interview.

23. Are there any key takeaways from your photographs and written works or our resulting conversations that you think should be reflected and emphasized in this research?
24. Is there anything that wasn't captured in your photographs and written works or our resulting conversations that you think should be reflected and included in this research?

That concludes our interview questions.

I would like to thank you again for your participation and remind you to reach out via email should you have any follow-up questions about the study. As a thank you for your participation a $10 Amazon e-gift card will be sent to you via the email you provided. I would like to share these mental health and well-being resources available for you to access should you feel any distress related to your experiences, thoughts, or emotions.

[A digital handout with freely accessible mental health and well-being resources was provided to the participant at this time].

https://docs.google.com/document/d/14FK2z0FOQ6lYNByVFhMGVqmHS651JTI2dISkQoQmpsM/edit?usp=sharing

Appendix E: Deductive Codebook

Structural Coding Category 1: Emotions experienced in relation to curricular and pedagogical aspects of post-secondary EE. (Related to RO1). Bolded exemplars include those explicitly measured in my survey which were sub-codes within these code categories. Other unbolded exemplars were coded as implicit examples of each code featured below.		
Emotional Code Category	**Description**	**Exemplars**
Surprise-related emotions	Emotions resulting from something unexpected or unusual.	Amazement, **awe**, wonder, surprise, disappointment, confusion, shock, astonished, etc.
Threat-related emotions	Emotions resulting from an intended, expected, or existent source of injury, damage, or destruction.	Fear, worry, **anxiety, dread,** helplessness, **powerlessness,** overwhelm, terror, panic, etc.
Sadness-related emotions	Emotions are characterized by sorrow, often in response to loss.	**Sadness, grief,** solastalgia, loss, yearning, longing, feeling blue, feeling low, depression, meaninglessness, **hopelessness,** etc.
Guilt and shame-related emotions	Emotions resulting from feeling deserving of blame for having committed an offence, wrongdoing, or breach of conduct.	**Guilt,** shame, embarrassment, feeling inadequate, regret, remorse, etc.
Indignation-related emotions	Emotions resulting from something unjust, unfounded, unworthy, or mean.	Indignation, moral outrage, **betrayal,** etc.
Disgust-related emotions	Emotions resulting from an aversive, distasteful, or repugnant stimulus.	Disgust, aversion, resentment, etc.
Anger-related emotions	Emotions resulting from displeasure, which can create threatening or violent expressions.	**Anger,** rage, frustration, irritation, etc.
Envy-related emotions	Emotions resulting from a painful awareness of an advantage enjoyed by another, accompanied by the desire to possess the same advantage.	Envy, jealousy, admiration, etc.
Hostility-related emotions	Emotions expressing a deep ill will or malevolence.	Hostility, contempt, skepticism, doubt, etc.
Motivation-related emotions	Emotions relating to the desire or perceived need to take action or achieve an outcome.	Motivation, interest, the urge to act, excitement, feeling moved, **determination,** etc.
Pleasure-related emotions	Emotions related to gratification, contentment, or achieved desire.	Joy, pleasure, **happiness, pride, gratitude,** etc.
Hope-related emotions	Emotions characterized by unobtained desire with anticipation and expectation of obtainment or fulfillment.	**Hope,** optimism, **inspiration,** empowerment etc.

Belonging-related emotions	Emotions resulting from engagement in a close or intimate relationship.	Belonging, togetherness, **connection,** community, etc.
Caring-related emotions	Emotions resulting from providing and/or receiving concern and kindness.	Love, care, empathy, sympathy, **compassion,** etc.
Notes: • Codes and exemplars are adapted from Pihkala, 2022, which reviewed the existing literature on climate emotions to develop an initial taxonomy. That source drew on the following literature among others. (Caillaud et al., 2019; Cunsolo Willox et al., 2013; Hamilton, 2020; Hickman et al., 2021; Hiser & Lynch, 2021; Hyry, 2019; Jovarauskaite & Bohm, 2020; Kleres & Wettergren, 2017; Marczak et al., 2021; Martiskainen et al., 2020; Minor et al., 2019; Ojala, 2012; Smith & Leiserowitz, 2014; Verlie, 2019; Verlie et al., 2020). • Descriptions are informed by definitions found in the Merriam-Webster dictionary.		
Structural Coding Category 2: Identified curricular and pedagogical sources of emotions experienced in post-secondary EE. (Related to RO1).		
Code	**Description**	**Exemplars**
Source: Source of Emotion - Curricular	The educational source or stimuli that led to an emotional response and are directly related to an aspect of the curriculum.	Course content, lecture content, readings, sources, topics, environmental issues, etc. Mentions of WHAT was taught in connection with an emotion.
Source: Source of Emotion - Pedagogical	The educational source or stimuli that led to an emotional response and are directly related to pedagogy.	Teaching approaches, delivery, presentation, lecture, discussion, creative, assignment, etc. Mentioned of HOW something was taught, in connection with an emotion.
Structural Coding Category 3: Self-reported variation in emotional experience by educational stage. (Related to RO2).		
Structural Coding Category 4: Student-identified recommendations for the emotional experience of EE. (Related to RO3).		

Appendix F: Research Project Timeline

Task	Description	Date
Submit proposal	Submit the proposal to advisors and committee members, an opportunity for revision.	May 2023
Ethics approval	Submit ethics proposals and receive clearance from all required university ethics committees.	Aug 2023
Review background literature	Continue reviewing relevant literature to inform research.	Ongoing
Recruitment period (survey live)	Recruit student participants to complete the survey through class presentations, LEARN posts and emails.	Sept-Dec 2023
Confirm participation in photo-elicitation	Select and inform participants of participant-led photo-elicitation methods.	Dec 2023 – Jan 2024
Schedule interviews	Follow-up two weeks after photo-elicitation and schedule interviews.	Dec 2023 – Jan 2024
Conduct interviews	Each interview will be about an hour long and will be conducted in person or via Zoom.	Dec 2023 – Jan 2024
Clean interview data	Interview recordings will be transcribed using Otter.ai. and then manually cleaned and anonymized.	Dec 2023 – Feb 2024
Analyze survey data	Survey data will be compiled and analyzed in Excel.	Nov 2023 – Mar 2024
Analyze interview data	Cleaned transcripts will be coded and analyzed using manual and software approaches. Photographs will be visually analyzed.	Jan – Mar 2024
Triangulation analysis	Findings from the three data sources will be compared and contrasted.	Mar 2024
Write data-reliant sections	Write results and discussion sections based on findings of data collection.	Mar 2024
Write data non-reliant chapters	Write an introduction, literature review, and methods sections.	Jan – Feb 2024
Initial round of revisions	Draft thesis sent to advisors and committee members, an opportunity for revisions.	Feb – Jun 2024
Thesis defence	Defend thesis to Sarah, Christy and committee members.	Jul-Aug 2024
Final revisions	Make required revisions post-defence.	Aug 2024
Submit thesis	Submit the final thesis to the department.	Aug 2024
Search for knowledge dissemination opportunities	Actively search for conferences, potential journals, and special calls for papers, and begin submitting proposals.	Jan – Sept 2024

Appendix G: Participant Photo-Elicitation Activity Submissions

This appendix includes a selection of the 26 photographs and accompanying written works submitted by participants as a part of this study.

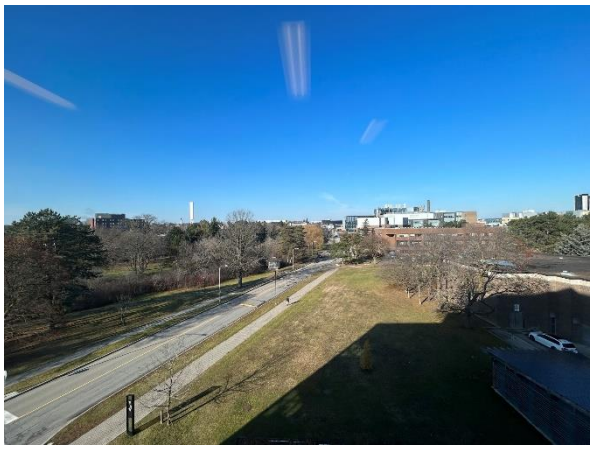
Photo-Elicitation Activity Prompting Question 1:

"What has been your emotional experience in environmental post-secondary education? Consider what emotions you have experienced in relation to your degree and the specific course content or teaching approaches that brought about those emotions."

Artist: Katherine Matos

"The photograph depicts a boat that is lost in a dark and foggy sea. On board, there is a plant that has limited time left to survive, unless it reaches land soon. Unfortunately, the boat does not have a clear direction and is in unstable conditions to keep floating for much longer. This situation seems quite hopeless. The image represents how I feel after some courses, especially the ones where we discuss how the ecosystem has been degraded due to human activities or topics like climate change. While analyzing the challenges, we see that the key leverage point to change the system is human behaviour. Even though we have received positive insights about a rising community that is concerned about the environmental challenges, and also the academic developments in the field, still the positive things don't compensate for all the negative impacts humanity is causing on the environment. From the lectures, we understand that we are in a critical time and changes should be made with a sense of urgency. However, there are other interests involved, and the situation sometimes seems hopeless, which gives me a sense of anxiety and frustration."

Artist: Owen Nowitsky



"Here I have a picture from the fourth floor of EV3. Throughout my undergrad I found the study areas here to be a safe place to unwind and re-orient my day. While I always wished I would get more work done in this area, I would always get distracted by the view of campus and the surrounding nature. As I tried to work on class topics, I would consider the work I was doing and where it stood in the world around me. I feel there exists a double-edged sword within environmental education as a young adult. Through many classes, we become familiar with the inequality and potential devastation that will be caused by climate change. We are given tools by educators on how

to quantify a changing climate, how to model the potential impacts, and how to advocate for policy implementation. While we need to learn how to do all these things, we as young environmental scientists have professors remind us of how devastating the world will become. While we understand why urgent action needs to be taken, a burden of knowledge and action is placed upon students to continue a long and difficult fight against climate change."

Artist: P1

"This photo is of an Amur Honeysuckle plant that I captured during the fall on a hike with my family. Through my classes this year one assignment we did was to identify fifty different species with the help of the iNaturalist app, which I took this photo for. It is really cool, almost empowering, to learn to identify different species around me. The flip side is that I am able to identify more and more invasive species (such as this Honeysuckle plant) which can be disheartening. I have found that the more we learn about plant identification, the more I see invasive species when I am outside, and it can be hard sometimes, especially as they are the most easily identifiable. I think this transcends a lot into my courses (beyond plant ID), where once we learn about certain patterns in class, I see them much more in real life. In my experience, these have been mostly negative. Aside from invasive species, I also notice environmental politics a lot more in the news, and those decisions have a lot more weight or significance now that I understand the concepts better."

Artist: P2

"On the surface, this photo looks beautiful. As I walk my dog, the morning sun is shining over the Red River and forest embankment. If this date were time-stamped, you would be able to see that it is December 21st, and there is no more than an inch or two of snow on the ground; a fact that triggers my eco-anxiety daily. At the centre of the photo is a garbage can, symbolizing that although overall I feel my emotional experience through my environmental education has been quite beautiful, there will always be a pang deep down at my core knowing how unpromising the environment's future is. I feel very lucky to have learned about the wonders of the natural world through my education, which allows for a deeper understanding and appreciation of my surroundings, but it has also heightened my awareness of how bleak the situation is."

Artist: P3

"My emotional experience in environmental post-secondary education is one defined by a unique mix of both "negative" (sadness, anger, guilt, doubtful) and "positive" (hope, a sense of community, relief) emotions. My experience with the course content and teaching approaches has not only expanded my academic capabilities but has also contributed to the way I emotionally respond to things I may disagree with or dislike. I think the courses I took tried to teach about the shortcomings of the modern world, while also instilling a sense of optimism and a we-can-do-something-about-it attitude within the students. It is easy to feel grim and hopeless in environmental post-secondary education because that seems to be the current state of the situation. But having courses that teach about solutions, the implementation of solutions, and how to "fix" the problem at hand is incredibly valuable in ensuring students can feel a sense of community in classes, feel hopeful towards a better future, and do not feel overwhelmingly overwhelmed. The picture I chose symbolizes the above statement because the man-made stormwater management creek is definitely broken and eroded. However, it can be fixed with a team of people who share a similar goal. It cannot be fixed by staring and feeling hopeless, although it can be a daunting task to fix the stormwater system in a punctual manner. Instead, people's energy can be focused on implementing a solution that fixes the problem at hand and improves the state of the world, one action at a time."

Artist: P4

"My default emotional state towards environmental education is curious and motivated. However, I can distinctly remember instances throughout my degree where this curiosity and motivation quickly disappeared in the face of complex and overwhelming lecture topics. I have had instructors teach about things like political complexities and energy systems, assuming that students have a thorough base of knowledge on the topic. The content was so overwhelming and confusing to me that I left the class feeling powerless, withdrawn, inadequate, and numb. Since the class was happening in a lecture-style format, there weren't any windows of opportunity where I felt like I was able to ask questions or catch up on my understanding. This picture was taken on the frozen canal near my childhood home. I see myself in the moments described above as the dark cracks in the ice; wanting to reach out with curiosity and to grow but being frozen in place and turning cold. Others are feeling this way in the distance, but they're difficult to see and seemingly impossible to connect with."

Artist: P6

“My environmental education throughout the last 5 and a half years has unfolded sort of like the weather in Alberta this Winter. From troubling, yet admittedly enjoyable high temperatures, to an intense and debilitating polar vortex, then back to unseasonably warm days—my environmental education has followed a similar fluctuating and varying path. I have felt alarmed by professors who were honest about the reality we face, and frustrated by those who could not name it. I have felt humanity was missing from certain lessons focused on the science, and I have felt immense guilt from lessons focused on our individual contributions. I have felt excited about the possibility of spearheading solutions, and I have felt swindled into believing there is no solution because there is no *perfect* solution. The photo I chose to represent these feelings is of my grandparent's farm, just outside Millarville, Alberta. I took this photo one morning in January while staying there to help my grandmother make jam out of fruit we harvested from the garden last summer. It was taken after the first true dump of snow they received this winter, just before the cold snap set in.”

Artist: Richa Mishra

“It feels like I am facing shape-shifting, formless challenges when I look at the facts and information I have in context to the climate emergency. Everybody sees this as something different, from their own perspectives, and their own realities. I see this crisis as a much deeper problem. This is an identity crisis for us humans. I no longer know how to make sense of the world in little parts and manageable segments. I have frozen, staring at the storm clouds that look like a hurricane. My own identity has been reinterpreted and, in some ways, I too have dissolved. As I have gone through these past few months, I have consciously realized how I deconstruct and make sense of the world around me. And even though many experiences tell me that I am where I was meant to be, I still feel afraid because I cannot fathom that humanity is where it was supposed to be, if the Earth is near burning right now. My brain is always filled with too many thoughts and emotions. I feel inadequate and small, the storm clouds look too massive. Maybe it should rain.”

Photo-Elicitation Activity Prompting Question 2:

"What recommendations (if any) would you like to share in relation to the emotional experience of the course content and teaching approaches utilized within your post-secondary environmental education?"

Artist: Katherine Matos

"The photograph depicts the earth rolling towards an edge point where it falls into a dark hole. However, the Earth's trajectory can be changed. If it leans towards the left side where poor actions are made, the result is a degraded environment with no life. On the other hand, the right side represents a healthy environment with life, in case humanity takes important actions. The image reflects how technical information that we receive during courses, such as the Earth's limits of growth, leaves us with a sense of urgency to act fast. Usually, after processing such technical information, I feel motivated to do something but at the same time, anxious about the future and indignant about why we are not doing enough and why people are careless. As an environmental practitioner, I feel that there is a need for more tools that can help us deal with the anxiety and overwhelming feeling that comes with the course content. It is also important to add tools that can help us take action towards solving the problem. For instance, we can work on improving our communication skills, and gain knowledge about sociology to understand human nature better and learn how to influence people. This way, we can spread information and be a part of the movement to make a positive change."

Artist: Mary Ingribelli

"I never realized how accessible and underused some natural areas are in my city until I became a parent and needed to get out of the house for fresh air and something to do with my baby. I had walked through this nature park a few times; however, I never had a full appreciation for what it had to offer. After my experience with an environmental policy and legislation course, I suddenly observed so many distinct aspects of this park that raised questions about enforcement, awareness and knowledge of protected areas, species, fish sanctuaries, etc. My first thought was that a walk through a nature preserve would be an ideal class setting. To be able to see an area and learn about applicable environmental laws around it would add so much more connection to the learning."

Artist: P3

"I feel I can assume that the overwhelming majority of students in the Environment Faculty want to see a more sustainable world that works for both people and nature. In today's world, this can seem like an impossible dream, which may influence one's emotions. Emotions are not a weakness, though. I have found it incredibly useful to learn how to use my emotions to fuel my desire to achieve a more sustainable world. I do not mean to allow your emotions to take over in all scenarios, but to use negative emotions such as sadness and guilt to influence positive change. It is much easier said than done, but it is a skill that was worthwhile for me to learn. Allow yourself a space to feel those emotions, but not overpower your will and desire to be a part of the positive change that the world needs. I feel as though the picture associated with this prompt demonstrates the use of "negative" feelings for something positive. The picture shows rain in the form of puddles on the road. Although rain is commonly associated with "bad" weather, it is beneficial for many reasons. Too little rain, and we experience drought. Too much rain, and we experience flooding. There's a balance to it that is needed, just like our emotions."

Artist: P4

"This picture is one of my favourite trees in the world. Its enormous branches reach out with such incredible warmth and strength. That is how I picture an alternative version of myself where my environmental education allows me to connect with my peers, make mistakes, be curious, and have my feelings validated."

Artist: P6

"The most impactful experiences I have had throughout my post-secondary environmental education have been grounded in land-based learning—from interning on a regenerative cattle farm while completing my undergraduate degree in Development Studies, to my experience in Costa Rica interviewing farmers who are passionate about conducting agriculture in new (and old) sustainable ways. I have found that the parts of my environmental education that have taken place in a classroom have felt largely theoretical—not always, but often. Seeing environmental issues with my own eyes and meeting people impacted by certain stressors made my learning tangible and made the lessons feel more pressing than before. The photo above is of a regenerative syntropic agricultural system in Costa Rica. I valued hearing about this system and all of its attributes directly from the farmer who cared for and maintained it, much more than I have valued the literature which describes these types of systems. I think it is far more likely that the impacts of environmental degradation on life and ecosystems are emphasized and considered when learning takes place in this form, compared to lectures in a classroom."

Artist: Richa Mishra

"I wanted to feel more hopeful, more independent, more 'enough.' I realize that reality is very different, and everyone's realities are coloured by their biases, yet only some people know how to recognize their biases and work with them. Humanity needs more time to step out of delusion and practice peace: peace with self, and each other. There is a need for purpose-driven lifestyles, instead of self-serving lifestyles. I want to live my life with uncompromised self-respect. I don't want to work for someone else. I don't want to have to make money. I want to grow my own food, catch my own fish, trap my own meat. I know if I walked into the woods today, I would not survive a day, and that breaks my heart. I have been born but have not learned to live. If I cannot survive on my own, what confidence shall I have, what dignity might I achieve? One cannot teach emotion in a university, and one cannot teach freedom. That comes from the mind and the strength of the mind. I don't know where *that* comes from, maybe from homegrown tomatoes?"

Artist: Neha Kapoor

"This picture is from Thunder Bay, Canada, overlooking the Sleeping Giant. It is a beautiful landmark, and there is an Ojibway story behind why it's there in the first place. One of the things that felt awfully familiar to me is the Indigenous connections to lands and waters, and how there is a human story behind every part of nature. Both my undergraduate and graduate courses have included some Indigenous content, and listening to their stories made me feel more connected to Canada. There needs to be more activities and teaching plans regarding Indigenous content and their philosophy towards taking care of their lands and waters. It is impossible to ignore the cultural impacts of environmental stewardship activities, hence it is important to include more of Indigenous storytelling and perspective and again, make it more accessible to a diverse audience, not just to white people."

Artist: P1

"This is a photo I took at a beach on Lake Ontario. We have spoken about the Great Lakes in a couple of the courses I have taken, specifically challenges to sustainability (such as development or agricultural pollution). This beach is one of my favourite places in my hometown, and learning more about these processes always makes me think of this place and the changes I have noticed over the years. The main emotion that comes to mind when we learn about this is worry, as I obviously do not want my favourite place to be degraded from pollution, but I also now better understand the ecological consequences of this. However, much of the teachings also focus on opportunities for better management, which in my experience can ease that worry a little bit."

Appendix H: R Markdown File

analysis_forpub_bethgrant

2024-04-04

#Load relevant packages

Prepping my positive frequency data

Load data set

```
PosFreq <- read.csv("C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/R Files/CSVFiles/PosFreqR2.csv", header = TRUE)
```

Reading the data as numeric or factor

```
PosFreq$Emotion <- as.factor(PosFreq$Emotion)
PosFreq$Frequency <- as.numeric(PosFreq$Frequency)
head(PosFreq)
```

```
##     Emotion Frequency
## 1 Happiness         3
## 2 Happiness         1
## 3 Happiness         3
## 4 Happiness         3
## 5 Happiness         1
## 6 Happiness         4
```

If needed I do not think this needs to be done, but just in case:

To convert to an ordered factor

```
#PosFreq$Frequency <- ordered(PosFreq$Frequency, levels = c("1", "2", "3", "4", "5"))
```

Analysis for PosFreq

Some preliminary calculations

Calculate the median for each emotion and set the order of the emotions

```
PosFreq <- PosFreq %>%
  mutate(Emotion = factor(Emotion, levels = c("Awe", "Pride", "Hope", "Gratitude", "Compassion", "Connection", "Determination", "Happiness", "Inspiration"))) %>%
  group_by(Emotion) %>%
  mutate(median_Frequency = median(Frequency)) %>%
  ungroup()
```

Create and format the plot

*The reason your violin plots extend beyond the 1-5 range is due to the way violin plots are constructed. Violin plots are essentially mirrored density plots, and the smoothing algorithm used to create the density curves can extend beyond the actual range of the data. This is a common characteristic of kernel density estimation, which is used to generate the smooth shape of the violin plot.

*If you want to strictly limit the violin plots to the range of 1-5, you can consider adjusting the kernel density estimation parameters to reduce the extent of the smoothing. However, this might make the plots less smooth and potentially less informative about the underlying distribution of the data.

*If you keep the current visualization as it is, understand that the extension beyond 1 and 5 is a result of the smoothing process and not an indication of data points outside that range. This is a common aspect of violin plots and is generally understood by those familiar with this type of visualization.

```
p_smoothing <- ggplot(PosFreq, aes(x = factor(Emotion, levels = c("Awe", "Pride", "Hope", "Gratitude", "Compassio
n", "Connection", "Determination", "Happiness", "Inspiration")), y = Frequency, fill = Emotion)) +
geom_violin(trim = FALSE) +
geom_boxplot(width = 0.1, fill = "white", outlier.shape = NA) +
scale_fill_brewer(palette = "YlOrRd") +
scale_y_continuous(breaks = 1:5) +
stat_summary(fun = mean, geom = "point", shape = 20, size = 2, color = "black") +
theme_minimal() +
theme(axis.text.x = element_blank(),
plot.title = element_text(hjust = 0.5)) +
labs(title = "Frequency of Positive Emotions",
x = "Emotion",
y = "Frequency")

p_smoothing
```

```
ggsave(filename = "C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/RFi
les/results/p_smoothingposfreq.tif",
plot = p_smoothing,
device = "tiff",
dpi = 300,
width = 10,
height = 6,
units = "in")
```

*For this plot, I adjusted the kernel bandwidth iteratively until reaching an optimal visualization that smoothed the bumps caused by Likert being an integer and not a true continuous variable. However, I ensured that it was not over-smoothed, obscuring relevant trends.

```
p_bw <- ggplot(PosFreq, aes(x = factor(Emotion, levels = c("Awe", "Pride", "Hope", "Gratitude", "Compassion", "Co
nnection", "Determination", "Happiness", "Inspiration")), y = Frequency, fill = Emotion)) +
geom_violin(trim = FALSE, bw = 0.45) +
geom_boxplot(width = 0.1, fill = "white", outlier.shape = NA) +
scale_fill_brewer(palette = "YlOrRd") +
scale_y_continuous(breaks = 1:5, labels = c("Once/month or less (1)", "Once/week or less (2)", "Once/day (3)", "2
-3 times per day (4)","3+ times per day (5)")) +
stat_summary(fun = mean, geom = "point", shape = 20, size = 2, color = "black") +
theme_minimal() +
theme(axis.text.x = element_text(size=11, angle=45, hjust=1),
legend.position = "none",
plot.title = element_text(size=12, hjust = 0.5)) +
theme(legend.text = element_text(size = 11))+
theme(axis.text.y = element_text(size = 11, angle = 25, hjust = 1)) +
labs(title = "",
x = "Emotion",
y = "Frequency") +
annotate("text", x = Inf, y = Inf, label = "N=60", size = 4, hjust = 1.1, vjust = 1.5)
p_bw
```

```
ggsave(filename = "C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/RFiles/results/p_bwposfreq.tif",
plot = p_bw,
device = "tiff",
dpi = 300,
width = 11,
height = 6,
units = "in")
```

Prepping my positive Intensity data

Load data set

```
PosInt <- read.csv("C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/RFiles/CSVFiles/PosIntR2.csv", header = TRUE)
```

Reading the data as numeric or factor

```
PosInt$Emotion <- as.factor(PosInt$Emotion)
PosInt$Intensity <- as.numeric(PosInt$Intensity)
head(PosInt)
```

```
##     Emotion Intensity
## 1 Happiness         2
## 2 Happiness         2
## 3 Happiness         3
## 4 Happiness         3
## 5 Happiness         1
## 6 Happiness         3
```

Analysis for PosInt

Some preliminary calculations

Calculate the median for each emotion and set the order of the emotions

```
PosInt <- PosInt %>%
  mutate(Emotion = factor(Emotion, levels = c("Awe", "Pride", "Hope", "Gratitude", "Compassion", "Connection", "Determination", "Happiness", "Inspiration"))) %>%
  group_by(Emotion) %>%
  mutate(median_Intensity = median(Intensity)) %>%
  ungroup()
```

Create and format the plot

```
p_smoothing <- ggplot(PosInt, aes(x = factor(Emotion, levels = c("Awe", "Pride", "Hope", "Gratitude", "Compassion", "Connection", "Determination", "Happiness", "Inspiration")), y = Intensity, fill = Emotion)) +
geom_violin(trim = FALSE) +
geom_boxplot(width = 0.1, fill = "white", outlier.shape = NA) +
scale_fill_brewer(palette = "YlOrRd") +
scale_y_continuous(breaks = 1:5) +
stat_summary(fun = mean, geom = "point", shape = 20, size = 2, color = "black") +
theme_minimal() +
theme(axis.text.x = element_blank(),
plot.title = element_text(hjust = 0.5)) +
labs(title = "Intensity of Positive Emotions",
x = "Emotion",
y = "Intensity")

p_smoothing
```

```
ggsave(filename = "C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/RFiles/results/p_smoothingposint.tif",
plot = p_smoothing,
device = "tiff",
dpi = 300,
width = 10,
height = 6,
units = "in")
```

*For this plot, I adjusted the kernel bandwidth iteratively until reaching an optimal visualization that smoothed the bumps caused by Likert being an integer and not a true continuous variable. However, I ensured that it was not over-smoothed, obscuring relevant trends.

```
p_bw <- ggplot(PosInt, aes(x = factor(Emotion, levels = c("Awe", "Pride", "Hope", "Gratitude", "Compassion", "Connection", "Determination", "Happiness", "Inspiration")), y = Intensity, fill = Emotion)) +
geom_violin(trim = FALSE, bw = 0.45) +
geom_boxplot(width = 0.1, fill = "white", outlier.shape = NA) +
scale_fill_brewer(palette = "YlOrRd") +
scale_y_continuous(breaks = 1:5, labels = c("Very low (1)", "Low (2)", "Moderate (3)", "High (4)","Very high (5)")) +
stat_summary(fun = mean, geom = "point", shape = 20, size = 2, color = "black") +
theme_minimal() +
theme(axis.text.x = element_text(size=11, angle=45, hjust=1),
legend.position = "none",
plot.title = element_text(size=12, hjust = 0.5)) +
theme(legend.text = element_text(size = 12)) +
theme(axis.text.y = element_text(size = 11, angle = 25, hjust = 1)) +
labs(title = "",
x = "Emotion",
y = "Intensity") +
annotate("text", x = Inf, y = Inf, label = "N=60", size = 4, hjust = 1.1, vjust = 1.5)
p_bw
```

```
ggsave(filename = "C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/RFiles/results/p_bwposint.tif",
plot = p_bw,
device = "tiff",
dpi = 300,
width = 11,
height = 6,
units = "in")
```

Prepping my positive persistence data

Load data set

```
PosPers <- read.csv("C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/RFiles/CSVFiles/PosPersR2.csv", header = TRUE)
```

Reading the data as numeric or factor

```
PosPers$Emotion <- as.factor(PosPers$Emotion)
PosPers$Persistence <- as.numeric(PosPers$Persistence)
head(PosPers)
```

```
##     Emotion Persistence
## 1 Happiness           2
## 2 Happiness           2
## 3 Happiness           3
## 4 Happiness           4
## 5 Happiness           1
## 6 Happiness           3
```

Analysis for PosPers

Some preliminary calculations

Calculate the median for each emotion and set the order of the emotions

```
PosPers <- PosPers %>%
  mutate(Emotion = factor(Emotion, levels = c("Awe", "Pride", "Hope", "Gratitude", "Compassion", "Connection", "Determination", "Happiness", "Inspiration"))) %>%
  group_by(Emotion) %>%
  mutate(median_Persistence = median(Persistence)) %>%
  ungroup()
```

Create and format the plot

```
p_smoothing <- ggplot(PosPers, aes(x = factor(Emotion, levels = c("Awe", "Pride", "Hope", "Gratitude", "Compassion", "Connection", "Determination", "Happiness", "Inspiration")), y = Persistence, fill = Emotion)) +
geom_violin(trim = FALSE) +
geom_boxplot(width = 0.1, fill = "white", outlier.shape = NA) +
scale_fill_brewer(palette = "YlOrRd") +
scale_y_continuous(breaks = 1:5) +
stat_summary(fun = mean, geom = "point", shape = 20, size = 2, color = "black") +
theme_minimal() +
theme(axis.text.x = element_blank(),
plot.title = element_text(hjust = 0.5)) +
labs(title = "Persistence of Positive Emotions",
x = "Emotion",
y = "Persistence")

p_smoothing
```

```
ggsave(filename = "C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/RFiles/results/p_smoothingpospers.tif",
plot = p_smoothing,
device = "tiff",
dpi = 300,
width = 10,
height = 6,
units = "in")
```

*For this plot, I adjusted the kernel bandwidth iteratively until reaching an optimal visualization that smoothed the bumps caused by Likert being an integer and not a true continuous variable. However, I ensured that it was not over-smoothed, obscuring relevant trends.

```
p_bw <- ggplot(PosPers, aes(x = factor(Emotion, levels = c("Awe", "Pride", "Hope", "Gratitude", "Compassion", "Co
nnection", "Determination", "Happiness", "Inspiration")), y = Persistence, fill = Emotion)) +
geom_violin(trim = FALSE, bw = 0.45) +
geom_boxplot(width = 0.1, fill = "white", outlier.shape = NA) +
scale_fill_brewer(palette = "YlOrRd") +
scale_y_continuous(breaks = 1:5, labels = c("Less than 1 minute (1)", "1-10 minutes (2)", "11-60 minutes (3)", "1
-4 hours (4)", "Longer than 4 hours (5)")) +
stat_summary(fun = mean, geom = "point", shape = 20, size = 2, color = "black") +
theme_minimal() +
theme(axis.text.x = element_text(size=11, angle=45, hjust=1),
legend.position = "none",
plot.title = element_text(size=12, hjust = 0.5)) +
theme(legend.text = element_text(size = 12)) +
theme(axis.text.y = element_text(size = 11, angle = 25, hjust = 1)) +
labs(title = "",
x = "Emotion",
y = "Persistence") +
annotate("text", x = Inf, y = Inf, label = "N=60", size = 4, hjust = 1.1, vjust = 1.5)

ggsave(filename = "C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/RFi
les/results/p_bwpospers.tif",
plot = p_bw,
device = "tiff",
dpi = 300,
width = 11,
height = 6,
units = "in")
```

Prepping my negative frequency data

Load data set

```
NegFreq <- read.csv("C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/R
Files/CSVFiles/NegFreqR2.csv", header = TRUE)
```

Reading the data as numeric or factor

```
NegFreq$Emotion <- as.factor(NegFreq$Emotion)
NegFreq$Frequency <- as.numeric(NegFreq$Frequency)
head(NegFreq)
```

```
##   Emotion Frequency
## 1 Sadness         3
## 2 Sadness         2
## 3 Sadness         4
## 4 Sadness         4
## 5 Sadness         5
## 6 Sadness         2
```

Analysis for NegFreq

Some preliminary calculations

Calculate the median for each emotion and set the order of the emotions

```
NegFreq <- NegFreq %>%
  mutate(Emotion = factor(Emotion, levels = c("Betrayal", "Dread", "Grief", "Anger", "Guilt", "Hopelessness", "Po
werlessness", "Sadness", "Anxiety"))) %>%
  group_by(Emotion) %>%
  mutate(median_Frequency = median(Frequency)) %>%
  ungroup()
```

Create and format the plot

```
p_smoothing <- ggplot(NegFreq, aes(x = factor(Emotion, levels = c("Betrayal", "Dread", "Grief", "Anger", "Guilt",
"Hopelessness", "Powerlessness", "Sadness", "Anxiety")), y = Frequency, fill = Emotion)) +
geom_violin(trim = FALSE) +
geom_boxplot(width = 0.1, fill = "white", outlier.shape = NA) +
scale_fill_brewer(palette = "PuBuGn") +
scale_y_continuous(breaks = 1:5,) +
stat_summary(fun = mean, geom = "point", shape = 20, size = 2, color = "black") +
theme_minimal() +
theme(axis.text.x = element_blank(),
plot.title = element_text(hjust = 0.5)) +
labs(title = "Frequency of Negative Emotions",
x = "Emotion",
y = "Frequency")

p_smoothing
```

```
ggsave(filename = "C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/RFi
les/results/p_smoothingnegfreq.tif",
plot = p_smoothing,
device = "tiff",
dpi = 300,
width = 10,
height = 6,
units = "in")
```

*For this plot, I adjusted the kernel bandwidth iteratively until reaching an optimal visualization that smoothed the bumps caused by Likert being an integer and not a true continuous variable. However, I ensured that it was not over-smoothed, obscuring relevant trends.

```
p_bw <- ggplot(NegFreq, aes(x = factor(Emotion, levels = c("Betrayal", "Dread", "Grief", "Anger", "Guilt", "Hopel
essness", "Powerlessness", "Sadness", "Anxiety")), y = Frequency, fill = Emotion)) +
geom_violin(trim = FALSE, bw = 0.45) +
geom_boxplot(width = 0.1, fill = "white", outlier.shape = NA) +
scale_fill_brewer(palette = "PuBuGn") +
scale_y_continuous(breaks = 1:5, labels = c("Once/month or less (1)", "Once/week or less (2)", "Once/day (3)", "2
-3 times per day (4)","3+ times per day (5)")) +
stat_summary(fun = mean, geom = "point", shape = 20, size = 2, color = "black") +
theme_minimal() +
theme(axis.text.x = element_text(size=11, angle=45, hjust=1),
legend.position = "none",
plot.title = element_text(size=12, hjust = 0.5)) +
theme(legend.text = element_text(size = 12)) +
theme(axis.text.y = element_text(size = 11, angle = 25, hjust = 1)) +
labs(title = "",
x = "Emotion",
y = "Frequency") +
annotate("text", x = Inf, y = Inf, label = "N=60", size = 4, hjust = 1.1, vjust = 1.5)
p_bw
```

```
ggsave(filename = "C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/RFiles/results/p_bwnegfreq.tif",
plot = p_bw,
device = "tiff",
dpi = 300,
width = 11,
height = 6,
units = "in")
```

Prepping my negative intensity data

Load data set

```
NegInt <- read.csv("C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/RFiles/CSVFiles/NegIntR2.csv", header = TRUE)
```

Reading the data as numeric or factor

```
NegInt$Emotion <- as.factor(NegInt$Emotion)
NegInt$Intensity <- as.numeric(NegInt$Intensity)
head(NegInt)
```

```
##   Emotion Intensity
## 1 Sadness         4
## 2 Sadness         3
## 3 Sadness         4
## 4 Sadness         4
## 5 Sadness         5
```

Analysis for NegInt

Some preliminary calculations

Calculate the median for each emotion and set the order of the emotions

```
NegInt <- NegInt %>%
  mutate(Emotion = factor(Emotion, levels = c("Betrayal", "Dread", "Grief", "Anger", "Guilt", "Hopelessness", "Powerlessness", "Sadness", "Anxiety"))) %>%
  group_by(Emotion) %>%
  mutate(median_Intensity = median(Intensity)) %>%
  ungroup()
```

Create and format the plot

```
p_smoothing <- ggplot(NegInt, aes(x = factor(Emotion, levels = c("Betrayal", "Dread", "Grief", "Anger", "Guilt", "Hopelessness", "Powerlessness", "Sadness", "Anxiety")), y = Intensity, fill = Emotion)) +
geom_violin(trim = FALSE) +
geom_boxplot(width = 0.1, fill = "white", outlier.shape = NA) +
scale_fill_brewer(palette = "PuBuGn") +
scale_y_continuous(breaks = 1:5) +
stat_summary(fun = mean, geom = "point", shape = 20, size = 2, color = "black") +
theme_minimal() +
theme(axis.text.x = element_blank(),
plot.title = element_text(hjust = 0.5)) +
labs(title = "Intensity of Negative Emotions",
x = "Emotion",
y = "Intensity")

p_smoothing
```

```
ggsave(filename = "C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/RFiles/results/p_smoothingnegint.tif",
plot = p_smoothing,
device = "tiff",
dpi = 300,
width = 10,
height = 6,
units = "in")
```

*For this plot, I adjusted the kernel bandwidth iteratively until reaching an optimal visualization that smoothed the bumps caused by Likert being an integer and not a true continuous variable. However, I ensured that it was not over-smoothed, obscuring relevant trends.

```
p_bw <- ggplot(NegInt, aes(x = factor(Emotion, levels = c("Betrayal", "Dread", "Grief", "Anger", "Guilt", "Hopelessness", "Powerlessness", "Sadness", "Anxiety")), y = Intensity, fill = Emotion)) +
geom_violin(trim = FALSE, bw = 0.45) +
geom_boxplot(width = 0.1, fill = "white", outlier.shape = NA) +
scale_fill_brewer(palette = "PuBuGn") +
scale_y_continuous(breaks = 1:5, labels = c("Very low (1)", "Low (2)", "Moderate (3)", "High (4)","Very high (5)")) +
stat_summary(fun = mean, geom = "point", shape = 20, size = 2, color = "black") +
theme_minimal() +
theme(axis.text.x = element_text(size=11, angle=45, hjust=1),
legend.position = "none",
plot.title = element_text(size=12, hjust = 0.5)) +
theme(legend.text = element_text(size = 12)) +
theme(axis.text.y = element_text(size = 11, angle = 25, hjust = 1)) +
labs(title = "",
x = "Emotion",
y = "Intensity") +
annotate("text", x = Inf, y = Inf, label = "N=60", size = 4, hjust = 1.1, vjust = 1.5)
p_bw
```

```
ggsave(filename = "C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/RFiles/results/p_bwnegint.tif",
plot = p_bw,
device = "tiff",
dpi = 300,
width = 11,
height = 6,
units = "in")
```

Prepping my negative persistence data

Load data set

```
NegPers <- read.csv("C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/RFiles/CSVFiles/NegPersR2.csv", header = TRUE)
```

Reading the data as numeric or factor

```
NegPers$Emotion <- as.factor(NegPers$Emotion)
NegPers$Persistence <- as.numeric(NegPers$Persistence)
head(NegPers)
```

```
##   Emotion Persistence
## 1 Sadness           3
## 2 Sadness           3
## 3 Sadness           4
## 4 Sadness           4
## 5 Sadness           4
## 6 Sadness           2
```

Analysis for NegPers

Some preliminary calculations

Calculate the median for each emotion and set the order of the emotions

```
NegPers <- NegPers %>%
  mutate(Emotion = factor(Emotion, levels = c("Betrayal", "Dread", "Grief", "Anger", "Guilt", "Hopelessness", "Po
werlessness", "Sadness", "Anxiety"))) %>%
  group_by(Emotion) %>%
  mutate(median_Persistence = median(Persistence)) %>%
  ungroup()
```

Create and format the plot

```
p_smoothing <- ggplot(NegPers, aes(x = factor(Emotion, levels = c("Betrayal", "Dread", "Grief", "Anger", "Guilt",
"Hopelessness", "Powerlessness", "Sadness", "Anxiety")), y = Persistence, fill = Emotion)) +
geom_violin(trim = FALSE) +
geom_boxplot(width = 0.1, fill = "white", outlier.shape = NA) +
scale_fill_brewer(palette = "PuBuGn") +
scale_y_continuous(breaks = 1:5) +
stat_summary(fun = mean, geom = "point", shape = 20, size = 2, color = "black") +
theme_minimal() +
theme(axis.text.x = element_blank(),
plot.title = element_text(hjust = 0.5)) +
labs(title = "Persistence of Negative Emotions",
x = "Emotion",
y = "Persistence")

p_smoothing
```

```
ggsave(filename = "C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/RFi
les/results/p_smoothingnegPers.tif",
plot = p_smoothing,
device = "tiff",
dpi = 300,
width = 10,
height = 6,
units = "in")
```

*For this plot, I adjusted the kernel bandwidth iteratively until reaching an optimal visualization that smoothed the bumps caused by Likert being an integer and not a true continuous variable. However, I ensured that it was not over-smoothed, obscuring relevant trends.

```
p_bw <- ggplot(NegInt, aes(x = factor(Emotion, levels = c("Betrayal", "Dread", "Grief", "Anger", "Guilt", "Hopele
ssness", "Powerlessness", "Sadness", "Anxiety")), y = Intensity, fill = Emotion)) +
geom_violin(trim = FALSE, bw = 0.45) +
geom_boxplot(width = 0.1, fill = "white", outlier.shape = NA) +
scale_fill_brewer(palette = "PuBuGn") +
scale_y_continuous(breaks = 1:5, labels = c("Less than 1 minute (1)", "1-10 minutes (2)", "11-60 minutes (3)", "1
-4 hours (4)", "Longer than 4 hours (5)")) +
stat_summary(fun = mean, geom = "point", shape = 20, size = 2, color = "black") +
theme_minimal() +
theme(axis.text.x = element_text(size=11, angle=45, hjust=1),
legend.position = "none",
plot.title = element_text(size=12, hjust = 0.5)) +
theme(legend.text = element_text(size = 12)) +
theme(axis.text.y = element_text(size = 11, angle = 25, hjust = 1)) +
labs(title = "",
x = "Emotion",
y = "Persistence") +
annotate("text", x = Inf, y = Inf, label = "N=60", size = 4, hjust = 1.1, vjust = 1.5)
p_bw
```

```
ggsave(filename = "C:/Users/15198/OneDrive - University of Waterloo/Documents/Grad School/Research/SurveyData/RFiles/results/p_bwnegPers.tif",
plot = p_bw,
device = "tiff",
dpi = 300,
width = 11,
height = 6,
units = "in")
```