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EXPLORING THE POTENTIAL OF ONLINE EDUCATION AND COLLEGE STUDENTS'
CONNECTION TO NATURE

A Dissertation

Presented to the Faculty of
Antioch University New England

In partial fulfillment for the degree of

DOCTOR OF PHILOSOPHY

by

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April 2022

EXPLORING THE POTENTIAL OF ONLINE EDUCATION AND COLLEGE STUDENTS'
CONNECTION TO NATURE

This dissertation, by Michael Weinstein, has
been approved by the committee members signed below
who recommend that it be accepted by the faculty of
Antioch University New England
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DOCTOR OF PHILOSOPHY

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ABSTRACT

EXPLORING THE POTENTIAL OF ONLINE EDUCATION AND COLLEGE STUDENTS' CONNECTION TO NATURE

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There is limited research examining the efficacy of online delivery for experiential, field-based, interdisciplinary coursework in environmental education geared towards undergraduate students, and how connection to nature can be understood through the theory of emerging adulthood. This research employed a convergent mixed methods approach to explore the experiences of 11 undergraduate students enrolled in an online, introductory ecology course, and how their experience of connection to nature was influenced through the course, technology-mediated nature embedded within the course, and how their identities as emerging adults were impacted by their connection to nature. Quantitative methods employed included pre/post surveys, while qualitative methods employed semi-structured interviews and reflective journal assignments. Based on this study, there are specific cognitive components of nature connection that may be delivered effectively in online education, while student attention is drawn to the affective components of nature connection that technology may not deliver. This study suggests that the ability of information technology to provide novel insights about ecological connections can be leveraged to increase conceptual understanding of environmental functioning and issues. Findings from this study illustrate the importance of connection to nature in shaping the identities of emerging adults, and the results can be applied broadly to programmatic development in college-level environmental education, as well as online environmental

education for various audiences. This dissertation is available in open access at AURA (<https://aura.antioch.edu>) and OhioLINK ETD Center (<https://etd.ohiolink.edu>).

Keywords: connection to nature, emerging adulthood, environmental education, technology-mediated nature

Acknowledgements

This dissertation was made possible by the students who agreed to participate in this research with me. Even putting aside the uncertainty and despair of living through a global pandemic, it is a lot to ask of undergraduate students to voluntarily add more potential stressors to their life. The students in my course placed their trust in me as their teacher, and I hope this dissertation pays service to the knowledge we co-created. I would like to thank my dissertation committee for guiding me through these uncertain times as well, and to acknowledge the time they were able to graciously give in the face of many life-transitions. My Chair, Dr. Elizabeth McCann, who introduced me to the theories that form the backbone of this research, always pushed me to be the best scholar I could. I will always be grateful for her dedication to the field of environmental education, as well as her belief in me and my work. Dr. Meaghan Guckian never hesitated to share her expertise in research, her skill in the technical aspects of my work, and her passion for the field of conservation psychology. Dr. Verna Delauer was always ready to offer her insight into my research, as well as a space to think creatively and share ideas. I am indebted to them for providing such amazing support, even through trying times. Finally, I would like to thank the Antioch University New England community and specifically my doctoral cohort. Their commitment to overcoming our current ecological crisis and their spirit of active scholarship and cooperation has been—and will continue to be—a huge source of inspiration.

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CHAPTER I: INTRODUCTION

There is now unequivocal, widespread understanding that anthropogenic disruption of planetary systems has surpassed many tipping points (Masson-Delmotte et al., 2021; Steffen et al., 2018). As a range of scholars contend, a critical aspect to overcoming this crisis is to address the widespread physical, cognitive, affective, and ethical separation from the natural world (Folke et al., 2011; Frantz & Mayer, 2009; Gould & Schultz, 2021; Ives & Abson et al., 2018). Efforts to address this separation have led to a rapidly growing interest in (re)establishing a closer human relationship with the planet, which is increasingly understood through the environmental and conservation psychology theory of “connection to nature” (Mayer & Frantz, 2004; Schultz, 2002; Zylstra et al., 2014).

Conceptual Framework for the Study

This research uses the theoretical frames of “Connection to Nature” and “Emerging Adulthood” to explore college-age students’ experiences in an asynchronous, online ecology course that also employed technological mediation of nature. Such theoretical underpinnings have not been used in this context and this research informs future research as well as enhancing practitioners’ ability to effectively engage undergraduate, online learners in nature experiences. Connection to nature (CTN) theory arose from the desire to quantify a close human relationship with nature as a measurable psychological construct. Häyrynen & Pynnönen (2020) state that “the human-nature relationship can generally be defined as the way human beings or societies perceive nature and the environment around them. It is foremost a worldview, an ethical and philosophical phenomenon” (p. 2). In addition to CTN, the terms “nature relatedness” (Nisbet et al., 2008; Nisbet, 2005), “environmental identity” (EID) (S. D. Clayton, 2003), and “connection/connectivity with nature” (Dutcher et al., 2007; Zylstra et al., 2014) are also used to

address the psychological aspects of the human-nature relationship. Several studies (Restall & Conrad, 2015; Tam, 2013a) have determined these various terms to be representative of a common construct, with a strong overlap in the concepts being investigated and measured. I use CTN as the umbrella term for this concept in this research

Such measurement of the human-nature connection is requisite for understanding the processes that influence pro-environmental behavior (PEB) (Mackay & Schmitt, 2019). Much like CTN, the concept has been studied under various names and across various fields (Larson & Stedman et al., 2015), resulting in what Schultz and Kaiser (2012) saw as a construct with intuitive clarity but technically difficult to define. However, Lange & Dewitte's (2019) literature review of PEB measurement noted that the concept can generally be thought to encompass "the commission of acts that benefit the natural environment (e.g., recycling) and the omission of acts that harm it (e.g., avoid air travel)" (p. 3). Because environmental education (explored later in this Chapter) is essential to the conceptual framework of my research, I opt to use the contextual definition of PEB provided by Kollmuss and Agyeman (2002), namely "behavior that consciously seeks to minimize the negative impact of one's actions on the natural and built world" (p. 240).

An individual's measure of CTN is a reliable predictor of their environmental values and PEB (Dutcher et al., 2007; Mackay & Schmitt, 2019; Restall & Conrad, 2015; Schmitt et al., 2019). The authors of a recent meta-analysis conclude that "the strong and robust association between nature connection and PEB, as well as evidence that nature connection causes PEB, suggest that nature connection is a promising avenue for promoting PEB" (Mackay & Schmitt, 2019, p. 1). Authors of another recent meta-analysis concluded that the positive relationship

between CTN and PEB holds “across gender, geographic location, and age group” (Whitburn et al., 2020, p. 188).

Because of the link between CTN and PEB, there exists abundant and growing interest in expressly linking environmental education (EE) with nature connection outcomes (Frantz & Mayer, 2014; Liefländer et al., 2013; Salazar, Kunkle, & Monroe, 2020). Frantz and Mayer (2014) state that “given the robust relationship between both self-reported and actual behavior, [CTN] should be considered not only as an important assessment tool for [EE] programs, but also an important goal of these programs” (2014, p. 88). This recommendation aligns with the goals of effective EE, which aims “to create new patterns of behavior of individuals, groups, and society as a whole towards the environment” (United Nations Environment Programme, 1977).

The conceptual framework explored above points to the opportunity for environmental educators to foster PEB in learners by way of CTN outcomes. However, there are specific components of this framework that require investigation and clarification for college educators because related CTN research oftentimes has focused on youth and childhood experiences in nature and not necessarily among young adults. Generally speaking, there is broad understanding that formative, childhood experiences have an impact on CTN (Chawla, 1999, 2007; Cheng & Monroe, 2010). This developmental understanding shows how childhood formation of high CTN measures persists into adulthood, and that the efficacy of later education for CTN may even depend on these formative experiences (Cleary et al., 2020; Kaiser et al., 2014).

The importance of formative experiences to CTN has led researchers and practitioners to draw a distinction between adult and nonadult populations. To wit, Salazar, Kunkle, and Monroe (2020) categorize assessment of CTN in EE into early childhood (ages 2–5), children and young adolescents (6–13), and adolescents and adults (14+). While age is operationally often a

surrogate for a broad set of descriptors in this context (National Center for Education Statistics, n.d.), the traditional undergraduate college student is typically defined as between the ages of 18–25 (Choy, 2002; Terenzini & Pascarella, 1998). Additionally, while undergraduate populations form a large percentage of literature on CTN (Häyrinen & Pynnönen, 2020), they are explored through the adult lens (Whitburn et al., 2020), leaving behind the lens of developmental psychology. While traditional college students may no longer be in the formative stages of development, there is an opportunity to retain the link to developmental psychology by understanding how experiences designed to foster CTN interface with the theoretical lens of emerging adulthood (Arnett, 2000).

First proposed in 2000, Arnett’s emerging adulthood theory of development offers both researchers and practitioners an avenue to understand and evaluate CTN outcomes among college students, including college students engaged in environmental education learning experiences. While biological definitions exist (Hochberg & Konner, 2019), Arnett (2000) defines the emerging adult as an individual between 18 and 25 years of age, experiencing an extended period of greater independence. Saliently, Arnett (2007) posits that “identity explorations become more prominent and serious in emerging adulthood” (Arnett, 2007, p. 24). The opportunity to use emerging adulthood is recognized when taken in context with CTN in undergraduate college students, as the authors of a study examining specifically this issue found that the “relationship between connection to nature and environmental commitment to sustainability was mediated by social identity” (Yu et al., 2019, p. 1). In summary, the links to developmental psychology and CTN need not be abandoned in the study of undergraduate populations, particularly given the relationship between CTN and identity (Brügger et al., 2011; Nisbet et al., 2008; Olivos et al., 2011; Schmitt et al., 2019) and between emerging adulthood

and identity formation (Morgan, 2013; Schwartz & Zamboanga et al., 2013; M. Walker & Iverson, 2016).

Beyond the need for clarity and nuance around linking developmental psychology and CTN in undergraduates, college educators and researchers also must contend with the prevailing recommendation for effective EE to foster CTN: exposure to nature (Chawla, 2007; Cosgriff, 2011; Liefländer et al., 2013; N. M. Wells & Lekies, 2006). This recommendation stems from findings that nature exposure during childhood is the foremost predictor of high CTN (Chawla, 1999; Colding et al., 2020). It follows that if an outcome of EE is CTN, then educators should enable and provide experiences in nature, since even brief nature experiences or “dosages” provide positive effects (“Ming” Kuo, 2013). As the authors of the article “Promoting Connectedness with Nature through Environmental Education” stated that “environmental education programmes that focus on the increase of connectedness *to* nature should enable positive experiences *in* [emphasis added] nature” (Liefländer et al., 2013, p. 380).

Such recommendations to immerse learners in nature experiences are made more challenging to meet amid the realities of 21st century college EE. Sustained growth in online college enrollment preceded and informed this research (Altbach et al., 2009; Peppers, 2016). Secondly, the COVID-19 pandemic greatly accelerated this growth of online educational modality across all levels of formal education (Amemado, 2020; Bao, 2020; C. Li & Lalani, 2020), and such pandemics will most likely continue to increase in frequency (Marani et al., 2021). College educators interested in engaging online learners in nature experiences can benefit from understanding the impacts and opportunities for nature exposure mediated by computer technology, including such online learning contexts.

Fortunately, there is increasing interest in the exploration of technology-mediated nature as it pertains to CTN (M. D. Smith et al., 2018; Sneed et al., 2020; Soliman et al., 2017). Studies in this arena have shown technology-mediation to have at least some positive associations with CTN (Ahn et al., 2016; Breves & Heber, 2019; Deringer & Hanley, 2021). More broadly, research into a range of technological interventions for EE has shown the ability of technology to foster positive educational outcomes (Coccoli, 2020; Karlin & De La Paz, 2015; Ritter et al., 2019; Tudor et al., 2018).

In summary, there is a broad understanding among researchers of EE's ability to foster CTN. However, the roles of emerging adulthood particular to college students in this context are limited, as is the ability of technology to provide CTN-fostering EE in online, undergraduate settings. Additionally, as information technology continues to evolve and expand, additional research in the context of EE and CTN is essential. Having outlined my conceptual framework, I next address the overall purpose of this study and introduce my research questions.

Purpose of Study

This research explores connection to nature among college aged students participating in a 15-week-long online ecology course. This research seeks to understand potential intersections between CTN and PEB among emerging adults, especially because this online ecology course incorporates multiple teaching strategies emphasized in environmental education. The hope is that this research provides greater insights into the potential for online learning and technology-mediated nature's capacity to impact emerging adults' connection to nature. Implications for theory, research, and practice are discussed.

Research Questions

As explored above, there is growing interest among both researchers and practitioners in

the ability of EE to foster CTN. However, there are several gaps in the research literature particular to college educators when exploring how to address CTN outcomes. The first of these is the lack of research-informed, promising practices and associated evidence at the intersection of online EE and technology-mediated nature. The second gap is the opportunity to address a specific pool of learners—namely traditional undergraduate college students—through a developmental lens. Thus, to both further a broader understanding and evaluate the efficacy of a particular pedagogical and technological approach in doing so, this dissertation research focuses on answering the following questions:

1. How do college students enrolled in an online ecology course perceive and experience their connection to nature?
2. What is the student experience with the digital mediation of nature in the course?
3. How is student experience of connection to nature related to emerging adulthood, if at all?

Methodology

The goal of this research was to explore the student experience with an online ecology class, particularly related to CTN, technology-mediated nature, and emerging adulthood. As the goal was to represent participant experiences, and not to generalize, this research was approached through the constructivist paradigm (Lincoln & Guba, 2013). Constructivism is a qualitative research paradigm, which rests on two specific ontological and epistemological claims: ontologically, that there exist multiple realities constructed by participants and researchers (Lincoln & Guba 2005), and epistemologically, that understanding arises through co-creation between both researchers and participants (Lincoln & Guba 2013). Thus, constructivist

methodology serves to directly address my research questions, which seek to explore and understand the student experience.

A convergent mixed methods approach was used to conduct this research. which explored the experiences of undergraduate, on-campus students at a private, New England, liberal arts university in an online section of BIO-315: Ecological Principles. As an educator-researcher, this site was chosen because of my access to both the students and to the technologies used to bring virtual fieldwork to the students from the university Arboretum. The course under study was chosen as I designed and taught the course to reflect EE practice and theory by containing integration of environmental knowledge and social responsibility, and informing lifelong commitment to pro-environmental action as explicit outcomes. EE pedagogical strategies were also employed, such as incorporating multiple disciplinary lenses in my teaching—including biology and the humanities—and student-centered, hands-on learning.

This research was designed as a pre-experimental, single-group before and after study (Creswell, 2012; Marsden & Torgerson, 2012). Quantitative and qualitative approaches were both warranted in order to fully explore and understand the student experience with online education and CTN, as combining both approaches provided a greater understanding of the research problem than either approach alone (Creswell, 2014; Onwuegbuzie & Leech, 2005). Primary methods employed were pre- and posttest surveys, posttest interviews, and reflective journal analysis. The design adhered to a convergent parallel approach, wherein both quantitative and qualitative data were collected simultaneously throughout the research period, and were weighted equally in analysis (Dawadi et al., 2021). Post analysis, data was merged using a joint display technique, specifically the pillar integration process, which was developed to address the lack of “specific, transparent, well-defined analytical techniques to support an integrated, joint

display approach” (R. E. Johnson et al., 2019, p. 303). The three pillar themes that emerged from this process served as the foundation for discussion.

A potential weakness of this research was the inherent bias of myself serving as both the research and primary educator facilitating the online college course that was a primary element of the research context. However, this dual role aligns with qualitative elements of the research. Qualitative research typically views research as subjective and contextual (Strauss & Corbin, 1998). Additionally, this dual role was advantageous in terms of offering greater access to research participants (Glesne, 1989). The constructivist approach taken to this research allowed me to both recognize my personal biases as a practitioner, while bracketing them within the context of the classroom (Rand, 2016).

Having outlined the key considerations and significance of this research and methodological considerations, the following section offers an overview of the dissertation format.

Dissertation Outline and Structure

The first phase of this study was to undertake a review of the literature. The purpose of this review was to: (a) identify extant research that demonstrated the potential for online environmental education to impact connection to nature measures in college students, and (b) to identify the feasibility of understanding CTN through both technology-mediation and the developmental lens of emerging adulthood. This literature review is presented in Chapter II. Chapter III introduces the study site, protocol, and participants, and explains the methods of data collection and analysis used to answer the research questions. Additionally, Chapter III describes steps taken to ensure ethical, rigorous, and valid research. Chapter IV presents the results of the research, with a focus on the pillar themes emerging from pillar integration process analysis.

Chapter V offers discussion of these themes regarding my three research questions, and additionally provides discussion on implications of study results for practitioners, scholarship, and research. I conclude this dissertation in Chapter VI, which restates my research purpose and summarizes how my research integrates with the body of literature on CTN, EE, and emerging adulthood. In total, this research contributes new knowledge to the broader understanding of CTN, especially in relation to the urgent need to form best practices around online environmental education. Additionally, this is the first study undertaken explicitly viewing CTN through the lens of emerging adulthood. The following Chapter II expands upon the novel conceptual framework introduced here, by reviewing significant and relevant literature on key concepts including CTN, EE, emerging adulthood, and technology-mediated nature.

CHAPTER II: LITERATURE REVIEW

Introduction

This research intersects across disciplinary lines of conservation psychology, particularly human connection to nature, environmental education, adult learning, and information technology. The purpose of this chapter is to present a literature review on what is meant by connection to nature (CTN), environmental education (EE), and online and technology-mediated nature. In addition, the chapter explores CTN through the lens of emerging adulthood, with implications for online EE programming and pedagogical practices among college students. This review provides a foundation for the design of the ecology course under study at a private, New England, liberal arts university, and the exploration of student experiences with the course vis-à-vis connection to nature.

First, I examine the contemporary dialog surrounding connection to nature and environmental education. I begin by examining the history of the theory of connection to nature, arriving at a working definition of the theory. Next, I explore efforts to operationalize the concept as a psychological construct. Then I examine critiques of the theory and its application. The history of environmental education is explored in order to arrive at a working definition. Finally, I explore the theoretical literature that links environmental education with connection to nature outcomes, and then provide examples of how environmental education for connection to nature is practiced.

This review also identifies several gaps in the literature where I plan to situate my own research. These gaps lead to an exploration of the emerging adult theory of development, beginning with a definition of the theory, and then examining criticisms of the concept. I finally examine online learning and the digital representation of nature in the context of connection to

nature. This section begins with an exploration of the practice of online environmental education, before broadening to encompass online science education, then broadening further to general theories of online learning. I then examine technological mediation of nature specifically as it pertains to connection to nature outcomes. Finally, I unify these concepts into a framework that offers guidance for a way to explore nature connection outcomes in online, college education.

Connection to Nature and Environmental Education

Theory of Connection to Nature

The concepts encompassed by the theory of connection to nature are most closely associated with the field of conservation psychology. Clayton & Saunders (2012) define conservation psychology as an overlapping field with environmental psychology, as both fields address an interdisciplinary approach to behavior in context, or place. However, Schultz and Kaiser (2012) assert that with its unique consideration of the non-human environment, conservation psychology is more readily able to pick up the challenge of researching and understanding pro-environmental behavior (PEB).

Specific to the context of environmental education (Lange & Dewitte, 2019)—explored later in this chapter—PEB is defined by Kollmuss and Agyeman (2002) as “behavior that consciously seeks to minimize the negative impact of one’s actions on the natural and built world” (p. 240). The interest in understanding motivating factors behind PEB rests on the argument that people’s everyday behaviors are, at least in part, responsible for the current ecological crisis (Nordlund & Garvill, 2002). Research into the determinants of an individual’s PEBs encompasses a variety of factors, including external variables like social norms (Vining & Ebreo, 1990), and individual variables like demographics (Botetzagias et al., 2015). Yet another

study found psychological factors to be a stronger determinant at the individual level (D. Li et al., 2019).

Research has shown that individuals are more willing to help others when interpersonal, psychological distance decreases (Aron, Aron, & Tudor et al., 1991; Cialdini et al., 1997). This interpersonal “closeness” as a determinant of altruistic or empathic behavior between individuals has been demonstrated and operationalized using the Inclusion of the Other in Self (IOS) scale (Aron, Aron, & Smollan, 1992). Similarly, this concept is thought to extend to an individual’s closeness with nature, in that a closer relationship between self and nature fosters increased PEB (Mayer & Frantz, 2004; Schultz, 2000; Whitburn et al., 2020). Conversely, the lack of a close psychological relationship with nature has been blamed for individuals exhibiting fewer PEBs (Pyle, 2003). The challenge, then, has been to explicitly define this human-nature relationship in the context of psychological determinants of PEB.

Connection to Nature Definition

Scholarly research into the broad human relationship with nature is an expansion of famed biologist E.O. Wilson’s biophilia hypothesis, which postulates that there is a fundamental need in humans to affiliate with nature (Kahn, 1999; Kellert & Wilson, 1993). The concept of a close human relationship with nature has been explored using “human-nature connection” (HNC) and “human-nature relations” (HNR) as general terms of inquiry throughout the literature (Glaeser, 2001; Kahn et al., 2009; Kellert, 2006; Schultz, 2002). Häyrynen & Pynnönen (2020) state that “the human-nature relationship can generally be defined as the way human beings or societies perceive nature and the environment around them. It is foremost a worldview, an ethical and philosophical phenomenon” (p. 1).

The desire to quantify HNC/HNR as a measurable psychological construct has resulted in the terms “nature relatedness” (Nisbet et al., 2008; Nisbet, 2005), “environmental identity” (EID) (S. Clayton, 2003), and “connection/connectedness to nature” (CTN) (Mayer & Frantz, 2004) or “connection/connectivity with nature” (Dutcher et al., 2007; Zylstra et al., 2014). In a 2013 study comparing the above concepts and their measures, Tam (2013a) determined them all to be representative of a common construct. A later review by Restall and Conrad (2015) likewise demonstrated a strong overlap in the concepts being investigated and measured. I use CTN as the umbrella term for this concept when not discussing any one particular measurement tool.

The term CTN was initially defined by Mayer & Frantz (2004) as “individuals’ affective, experiential connection to nature” (p. 504). Restall and Conrad (2015) later defined CTN more broadly as the way people identify with natural environments and the relationships they form with nature. This definition encompasses both Schultz’s (2002) definition of a cognitive understanding and representation of nature in individuals, as well as an affective connection to nature (Kals & Müller, 2012).

Some of the earliest investigations into CTN proposed that “environmental concern is tied to a person’s notion of self and the degree to which people define themselves as independent, interdependent with other people, or interdependent with all living things” (Schultz, 2000, p. 394). Further CTN studies on the psychological determinants of environmental attitudes (Mayer & Frantz, 2004; Nisbet, 2005; Schultz, 2001; N. M. Wells & Lekies, 2006) affirmed the linkage between these identities, attitudes, and PEB (Guckian et al., 2017; Kollmuss & Agyeman, 2002; Vining & Ebreo, 1990). Schultz et al. (2004) confirmed CTN as primary determinant of an ecological worldview, stating their work,

affirms the importance of connectedness in understanding attitudes about environmental issues. At a psychological level, the degree to which an individual

associates him or herself with nature is directly related to the types of attitudes that s/he develops. In essence, individuals who associate themselves with the natural environment tend to hold broader sets of concerns for environmental issues. (p. 39)

Having defined CTN in the context of this research, I next explore how researchers have sought to operationalize the concept as a psychological construct.

Connection to Nature Operationalization

Several tools have been defined in the literature to describe CTN and assess its level in individuals. Each instrument measures along three interrelated dimensions to varying degrees: affective, cognitive, and behavioral. As Häyriinen and Pynnönen (2020) state, “the affective dimension reflects feelings towards nature, the cognitive dimension captures knowledge and beliefs about nature and the behavioural (or experiential) dimension relates to actions and experiences in nature” (p. 2).

Based on the understanding that interpersonal closeness correlates with a propensity to help others (Aron, Aron, & Tudor et al., 1991; Cialdini et al., 1997), Schultz used a modified IOS (Aron, Aron, & Smollan, 1992)—designed to measure interpersonal closeness—to create the Inclusion of Nature in Self scale (INS) (2001). The INS is a single-item, unidimensional scale, describing an individual’s cognitive representation of nature in relation to themselves. Schultz (2002) proposes a purely cognitive approach by defining CTN as the “extent to which an individual includes nature within his/her cognitive presentation of self” (p. 61).

The INS has been widely employed in CTN research, ranging across diverse demographics. For example, Prévot et al. (2018) used the INS to explore relationships between everyday experiences with nature and PEB among adults in Paris. They analyzed their results by how explicit attentiveness to biodiversity was in each experience and found that people who experienced nature daily—regardless of the type of experience—exhibited higher CTN and

demonstrated greater levels of PEB. Liefländer et al. (2013) used the INS to study the effects of environmental education on CTN in German children and young adolescents. Using a pre- and post-test design and analyzing by age, they found that while CTN was raised across age groups, younger participants retained these higher CTN measures for longer than their older counterparts. Other studies using the INS include Kossack and Bogner (2012), Schultz et al. (2004), Bruni and Schultz (2010), and Windhorst and Williams (2015).

While it has been demonstrated that the INS converges with other CTN measurement tools (Restall & Conrad, 2015; Tam, 2013a), some critiques have led to researchers using modifications of this tool. In a study on the relationship between outdoor time and screen time and its effect on CTN for youth in rural South Carolina, L. R. Larson and Szczytko et al. (2019) condensed the tool from seven to five responses. The researchers found this modified INS easier to aggregate with other CTN measures, while still being an effective and reliable measurement tool. Martin and Czellar (2016) argued that the single-item nature of the INS trades predictive validity and range of application for parsimony and ease of administration. To rectify this, the researchers developed the Extended Inclusion of Nature in Self Scale (EINS) through the addition of three items. They found the EINS to converge with the INS in terms of measurement, while circumventing validity issues related to a single-item scale.

An early critique of the INS by Mayer and Frantz (2004) centered not only on its single-item nature, but also on the purely cognitive definition of CTN that Schultz used to create the tool. Rather, Mayer and Frantz argued that CTN is more affective, or emotional, than cognitive, and thus more appropriate tools were needed to measure along this component. This led to the creation of the Connectedness to Nature Scale (CNS), a 14-item, five-point scale questionnaire. Mayer and Frantz stated that studies on the CNS demonstrated that “feeling a

sense of community, kinship, egalitarianism, embeddedness, and belongingness to nature are all aspects of a broader sense of feeling connected to it” (2004, p. 512).

The CNS was designed for use with adults, and initial testing was done with college students before being applied to broader age groups (Mayer & Frantz, 2004). For example, Markowitz et al. (2012) found that the relationship between openness to experience and PEB was mediated by individuals’ CNS measures. Warner and Diaz (2021) used a modified version of the CNS to show that individuals’ CTN predicted PEB specific to water conservation. Tam et al. (2013) found that the relationship between anthropomorphism of nature and PEB was mediated by CNS in undergraduate students.

As the CNS was developed with adult populations, critiques around its ability to be used with children and youth have led to multiple modified versions of the tool. Cheng & Monroe (2010) addressed this by using the CNS to create the Connection to Nature Index, a tool designed specifically to measure the affective component of CTN in children. Recognizing the need for such a tool, Mayer and Frantz modified the CNS by using simpler language, and 10 statements with a seven-point scale, to create the CNS Revised (CNS-R) scale (Salazar, Kunkle, & Monroe, 2020).

One critique leveled against the CNS by Perrin and Benassi (2009) claims that the tool does not measure affect or emotions as it purports to. Rather, they argue that both ambiguous wording and misinterpretation of results by Mayer and Frantz point towards the CNS as a tool for measurement of the cognitive dimension of CTN. While this argument has important ramifications for pure psychometrics in practice, the CNS has converged on the same construct as other tools used for measuring CTN (Restall & Conrad, 2015; Tam, 2013a). The CNS and INS in particular are both closely correlated (Brügger et al., 2011; Gkargkavouzi et al., 2019).

Beyond a convergence amongst the various operationalizations of CTN, it has been shown that extant measures—though differing in strength—have a positive relationship with PEB (Whitburn et al., 2020). This reinforces the use of CTN as a key psychological determinant of PEB. These tools exist to answer the question of how to measure and describe CTN, and ultimately how to address a perceived individual separation from biospheric functioning. Having explored the tools used for operationalizing CTN, I next return to a high-level view of the concept and examine critiques of the theory.

Critiques of Connection to Nature Theory

Connection to nature theory is not without criticism. Fletcher describes the concept as “fundamentally oxymoronic” (2017, p. 226). In this, they lean heavily on Dickinson’s (2013) critique of Louv’s (2005) Nature Deficit Disorder concept, where Dickinson argues that Louv’s “naming” of nature calls it out as apart from humanity, and perpetuates a false separation. While echoing Dickinson’s call to further interrogate the cultural concept of “nature,” Fletcher further argues that the CTN perspective reinforces “a focus on individual responsibility and action and thus displac[es] attention from the overarching political economy of ecological degradation that ... should be a main focus of attention” (2017, p. 227).

The first part of this critique is the argument that calling out nature “paradoxically exacerbates a sense of separation from the very entity with which [CTN] seeks reconciliation” (Fletcher, 2017, p. 226). The concept of a nature-culture dichotomy is problematic at best (see (Descola & Pálsson, 1996). Arnold (1996) is not alone in seeing nature as a primarily social construct, necessarily bound-up in linkages to race, class, and gender power structures. Consequently, Dickinson says “researchers have problematized environmentalist messages that ignore these issues and largely speak for and to affluent white audiences” (2013, p. 322). While

the term “nature” is culturally weighted and may be problematic, finding a terminological solution is beyond the scope of this dissertation. Whether one conceptualizes nature as purely cultural or as a practical entity “out there,” Proctor (1998) argues that discourse among both views is complimentary, ultimately making researchers and practitioners alert to, as Castree (2014) says, the epistemology of nature.

The second part of this critique is that a focus on CTN theory—particularly by educators—is mutually exclusive of political-ecological analysis and engagement. However, Chawla and Cushing (2007) report that individuals who have had experiences that are shown to result in higher CTN scores tend to be more highly engaged in the sociopolitical sphere. Mayer & Frantz (2004) demonstrated that CTN measures are negatively correlated to consumerist value orientations. In terms of political activism, Schmitt et al. (2019) predicted that this specific type of PEB could be predicted by an individual’s politicized environmental identification, or “identification with a group that is engaged in a collective struggle to create pro-environmental social change” (p. 20). They found that politicized environmental identification mediated an indirect relationship between CTN and political activism. Thus, CTN can strengthen activism in those with politicized identification, making educating for CTN—at worst—complimentary to political-ecological education. Even in practice, Cudworth (2020) found that forest schools, and their focus on CTN, promote values antithetical to the neoliberal classroom. Thus, engagement with CTN does not preclude critical engagement with the global, neoliberal capitalist structure, but nurtures a necessary confrontation with it. Having discussed CTN and research tensions, the following section takes a deeper dive into CTN intersections with the field of environmental education, which oftentimes focuses on immersion in the natural world for youth and adult audiences in both formal and nonformal learning contexts.

Environmental Education

A recurring theme in CTN research is the role of environmental education (EE) in fostering increased CTN measures (Ardoin, Bowers & Gaillard, 2020; Powell et al., 2019). Liefländer et al. (2013) investigated whether EE could help promote and sustain CTN in children and youth. They found that participation in EE resulted in an increase in CTN. A review by Frantz and Mayer (2014) affirmed a positive relationship between CTN and PEB across multiple demographics, leading them to conclude that “given the robust relationship between both self-reported and actual behavior, [CTN] should be considered not only as an important assessment tool for [EE] programs, but also an important goal of these programs” (p. 88). Thus, it is necessary to define what EE is in order to describe how educating for CTN is practiced.

History & Definition.

The formal field of EE arose with the modern environmental movement in the middle of the 20th century (Carter & Simmons, 2010). Influenced by century-old field of nature study in the United States, and further influenced by events of the 1960s and 70s like the publication of Rachel Carson’s *Silent Spring* in 1962 (Lytle, 2007), The field reflected a shift away from nature study (Minton, 1980) and toward interdisciplinarity, problem solving and civic engagement, particularly as Western capitalist societies were first alerted to widespread, ecological disaster (Somerville, 2016). The concept was first formally defined by Stapp (1969) in the inaugural issue of the *Journal of Environmental Education*, in which they wrote that “environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to help work toward their solution” (p. 34).

Following Stapp's writing, a number of international conferences and directives endeavored to establish universal criteria and guidelines for EE (Wright, 2004). In 1975, sponsored by the newly-formed United Nations Environment Programme, The International Workshop on Environmental Education was held in Belgrade, Yugoslavia, and resulted in a document known as The Belgrade Charter (Čeřovský, 1976). The Belgrade Charter proposed what became the first widely accepted definition of EE, by codifying the goals, audiences, and guiding principles of the field (Carter & Simmons, 2010):

The goal of EE is to develop a world population that is aware of and concerned about the total environment and its associated problems, and which has the knowledge, attitudes, motivations, commitments, and skills to work individually and collectively toward solutions of current problems and the prevention of new ones. (United Nations Environment Programme, 1975)

In 1977, again organized by the United Nations, the world's first intergovernmental conference on EE produced the Tbilisi Doctrine (Somerville, 2016). This document provided goals that formed the foundation for much of EE practice through the end of the 20th Century (Carter & Simmons, 2010). With a greater focus on built environments than the Belgrade Charter, the Tbilisi Doctrine stated the goals of EE are:

to foster clear awareness of, and concern about, economic, social, political, and ecological interdependence in urban and rural areas; to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment; and to create new patterns of behavior of individuals, groups, and society as a whole towards the environment. (United Nations Environment Programme, 1977)

These early declarations and definitions indelibly shaped the formal concept of EE, fundamentally tying environmental action to lifelong outcomes. This legacy is seen in current definitions of the field, such as that from the North American Association for Environmental Education, which describes EE as a "process that helps individuals, communities, and organizations learn more about the environment, and develop skills and understanding about how

to address global challenges” (NAAEE, 2015). Likewise, the United States Environmental Protection Agency defines EE as a process that “allows individuals to explore environmental issues, engage in problem solving, and take action to improve the environment” (EPA, 2012).

As EE is practiced today, it draws from a broad set of disciplines, including “science, mathematics, language arts, social science, politics, and philosophy” (Carter & Simmons, 2010, p. 12). Pedagogically, EE comprises a wide span of approaches, including outdoor learning (Otto & Pensini, 2017; Stewart, 2008), laboratory and citizen science (Branchini et al., 2015; Erdogan, 2015), project-based learning (Vasconcelos, 2012), and participatory action research (Krasny & Bonney, 2005). While broadly disciplinary and pedagogically diverse, the field remains aimed at producing a society with the knowledge and skills to take positive action on behalf of the planet. Thus, in the context of this research, EE should be understood as an interdisciplinary field that emphasizes lifelong learning by building attitudes, awareness, and skills for learners of all ages to make wise choices in their personal lives and their communities.

Environmental Education and Connection to Nature Outcomes

As discussed previously, the *Tbilisi Declaration* states that an express goal of EE should be “to create new patterns of behavior of individuals, groups, and society as a whole towards the environment” (United Nations Environment Programme, 1977). Saliently, the guiding principles of EE move beyond knowledge transfer to imparting motivation through new attitudes and values. This is a critical component of EE, as it has been demonstrated that knowledge alone does not foster behaviors capable of solving global environmental problems (Saunders et al., 2006). For example, Kollmuss and Agyeman reviewed several influential frameworks that attempted to explain “the gap between the possession of environmental knowledge and environmental awareness, and displaying [PEB]” (2002, p. 239). While they found that no one

framework provided a satisfactory explanation, they proposed their own that included internal factors such as feelings, emotion, and values.

What has instead been shown to correspond to PEB and positive sociopolitical action for the environment are higher measures of CTN in individuals (Bruni & Schultz, 2010; Geng et al., 2015; Häyrynen & Pynnönen, 2020; Whitburn et al., 2020). In the studies above and others (Barrable, 2019; Cosgriff, 2011; Ernst & Theimer, 2011; Lankenau, 2018; Mullenbach et al., 2019), it has been shown that effective EE is capable of increasing CTN measures. Thus, it is critical to understand the pedagogical approaches environmental educators can take to foster CTN, as informed by theory. Particular to this research is the further need to understand how these practices interface with college students. In the next section, these practices and associated theoretical underpinnings are explored, and placed in context with college education.

Theory and Practice

Despite the urgent need for CTN in EE, college educators are presented with several difficulties based on established practice as shown above: a theoretical focus on children and youth populations, and direct experience of nature. Both issues stem from fundamental understandings of the CTN concept. To wit, researchers have long been interested in what factors may lead individuals to exhibit high scores on CTN measures.

Chawla's (1998) research in the late 1990's found that prolonged, repeated exposure to wild natural space was the unifying experience for individuals who both acted environmentally and expressed higher perceptual inclusion with the natural environment, and found that these natural encounters most frequently occurred during childhood (1999). Thus, formative childhood experiences in wild nature form the backbone for understanding CTN development (Ewert et al., 2005; Kahn, 2002; N. M. Wells & Lekies, 2006). Furthermore, understanding education for CTN

development through a formative lens aligns with studies showing that early childhood is when key skills like empathy begin to emerge (Berliner & Masterson, 2015; Roth-Hanania et al., 2011). Such skill development is crucial when contextualized with empathy and perspective-taking being key constituents of the CTN construct (Dutcher et al., 2007; Schultz, 2000; Tam, 2013b).

These theoretical underpinnings of CTN development (i.e., formative experiences in nature) were explored in a 2017 study by Otto and Pensini. In the study, the authors evaluated the effect of participation in nature-based EE on PEB outcomes for 4th–6th graders. They found that the positive impacts of the program on PEB—such as energy conservation, waste avoidance, and recycling—were mediated primarily through the participants’ level of CTN. While not providing causal evidence, this study reinforces the practical application of nature exposure in childhood EE for PEB outcomes by way of fostering CTN (Otto & Pensini, 2017).

As it relates to EE beyond childhood, studies have indicated that the efficacy of CTN outcomes may even be dependent on an individual’s previous childhood experiences in wild nature (Cheng & Monroe, 2010). While it is possible to foster increased CTN attitudes in adults, it has been shown that high CTN measures developed in childhood persist throughout adulthood (Cleary et al., 2020; Kaiser et al., 2014), reinforcing the importance of understanding CTN through a developmental lens. Finally, it has been shown that an inverse relationship exists between youth experiences in wild nature and screen-time (L. R. Larson & Szczytko et al., 2019; Michaelson et al., 2020). Such findings reinforce a narrative of information technology as an impediment to formative CTN experiences. In the following sections, I expand on the themes of development and nature exposure to explore several gaps in the literature for how college educators and online EE can practically interface with this theoretical knowledge.

Gaps

Two gaps in the CTN scholarship that are particularly relevant to college educators correspond to the two conceptual components described above: namely, formative experiences and time in nature. A formative lens is useful in understanding both the development and persistence of CTN measures, given their relationship to skills such as empathy and perspective-taking (Dutcher et al., 2007; Schultz, 2000; Tam, 2013b). However, given the linkages between CTN, PEB, and identity (Brügger et al., 2011; Schmitt et al., 2019), the topic of college-level EE for CTN is underexplored within a developmental framework. This gap can be addressed by examination of undergraduate college students through the lens of emerging adulthood, which posits that individuals in this group are still—in fact—in a unique developmental phase, albeit between adolescence and adulthood (Arnett, 2000).

The latter component of CTN understanding—the importance of time in nature—presents a much broader problem for educators. While it remains true that growth in online college enrollment preceded and informed this research (Altbach et al., 2009; Peppers, 2016), the COVID-19 pandemic greatly accelerated this trend across all levels of formal education (Amemado, 2020; Bao, 2020; Irwin et al., 2021; C. Li & Lalani, 2020). The increasing reliance on, and occasional necessity for, online education warrants a wider exploration of fostering CTN without time in nature. The concepts and literature for both of these gaps will be explored in the following sections.

Theory of Emerging Adulthood

There exist a handful of studies specifically examining the measurement of CTN specifically through the lens of college-age populations (Lankenau, 2018; Lumber et al., 2017; Schultz & Tabanico, 2007; Yu et al., 2019). A 2018 study investigated the effects of an

introductory ecology course on the CTN measures of students at Pennsylvania State University (Lakenau, 2018). Using pre- and post-test surveys, Lakenau found that after taking an introductory ecology course designed specifically around identity transformation, students significantly raised their nature relatedness (NR) scores. Lakenau found that the students' NR scores increased significantly more than peers in control groups (course sections not centered on identity transformation) despite no significant differences between pre-test scores across all groups. Lakenau concluded that while formative experiences may be crucial for fostering CTN, opportunity exists for the same in college classrooms. However, while nominally linking college students' CTN with (childhood) development, Lakenau's study keeps intact the nature-exposure component of the concept. My research addresses this by replacing outdoor experiences with technology-mediated nature experiences.

A 2019 study by Yu et al. likewise examined CTN specifically in undergraduate college students, but in relation to both PEB and social identity, among other factors. The authors found that participants' CTN enhanced their social identity as individuals willing to act on behalf of the environment. Further, they found that the relationship between CTN and PEB in college students was mediated by their identities, in that it was the transfer of CTN between individuals which informed participants' social identities and environmental concern (Yu et al., 2019). While these results highlight the importance of identity in examining EE for college students, the authors did not examine the role of development on the identity of their participants. My research addresses this through the framework of emerging adulthood theory, in which identity development plays a key role.

The studies above demonstrated that college EE can impart positive CTN outcomes, and that identity and CTN in undergraduates are linked. Taken together, they provide impetus to join

the understanding of college EE and CTN with the application of a developmental lens. To build from this research, and to more explicitly tie the developmental aspects of CTN theory to college learners, I apply the lens of emerging adulthood, discussed in more detail in the following sub-sub-section.

Defining Emerging Adulthood

The opportunity to explore experiences with CTN in college students can be informed by the emerging adulthood theory of development (Arnett, 2000). Arnett (2000) defines the emerging adult as an individual between 18 and 25 years of age, experiencing an extended period of greater independence. What is important to note is he asserts that “identity explorations become more prominent and serious in emerging adulthood” (Arnett, 2007, p. 24).

The crux of emerging adulthood theory is the lived experience of young people within the context of Western society. In particular, and relevant specifically to research around undergraduate college students, is the lengthening of higher education. Thus, for these individuals, commitment to long-term choices—such as marriage and parenthood—is delayed (Arnett, 2000). Subsequently, young people are presented with more opportunities to experiment with different roles and identities until reaching adulthood (Arnett, 2000).

During emerging adulthood, individuals examine possibilities for forming their adult identities and choose to reject or commit to them. Studies have validated this across multiple aspects of identity including political preference (M. Walker & Iverson, 2016), religious orientation (Stoppa & Lefkowitz, 2010), and gender and sexuality (Morgan, 2013). Left unexplored in the emerging adult literature is the potential for development of environmental identity, defined as “a belief that the environment is important to us and an important part of who we are” (S. Clayton, 2003, p. 46).

It is reasonable to assume that emerging adulthood interfaces with environmental identity, given its similarity to other social identities as described above, and in that it offers a sense of belonging to a group (Schultz & Tabanico, 2007). This would make emerging adulthood the ideal developmental lens through which to understand CTN in college students, as environmental identity is understood to be a core component of the CTN construct (Brügger et al., 2011; Schultz, 2001). Environmental identity is a determinant of activism-centered PEB (Schmitt et al., 2019), and even serves as a mediator between CTN and PEB (Mackay et al., 2021; Yu et al., 2019). Even more specific to my research, individuals' scores on the connectedness to nature scale (CNS) are positively associated with their scores on Clayton's environmental identity scale (Olivos et al., 2011). This confirms the convergence between identity and CTN, and reinforces the value in understanding CTN in relation to emerging adults.

The novel use of emerging adulthood to understand CTN in college students can provide continuity in understanding the developmental aspects of CTN formation, despite the fact that these populations are no longer in their formative stage. Such an approach avoids the binary categorization of adult and youth EE programming, and allows for nuance in exploring the specific experiences of undergraduate students with CTN. Having defined emerging adulthood and its inclusion in my conceptual framework, I address critiques of the emerging adulthood concept next.

Critiques

The principal criticism leveled at emerging adulthood is of its questionable universality. Côté (2014) argued that the seminal study did not account for the social class of participants. To them, this raised doubts that emerging adulthood applies across all social backgrounds and classes (Schwartz & Côte et al., 2005). In response, Arnett has since directly addressed the role

of class in follow up studies, where they have clarified that the theory is primarily demographic in origin, and stated that “although social class is important ... people in this age range can be understood as emerging adults across social classes” (2016, p. 233).

Additionally, the universality of the theory has been challenged more fundamentally by Hendry and Kloep, who argued that since Arnett classified “emerging adulthood as a developmental stage, there should be ‘something’ that develops during this time, and Arnett never clarifies what exactly that might be” (2010, p. 11). I argue that Arnett (2000) states very clearly that the stage is characterized by identity development, enabled by the demographic components of the theory.

Additional scholars have argued that the role of culture is underexplored within this framework, and that Arnett’s original theory is primarily applicable only within a United States/Western culture context (Galanaki & Leontopoulou, 2017; Nelson et al., 2004; Syed, 2016). As far as universality of the concept through a cultural lens, the full debate is outside the scope of my work. However, given that my research is bounded within a United States cultural context, I argue that the use of the theory is appropriate. Thus, emerging adulthood theory makes sense as a lens through which to understand CTN in college students.

Online Environmental Education and Technological Mediation of Nature

While it remains true that growth in online college enrollment preceded and informed this research (Altbach et al., 2009; Peppers, 2016), the COVID-19 pandemic greatly accelerated this growth of online educational modality across all levels of formal education (Amemado, 2020; Bao, 2020; C. Li & Lalani, 2020). The increasing reliance on, and occasional necessity for, distance education warrants a wider exploration of fostering CTN without time in nature.

Several studies have explored how technological mediation of nature experiences—ranging from non-interactive videos (Arendt & Matthes, 2016), to augmented reality (Koutromanos et al., 2018; Schneider & Schaal, 2018), to immersive virtual representation (Breves & Heber, 2019; Deringer & Hanley, 2021; Klein & Hilbig, 2018; Sneed et al., 2020)—can positively impact one or more aspects of CTN measurements. However, few studies exist that explicitly examine both college-level EE and digital mediation of nature collectively. As such, this is an opportune space to explore the experience of college learners and contribute to the understanding of CTN and emerging adults.

Exploring Online Environmental Education

According to foundational documents in the field, in the effective practice of EE, the learner should gain new understanding through which they are motivated to take action (United Nations Environment Programme, 1975, 1977). As The North American Association for Environmental Education (NAAEE) advocates, certain cognitive approaches to EE can bolster a program's efficacy in communicating information to inspire PEB (Oxarart & Monroe, 2016). Pertinent to this dissertation research, Wojcik et al. (2016) outlines the need to effectively leverage information technology in environmental education contexts, noting that:

“...with the advent of the Internet, the pace of global communication, scientific collaboration, and technological discovery has been permanently altered. While an increase in time spent online probably means people are spending less time experiencing the natural world, there can be a silver lining to using technology for communication” (p. 49).

Despite all of this, there exists a major gap in the literature surrounding the online delivery of effective, formal EE.

One of the most highly cited studies specifically focused on this area is well over a decade old as of this writing. In Aivazidis, Lazaridou, and Hellden's (2006) “A Comparison

Between a Traditional and an Online Environmental Educational Program,” the researchers compared the knowledge outcomes of an in-person class versus an online delivery model for a high school EE program. Results indicated that the students in the online program significantly increased their knowledge and environmental attitudes above those in the control group. The authors concluded that online delivery and information technology can indeed be vehicles for effective EE. The study comprised a quasi-experimental design with administration of pre- and post-tests to nonrandom groups. The outcomes for the course in question focused specifically on information transfer. As such, the researchers’ primary interest was in the efficacy of computer assisted instruction, or automated feedback on tasks and practice for students (Fletcher-Flinn & Gravatt, 1995). Thus, the success of the intervention was in the routine drill-and-practice aspects of education. However, to foster environmental attitudes and behaviors, this needs to be contextualized within the widely agreed-upon goals of EE (such as NAAEE’s definition of the practice) as defined by the Tbilisi Declaration (United Nations Environment Programme, 1977). It has been demonstrated that information transfer does not equate simply to increased PEB (Guckian et al., 2017; Kollmuss & Agyeman, 2002; Vining & Ebreo, 1990). Additionally, environmental knowledge is understood to be only one aspect of CTN (Schultz & Kaiser, 2012). Since the affective and behavioral components of CTN are not addressed in this study, the online delivery of *effective* EE remains starkly unexplored.

One of the few papers addressing this gap explored online EE for college students (J.M. Wright, 2008). This author explored the capability of online college EE to impart environmental literacy outcomes. Environmental literacy outcomes for EE—with a focus not just on knowledge gain but behavioral transformation (Golley, 1998; McBride et al., 2013; Moseley, 2000)—are an intermediary between pure cognitive understanding outcomes and full CTN outcomes, which

include an affective component. Thus, this study moves closer towards developing a picture of online EE for CTN. Wright (2008) served as researcher and instructor of both in-person and web-based sections of an introductory environmental science course, used a pre- and post-test survey comprising the Environmental Literacy Instrument (ELI) to assess student knowledge and opinions. They generally concluded that “students from the in-class group had significantly improved their environmental knowledge and expressed more environmentally friendly opinions compared with students from the Web-based group” (Wright, 2008, p. 33). However, because of the complexity of results, this statement does not provide a complete description. Firstly, it was shown that students in both groups raised their ELI scores, illustrating that the online instruction was, in fact, effective at least in terms of literacy. Secondly, the web-based group scored significantly higher on the pre-test than the in-person group, while there was *no* significant difference between groups on the post-test. Thus, one explanation is that the *change* in score for the web-based group would be lower if the in-person group had “further to go” up the ELI scale. Consequently, this study provides further impetus to explore CTN in online learning environments.

Relative to environmental science, online education has been shown as effective versus in-person learning, with equal or superior outcomes in terms of knowledge transfer and skill acquisition (Azeiteiro & Bacelar-Nicolau, 2016; Hanley et al., 2019; Paul & Jefferson, 2019), as well as student self-efficacy (Ismail et al., 2019). Specific technologies such as virtual labs and fieldwork bolster these outcomes (Garner & Gallo, 2005; Rowe et al., 2017), and as such are recommended in practice (Granshaw & Duggan-Haas, 2012; Joshi et al., 2020). With the literature illustrating how effective online environmental science can be done, now is an opportune time to evaluate online environmental learning for CTN outcomes. In general, there

continues to be serious academic debate about the overall efficacy of online education (Hart et al., 2019; Nguyen, 2015; Protopsaltis & Baum, 2019), the full scope of which is outside the scope of this research. However, the COVID-19 pandemic has fore-fronted the need to understand EE in the context of online delivery formats (see Quay et al., 2020). Rybakova et al. (2021) state that the “coronavirus pandemic ... brought the digital surge in the system of education, including ... sustainable education. All these innovations might stay after the pandemic and help ... education to evolve and to embrace more novel trends and technologies” (p. 1). With these unexpected and expected trends and changes in technology use in college contexts, the following section outlines research on the impacts of technological mediation of nature.

Technological Mediation of Nature

While less of a focus than the delivery method, the content of the course under study is nevertheless central to my research question. From the very start of theoretical development, Schultz (2000) advised that CTN outcomes could not be achieved when “nature [is] taught abstractly in a classroom” (p. 403), instead suggesting practices such as class trips to parks or forests. In a follow-up paper, Schultz, along with Liefländer, Fröhlich, and Bogner, demonstrated that while effective EE strengthens CTN, “environmental education programmes that focus on the increase of connectedness *to* nature should enable positive experiences *in* nature [emphasis mine]” (2013, p. 380). Thus, there is a need to broadly explore the efficacy of technology in fostering CTN.

Yet, as environmental professionals grapple with increasing youth screen-time (Edwards & B. M. Larson, 2020; L. R. Larson & Szczytko et al., 2019)—or “videophilia” (Pergams & Zaradic, 2006)—there is an increasing interest in understanding the impact of different digital

media in relation to CTN. Studies on the digital mediation of nature include research on nature documentaries (Arendt & Matthes, 2016; Bagust, 2008) and interactive media like virtual (Ahn et al., 2016; Deringer & Hanley, 2021; Klein & Hilbig, 2018) and augmented reality (Schneider & Schaal, 2018). In short, these studies have so far shown digital representation of nature to be effective in increasing specific aspects of CTN.

In some studies, exposure to or interaction with digital media positively affected PEB in participants (Arendt & Matthes, 2016; Breves & Heber, 2019; Zelenski et al., 2015). A recent study by Deringer and Hanley (2021) assessed the impact of virtual nature experiences on PEB. The willingness of participants to engage in pro-environmental political action (writing a letter to their representative) was measured against their experiences either on a short hike or a ten-minute virtual representation of the same hike. When compared to a control group, the researchers found that both participants in the actual and virtual hikes were more likely to engage in PEB, leading them to conclude that “virtual reality of nature may be as effective as actual nature in promoting [PEB]” (Deringer & Hanley, 2021, p. 1). Likewise, in alignment with more broad research into virtual reality (Kleinsmith et al., 2015; Piumsomboon et al., 2017; Shin, 2018), some of these studies have shown success in imparting affective responses, such as empathic perspective-taking (Ahn et al., 2016) and feelings of commitment (Breves & Heber, 2019).

There do exist studies or reviews, in which authors conclude that digital mediation has limited or no effect on CTN (M. D. Smith et al., 2018; Sneed et al., 2020; Soliman et al., 2017). In these extant cases, the authors are, in fact, either misinterpreting or discounting their results in relation to the theoretical understanding of the CTN construct. CTN is understood to comprise cognitive, behavioral, and affective domains (Ives & Giusti et al., 2017; Mayer & Frantz, 2004;

Schultz & Kaiser, 2012). If digital representation of nature is capable of imparting new information (Lu & Liu, 2015), effecting behavior change (Deringer & Hanley, 2021), and eliciting emotional response (Ahn et al., 2016), then the effective use of information technology can indeed impart holistic CTN outcomes. Furthermore, some such interventions are readily integrated into existing online learning platforms (Bronack, 2011), thus demonstrating an opportunity to incorporate “virtual” nature into investigations of online EE for CTN.

Chapter Summary

This chapter described a novel conceptual framework wherein EE for CTN can be explored and analyzed through the lens of emerging adulthood. Further, it presented the opportunity to apply these concepts to online, technology-enhanced college education. Following from the framework presented in this literature review, Chapter III outlines and describes the methodology used for answering my research questions.

CHAPTER III: METHODOLOGY

Introduction

The goal of this research is to explore connection to nature (CTN) among participants in an online, college-level environmental education focused ecology course, particularly for emerging adult populations. A constructivist approach was taken to best represent participant experience and guide pre-experimental research. This dissertation research focuses on answering the following questions:

1. How do college students enrolled in an online ecology course perceive and experience their connection to nature?
2. What is the student experience with the digital mediation of nature in the course?
3. How is student experience of connection to nature related to emerging adulthood, if at all?

I begin this methodology chapter by explaining the rationale for a mixed methods design to more fully represent the participant experience. Next, I describe the study site and participants, followed by a description of the methods used to collect and analyze both quantitative and qualitative data, ending with a description of the process used to integrate the two. Finally, I address the aspects of quality and rigor in this study.

Study Design

To develop an answer to my research questions, this research was conducted as an exploration of an online ecology course for undergraduate students at a private, New England, liberal arts university during the Fall 2020 semester. My intent in this research was to explore the student experience with this online class, particularly related to CTN, technology-mediated nature, and emerging adulthood. As one of the goals was to represent participant experiences,

and not generalizability, this research was approached through the constructivist paradigm (Lincoln & Guba, 2013). Such a paradigmatic approach is necessary and appropriate for the goal of generating understanding, as Guba and Lincoln stated: “The aim of inquiry is understanding and reconstruction of the constructions that people (including the inquirer) initially hold, aiming towards consensus but still open to new interpretations as information and sophistication improve” (1994, p. 113).

Constructivism is a qualitative research paradigm that rests on two specific ontological and epistemological claims. Ontologically, constructivism adheres to the worldview that there exists multiple realities, each constructed by participants and the researchers themselves (Lincoln & Guba 2005). As Lee (2012) put it, individuals’ “realities [within the constructivist paradigm] are constructed, and as constructions are multiple, so are realities” (p. 407). Epistemologically, constructivism rests on the assumption that understanding arises through co-creation between both researchers and participants (Lincoln & Guba, 2013). Thus, Guba and Lincoln (1994) described the epistemology of the paradigm as both subjectivist and transactional, stating that “the investigator and the object of investigation are assumed to be interactively linked so that the “findings” are *literally created* as the investigation proceeds” (p. 111).

One major critique leveled against constructivism—in both research and education—is that the prioritization of identity leads constructivists to ignore or conflate the broader cultural milieu in which the participants are situated. Bader (2001) argued that “constructivists have trouble distinguishing between cultures and identities and—at least their most radical proponents—dissolve cultures into discourses about identity” (p. 206). Additionally, some claim that “constructivists’ focus on explaining ... *change* has also meant that there are far fewer works that examine or seek to explain ethnic structures or the *stability* of ... identities” (Goode &

Stroup, 2015). Thus, the contention here is that the understandings of identity gleaned through constructivism often fail to provide actionable results within a broader, sociocultural context.

The critique that constructivism collapses culture into identity has implications for this research, specifically around the role of identity formation in the theory of emerging adulthood. Arnett's original research (2000) and much follow-up work (2015) occurred in the context of college students in the United States. Thus, critics argue that the role of culture is underexplored within this framework, and that the theory is primarily applicable only within a United States/Western culture context (Galanaki & Leontopoulou, 2017; Nelson et al., 2004; Syed, 2016). Arnett (2016) did not seek to deny the interplay between culture and identity formation in emerging adulthood, but instead argues that there are multiple paths into emerging adulthood. By way of comparison to the developmental theory of adolescence, Arnett (2016) stated that it remains "conceptually valuable to recognize adolescence as a life stage that exists in nearly all cultures, in some form" (p. 233). Thus, the culture in question—that of college students in the United States—is embedded within my theoretical framework. Further, while this research explores participant identity development through a constructivist lens, the research and scholarship implications arising from my results can be interpreted within this cultural perspective.

My study was pre-experimental, employing a single-group before and after design (Jimenez-Buedo, 2018). A pre-experimental study was necessary given the unique circumstances surrounding the course in question; namely, that it had been suddenly and temporarily moved to an online format due to COVID-19, and that no equivalent section of the course ran concurrently during the study period, online or in-person.

A single-group before and after design was appropriate as it offered better evidence on intervention effects than one-shot case studies or static group comparison designs (Robson et al., 2001). While some researchers argue that such single-group before and after study designs are the “traditional gold standard to evaluate a program or an intervention effect” (Little et al., 2020, p. 175), others argue that such an approach is flawed since it is assumed that respondents will “evaluate themselves against the same reference value at each time point” (Nieuwkerk & Sprangers, 2009, p. 1623). Specific to education, Spurlock (2018) posited that single-group before and after designs in education research are overutilized and poorly interpreted, leading to a glut of misleading conclusions, which negatively impact practice. Spurlock (2018) argued that “the only real solution to the challenges presented by single-group, pre- and post-test studies is to stop conducting these studies” (p. 71). This is particularly true if many researchers approach a single-group before and after study as if it were an experimental design, rather than more akin to an observational one (Jimenez-Buedo, 2018). However, Spurlock appeared to conflate design with methodology, by inherently assuming a strictly quantitative, post-positivist point of view. In fact, as generalizability was not a research goal, quantitative data is only a part of my study. I demonstrate, then, that my research makes a necessary and urgent contribution to broader understanding of CTN in online EE.

Methodological Framework

My research approach was mixed methods in nature, collecting and integrating both quantitative and qualitative measures to examine the CTN experience of students in the course through the lens of emerging adulthood. My design for this approach was a convergent parallel design, wherein the collected data was merged to answer the research question (Creswell, 2014). Both qualitative and quantitative data were collected concurrently throughout the study period

and weighted equally during comparison and integration in order to determine if and how results from the two data sets supported and explained each other (Creswell, 2012).

Mixed methods were appropriate because the methodology rests upon the assumption that both quantitative and qualitative data will provide a greater understanding of the research problem than either alone (Creswell, 2014; Onwuegbuzie & Leech, 2005). My research goal was to build understanding of the participant experience, while also assessing the outcomes of the program vis-à-vis CTN. Yet these two components—EE *experience* and EE *assessment*—are consistently approached with different methods. A recent literature review by Ardoin et al. (2018) found that 82% of papers assessing EE *outcomes* used quantitative methods. Alternatively, Rickinson et al. (2010) found that there was a greater mix of quantitative, qualitative, and mixed methods approaches to research on the EE student *experience*. As my research questions pertain primarily to student experience with the course, and secondarily pertain to CTN outcomes, it was appropriate for me to use mixed methods

A mixed methods approach addressed concerns of my study design. Marsden and Torgerson (2012) discovered that single-group, pre- and post-test studies in education consistently demonstrated threats to validity—most glaringly, regression to the mean (RTM) effects. My own previous, unpublished research on CTN in college students exhibited the same RTM effect: small sample size leading to higher variance in the pre-test scores closing around the mean in post-test. While this limitation can be somewhat addressed through analysis of covariance (Clifton & Clifton, 2019), Barnett et al. suggested the effect is best addressed at the study design phase (2005). Although the authors were speaking from a purely quantitative perspective, taking a mixed methods approach indeed addresses the inherent quantitative limitations of a small, pre-experimental study.

A convergent parallel design for my mixed methods study was likewise appropriate and necessary. As my research design was pre-experimental, neither quantitative nor qualitative methods were used sequentially to inform the other. Rather, both datasets were collected concurrently within the study period. Additionally, with no rationale for weighting either dataset more heavily (Creswell & Plano Clark, 2017), an embedded design was precluded (Creswell, 2017), necessitating a convergent parallel approach. The collection and synthesis of quantitative and qualitative data allowed me to investigate personal stories and probe the perspectives of participants (Creswell, 2014) as emerging adults. Further, this approach simultaneously contributed to a nascent (and growing) body of literature examining the implications of online EE, technologically-mediated nature experiences, and emerging adulthood.

Quantitative Data

The purpose of this research was to increase understanding of college students' and emerging adults' experiences with online education for CTN, and to build upon existing research related to CTN outcomes and education. The measurement of the CTN construct has been considerably operationalized and studied using quantitative metrics, specifically in the form of psychological assessment scales (see Mayer & Frantz, 2004; Nisbet et al., 2008; Schultz, 2002). Evaluations of EE interventions on CTN utilize statistical analysis of participant measurements on these scales extensively (e.g., Lanckenau, 2018; Schneider & Schaal, 2018). Thus, to integrate my work with the foundational understandings of CTN, quantitative measures of the construct were necessary.

The need for other quantitative data informed my methods, beyond CTN scales. Participants provided data on demographics, which are necessarily statistical in nature (Schuele, 2010). I assessed participant closeness with themes of emerging adulthood through a subscale of

the Inventory of Dimensions of Emerging Adulthood (IDEA) (Reifman et al., 2007), which scholars have shown to be a valid measurement tool for this purpose (Hill et al., 2015; D. C. Smith et al., 2014). Finally, quantitative surveys comprise a novel, common instrument developed to assess 21st century environmental education outcomes (EE21) across a range of EE programming (Powell et al., 2019). I employed modified portions of EE21 to assess outcomes of the course under study. Thus, quantitative methods are broadly indicated in my study.

Qualitative Data

There are several reasons why pursuing qualitative data was necessary for my study. Primarily, qualitative data speaks directly to my research goal of understanding the participant experience. Rich qualitative descriptions from participants allowed me to learn about the participant experience from their own point of view (Rossman & Rallis, 2003; Strauss & Corbin, 1998).

Pertaining to the assessment of EE outcomes, there is ongoing debate as to the universality of quantitative assessments. On one hand, is the argument that outcomes can be broadly assessed quantitatively (Powell et al., 2019). On the other hand, is the argument that standardized, quantitative measures are unable to account for socio-cultural context (Briggs et al., 2019), and thus may not provide an accurate account. As an example, a study by Kopnina (2011) found that by combining qualitative research with an established quantitative scale (the New Environmental Paradigm), a more culturally-responsive assessment of outcomes could be created. It is also worth noting a comparable recent CTN study, wherein the authors determined that it is necessary to obtain qualitative data to develop a CTN measurement more responsive to adolescents (Tseng & Wang, 2020). Based on these examples, the collection and analysis of qualitative data was warranted in order to more fully explain quantitative results.

Site and Participant Selection

The campus of the private, New England university is essential to my research. As an educator at the university and founder of the university Arboretum, I have a vested interest in understanding what educational practices are most beneficial to students, the wider community, and for the Arboretum. The space has served in the past as a focal point for the outdoor experiences in my courses, both online and in-person. As a conservation project, the Arboretum was founded on its ability to provide educational opportunities to the community as a whole, and the continued integration of this physical space with online learning has taken on a new urgency and importance.

Participants comprised 11 of 14 students enrolled in a section of BIO-315: Ecological Principles (Appendix A). One of the primary objectives of the course is to foster connectedness by transforming students' awareness of their role within the biosphere. This is done alongside and through a survey of the field of ecology. The course is structured so that students gain an introduction to a topic through readings—textbook and peer-reviewed articles—and lectures. This is followed by a field visit to the Arboretum and outdoor classroom. Here, students participate in ongoing studies related to each topic. These include camera trap surveys, coverboard plots for salamanders, invasive species identification and surveys, vegetation monitoring (transects and quadrats to classify groundcover), forest dynamics monitoring through tree plots, and environmental monitoring (climate, soil, and water metrics). Students choose one topic for which to create a group presentation but reflect on each topic in an ongoing journal during and after their visit to the space. These journal assignments ask students to place themselves into the ecological functioning of both the Arboretum and the world in general.

An example journal prompt on the topic of “The Organism” is:

After observing the behavior of one or more organisms in the Arboretum, choose one organism and one of its behaviors. What do you think the stimulus for that behavior was? In what ways would your own response be different? In what ways would it be similar? Compare and predict your responses if you were both presented with these same stimuli: hunger, a cell phone ringing, and a member of the same species approaching.

Through this type of journaling, students augment their knowledge of ecological functioning with reflective self-attention (Frantz et al., 2005; Richardson & Sheffield, 2015) and perspective-taking (Schultz, 2000; G. J. Walker & Chapman, 2003), both of which are known antecedents to and predictors of high CTN measures. Based on this rationale, it is reasonable to assume that the course has the potential to positively influence CTN in students. Additionally, The North American Association for Environmental Education (NAAEE) advises that assessing this course for CTN outcomes is appropriate, as it “encourages [students] to reflect on their relationship with nature” (Salazar, Kunkle, & Monroe, 2020, p. 4).

However, with the compulsory shift to online delivery, students in the course did not have the opportunity to make class visits to the Arboretum to participate in research and spend time in observation. This did not preclude individual, in-person field visits. It did, however, offer the opportunity to explore the students’ experiences with various technological mediations of the space combined with online content delivery for the course through the lens of CTN. During the course, students interacted with the following digital representations of the Arboretum space:

- 360-degree photography and audio recordings: at two points during the course, once during the second week and once during the 11th week, students virtually visited study plots and observation sites using 360-degree photography paired with audio recordings of the sites. Spherical imagery was captured of five locations in the Arboretum using a Ricoh Theta S digital camera; five minutes of

audio was recorded concurrently at each location using a TASCAM DR-05X stereo recorder. The media was recorded within several days of when students accessed it during the related modules to reflect characteristics of the space 10 weeks apart. The combined media was hosted on the website Kuula, where students were able to virtually move through the space from site to site. After each of the two visits, students completed a one- to two-page journal reflection on their observations, connections to theory, and their own personal feelings on the experience. This type of interaction can be considered generally within the context of virtual field trips (Kolås et al., 2020; Lacina, 2004; Stevenson, 2001). Specifically, within environmental science and ecology settings, these experiences have been demonstrated effective in increasing scientific understanding (Puhek et al., 2012; Ramasundaram et al., 2005) and environmental attitudes (Tudor et al., 2018), and students were generally receptive to them (Fung et al., 2019). The photography and audio were updated as the course progressed throughout the fall semester. My own previous, unpublished research showed no statistical difference in CTN measures (using the CNS, in this case) pre- and post-test after students in a different course at the university made similar, repeat virtual observation visits to the Arboretum. However, the course itself presented major differences, primarily in that it was a general education environmental studies course that met in-person. The coupled ecology curriculum and wholesale move to online delivery warranted further exploration of the course under study.

- Cellular camera traps: as part of the module on organism ecology during week four of the course, cellular traps allowed wildlife photography data to be pushed

to students in real time. Two Spartan GoCam Blackout 4G camera traps were placed in the Arboretum. As they were captured, images were automatically uploaded to a Google Drive folder which students had access to. Students also had the option to have images emailed directly to them as they were captured; one student opted for this. During the week that this “field” module ran, any images of wildlife that were captured were added to an image carousel linked on the homepage of the course learning environment, to facilitate easier browsing of wildlife photographs. At the conclusion of the week, students completed a one- to two-page journal reflecting on their observations, connections to theory, and their own personal feelings on the experience. Studies have promoted the use of camera trapping as a virtual fieldwork method due to the tool’s accessibility (Karlín & De La Paz, 2015) and ability to foster engagement in courses through enhanced motivation and enjoyment (Coccoli, 2020; Edelman & Edelman, 2017).

- Drone imagery: during week seven, as a part of the module on community ecology, drone videography was used to investigate community composition of the Arboretum. A DJI Mavic Air 2 was used to capture flyover video of the Arboretum and surrounding environment the week prior, in order to reflect the conditions of the space as closely as possible during the module. Fifteen minutes of video were captured, which were edited down into 10, over which I added commentary on what was onscreen. The video was then uploaded to YouTube and embedded in the homepage of the course learning environment. After viewing, students completed a one- to two-page journal reflecting on their observations, connections to theory, and their own personal feelings on the

experience. The literature shows that the use of drone imaging in environmental education contexts imparts engagement through increased motivation and enjoyment (Jahn et al., 2010; Palaigeorgiou et al., 2017) and increases environmental knowledge and engagement (Ritter et al., 2019).

- Real-time and data-logged environmental readings: during week 10, in the module on biogeochemical cycles, students accessed the Arboretum environmental monitoring network. Information consisted of data logged by an Onset HOBO RX-3000 4G remote monitoring station. The station was fed by sensors that record air temperature, relative humidity, barometric pressure, rainfall, soil temperature, and soil moisture within a forest research plot. Water level and water temperature were also transmitted from a wetland monitoring station in Sudden Pitch Brook, which flows through the Arboretum. This data was accessible in real-time via a graphical dashboard, as well as direct access to the network station, which students were granted. Both of these were linked on the homepage of the online learning environment. Students accessed and viewed the readings during the week in which the module ran. At the conclusion of the week, students completed a one- to two-page journal reflecting on their observations, connections to theory, and their own personal feelings on the experience. Participation in environmental and weather monitoring has been shown to positively impact environmental attitudes (Chase & Levine, 2018) and engage students with environmental issues (Jormanainen et al., 2018; R. Walker et al., 2017).

Participants were not “selected,” but rather a convenience sample of students in the course. By using a nonprobability sampling method, which makes no attempt to represent a larger population outside of students in the course, results from my study are necessarily limited. However, convenience sampling is able to provide useful information for answering questions in educational research (Creswell, 2012). While there exist criticisms that convenience sampling may represent a “lazy” approach to research (Denscombe, 2014), it is in fact an appropriate strategy when researcher resources are limited and results will not be generalized to a larger population (Creswell, 2012; Etikan et al., 2016).

Some general characteristics of the sample were anticipated. According to institutional research data, students at the university are primarily white ($\approx 75\%$) and 18–21 years of age. As the course is a requirement for the university’s environmental science degree program and a specific concentration in the school’s biology degree program, student make-up was also expected to be majority female-identifying ($\approx 70\%$).

Participants were predicted to have higher CTN measures to begin with than their peers, as the course is required for environmental science majors. Students in this program were expected to hold higher levels of environmental concern (Lang, 2011; Ridener, 1999) and to place more value in the Arboretum space (Sherburn & Devlin, 2004). Non-science majors who were taking the course to fulfill a general education credit would have taken at least one environmental science course prior to BIO-315, which is likely to have positively impacted their attitudes towards environmental issues (Gerstenberger et al., 2004; Hess-Quimbata & Pavel, 1996). However, a study by McMillan, T. Wright, and Beazley (2004) found that effective college EE could positively impact environmental values even in undergraduates expressing higher pre-existing levels. Thus—as CTN is a determinant of environmental values (Colding et

al., 2020; Häyriinen & Pynnönen, 2020; Restall & Conrad, 2015)—it was reasonable to assume by transitive property that CTN scores could still be positively affected in my study, despite a probable, relatively-high measurement in my sample pre-course.

Research Protocol

The research period was the 2020 fall semester of the university's academic year (September 9–December 18).

Methods for Data Collection

This mixed method research explored CTN among young adult college students enrolled in a technologically-mediated, introductory ecology course, which had emphasis placed on student-centered, experiential, and interdisciplinary elements of environmental education pedagogy. The following sections outline the methods selected for this constructivist research approach, which included: surveys, semi-structured interviews, and student artifacts (Table 1). Each data collection method is discussed in more detail, as well as the general strengths and weaknesses of each.

Quantitative Data

Connection to nature (CTN) research has often relied on pre- and post-test methods (Häyriinen & Pynnönen, 2020). While there exists arguments that post-retrospective methods are preferable in education research due to lower resource use and increased accuracy (Lam & Bengo, 2003; Pratt et al., 2000), it has also been argued that a robust, mixed methods pre-post design should be implemented initially to thoroughly evaluate future application of post-retrospective assessments (Geldhof et al., 2018).

Quantitative data was collected via pre- and post-course surveys (Appendices B & C). Surveys were hosted on Qualtrics, and a link was emailed to students as well as posted on the

homepage of the course learning environment. Eleven participants completed the pre-course survey in week one of the course. Six participants completed the post-course survey in week 16 of the course.

Surveys were the most appropriate strategy for quantitative data collection in this study, as they provide information to evaluate educational programs and can help identify important beliefs and attitudes in participants (Creswell, 2012). My research area is highly topical, and surveys provide empirical input from participants that is “up-to-date” with the current era (Denscombe, 2014). The surveys in this study were designed to collect data on one of five “dimensions:” CTN measures, demographics, identity, course experience, and connection to the Arboretum. A description of each dimension follows.

CTN Measures. In EE research and assessment, CTN outcomes are routinely assessed using one or more psychological scales (Frantz & Mayer, 2014; Lankenau, 2018; Salazar, Kunkle, & Monroe, 2020). Tam (2013a) demonstrated that despite differences in extant scales, the same underlying construct is measured by all of them. That is to say, the choice of which scale to use rests on other factors, such as age of the study population and intensity of the experience being studied (Salazar, Kunkle, & Monroe, 2020). Additionally, as I sought to explore the student experience rather than explain effects, a more robust dataset was acquired through the use of multiple scales. This research used two different scales, one single-item and one multiple-item. The assessment of complex constructs—such as CTN—benefits from the depth enabled by use of multiple-item scales (Loo, 2002). However, Gardner et al. (1998) state that when both a single- and multiple-item psychological scale are markers of the same construct, neither is empirically better. Participant responses to these scales were collected on both the pre-course and post-course surveys.

The first scale I employed was the inclusion of nature in self scale (INS), which was selected for multiple reasons. Because the INS is a single-item scale, it provides the benefits of being easy to administer while also being a reliable measurement tool (Schultz, 2002). Perhaps more saliently, the INS has been utilized in studies with college students. For example, a 2016 study measured the effects of virtual environments on college students' INS scores, finding that aspects of the experience were positively correlated with the measure (Ahn et al., 2016). While no studies have investigated INS in college students alongside a developmental lens, they nevertheless demonstrate the utility of the scale in studies with college populations.

Building on technological mediation of nature research, a 2018 study by Schneider and Schall investigated the impacts of EE on CTN in youth by pairing the INS with the disposition to connect with nature scale (DCN). The researchers' rationale was that the DCN augments the INS as it is intellectually easier, thus making it suitable for younger populations by avoiding deep introspection. Thus, to address perceived shortcomings of the INS as a single-item scale (see Mayer & Frantz, 2004), relate my work to extant literature, and allow a more robust exploration of student experience, I also chose to administer a second test to participants. Instead of the DCN, however, I administered the connectedness to nature scale (CNS), which is appropriate for several reasons. A 14-item scale, CNS was developed for use with adults, and thus was applicable in my study population. However, as studies indicated (Frantz & Mayer, 2014; Mayer & Frantz, 2004; Zylstra et al., 2014), the concepts measured by the CNS remain relatively stable over time. Thus, the concurrent use of these two scales served to alleviate any shortcomings of either. Unlike the DCN, the CNS does not relate to past behavior; however, the intellectual ease of the DCN for younger populations was not necessarily warranted in my study. The authors of the DCN found it convergent specifically with the CNS (Brügger et al., 2011). Finally, the CNS

has been demonstrated as convergent with the Environmental Identity Scale (EID) (S. Clayton, 2003), and thus a reliable assessment of environmental identity. Therefore, the CNS was appropriate for addressing my research questions about emerging adulthood, student identity, and learning experiences in the course under study.

Demographics. The surveys collected data on participant age, gender identity, racial and ethnic identity, and academic major. These measures were based partly on the EE21 survey, designed to be a cross-cutting tool for assessing outcomes of EE programming (Powell et al., 2019). However, the EE21 is designed for adolescent demographics—specified by the authors as 10 to 14 years of age—and uses an expanded binary measure with a third category to capture sex and gender (boy, girl, transgender, or other). I modified this question to be more intentional about gender identity (Fraser, 2018), as gender exploration is an empirical aspect of emerging adulthood (Morgan, 2013).

Identity. The surveys collected data that allowed for investigation of participant identity. In the pre-course survey, this data came from a subscale of the Inventory of the Dimensions of Emerging Adulthood (IDEA), a tool designed to assess identification with the themes of emerging adulthood theory (Reifman et al., 2007). The IDEA is a 31-item instrument that addresses six dimensions of emerging adulthood. Since I was interested in correlating the identity-exploration dimension of emerging adulthood with environmental identity (S. Clayton, 2003)—as this construct is tightly linked with CTN (Schmitt et al., 2019)—I opted to administer a subscale of the IDEA. The subscale consisted of seven Likert-type questions which measure the state of the participants' identity exploration. As it is specifically called out as a “subscale,” results were averaged and analyzed as a Likert-scale.

Likert-type items grouped into a “survey scale,” from which a total score is calculated, are often used in education research (Croasmun & Ostrom, 2011; Sullivan & Artino, 2013). This practice is recommended when researchers are unlikely to be able to fully capture the concepts being assessed using a single item (Rickards et al., 2012). Despite the small sample size in this study—which precluded the use of parametric tests—research has shown that analysis of Likert scale data is still capable of providing interpretable information even under situations in which normalcy is not assessed (Norman, 2010).

Course Experience. Data on participant experience with online learning was collected in the pre-course survey. Participants indicated the number of online classes they had taken prior to the one under study. They also used a 10-point Likert-type question to indicate their general experience with online learning. This question is adapted from the EE21 assessment of post-program enjoyment (Powell et al., 2019) that was included in the post-course survey, during which time participants rated their experience with this specific course. Multiple item Likert scales such as EE21 have demonstrated efficacy in understanding student enjoyment in online contexts (Hoover, 2017; S. L. Walker & Fraser, 2005).

Connection to University Arboretum. The literature shows a long history of “place” and its role in EE (Ardoin, 2006; Kudryavtsev et al., 2012; R. Wells & Zeece, 2007). Because place can be correlated to the three components of CTN—knowledge (Sobel, 2004), behavior (Hausmann et al., 2016), and emotion (Bertling, 2015)—some have argued that “place” is more appropriate than “nature” in CTN (Beery et al., 2015; Beery & Wolf-Watz, 2014). While my study does not directly address the frameworks around sense of place in EE, it nonetheless presents an opportunity to explore student experiences with a particular place that is central to the course.

During the pre-course survey, participants were asked to indicate how many times they have visited the Arboretum. To avoid missing data, the question was an ordinal measurement with five categories: never, less than once a month, once or twice a month, about once a week, and several times a week.

During the post-course survey, participants provided place data through a three Likert-type item question. This question was adapted from EE21 items designed to assess place connection outcomes (Powell et al., 2019). While the first two items were presented with only slight modification as advised by the authors (i.e., changing the ambiguous phrase “place” to “Arboretum”), the third item was more heavily modified. This item asked participants about their likelihood of revisiting the place under assessment. This was determined to be unclear in the context of this study, as participants did not physically visit the Arboretum. Instead, the question assessed participants’ likelihood of visiting in general. Given these modifications and the fact that it consists of only three items, this question was not analyzed as Likert-scale data, and each Likert-type item was analyzed separately. Having outlined my survey design and quantitative tools, the following section describes the qualitative methods used in this mixed methods research.

Qualitative Data

Journals. During the study period, participants completed five reflective journals, which were analyzed qualitatively using in vivo coding and thematic analysis (Bowen, 2009). The analysis of student journals for assessment of learning outcomes in higher education is particularly useful, as these documents provide meaningful feedback (Gulwadi, 2009; YuekMing & Manaf, 2014) from a student perspective (Wagner, 1999). It has also been shown that in science education, students’ reflective journals capture information about emotion (Avci &

Karaca, 2012), which is central to understanding CTN experiences of participants. Analysis of participant journals helped to build a better understanding of the research questions through textual data (Creswell, 2012), which was retrospective to course content modules and experiences (Denscombe, 2014). Data from journals presented the disadvantage of having been filtered through the biases of the participant (Denscombe, 2014). However, analysis of reflective journals provided a rich description of students' experiences (Bashan & Holsblat, 2017), and such analyses have been demonstrated to add validity to interview data in educational research (Hansen, 1995; Oliver-Hoyo & Allen, 2006), which was also collected.

Journals were assigned to participants at five points throughout the 15-week study period: in weeks two, four, seven, 10, and 1. In one to two pages, participants responded to a prompt relating to course content and a "field" experience, which included interactions with virtual tours of the Arboretum, camera trap imagery, drone imagery, and environmental monitoring data. Entries were written electronically and submitted through the course learning environment. A total of 42 journal entries were received during the course study period. Entries were automatically checked for originality by Turnitin in an effort to ensure quality and rigor in the research. As the journals were expected to be wholly personal and reflective (i.e., not based on a synthesis of literature), any entries with a similarity rating of over 20% were planned to be excluded from analysis. No journal entries reached this threshold. In addition to journals, interview data was also used to generate qualitative findings, the design for which is described next.

Semi-Structured Interviews. Semi structured interviews were also used to collect qualitative data because my research was a novel inquiry into online EE and CTN, and as such, required the detailed information that interviews were capable of supplying from each individual

participant (Denscombe, 2014). Interviews were semi-structured in format (Appendix D). Structured interviews were not warranted, as my quantitative methods already offer tight control over responses (Creswell, 2017), which freed me to gather open-ended responses in my qualitative data collection (Creswell, 2012; Denscombe, 2014). At the other end of the spectrum, *unstructured* interviews would cede my ability to focus responses on addressing my research questions (Brinkmann, 2014). Additionally, it has been found that when conducting interviews remotely, interview time is often decreased, and respondent requests for clarification is often increased (Irvine et al., 2013). This demonstrates the benefits of a semi-structured interview for “staying on task.” Semi-structured interviewing was therefore a necessary and appropriate format.

The intent of the interviews was to facilitate exploration of student experiences with the course vis-à-vis online delivery and digital mediation of nature, in addition to gathering information for comparison to quantitative data on identity as it pertains to emerging adulthood. Studies on undergraduate course outcomes (Magnussen & Amundson, 2003; Reynders et al., 2020) have demonstrated that interviewing is an appropriate strategy for comparing stated outcomes with the actual student experience. McMillan, T. Wright, and Beazley (2004) paired interviews with pre- and post-course surveys to test outcomes of an undergraduate EE course. The authors found that the interviews provided a richly detailed source of information that helped explain survey results and confirmed that the course positively impacted environmental values. Lastly, interviewing has been shown to be a valuable strategy in developing understanding of undergraduate student experiences with online learning (Plews, 2017; Sato & Haegele, 2018; Tanner et al., 2019). Interviewing, therefore, was a necessary and appropriate approach to qualitative data collection in my study.

Semi-structured interviews were conducted within two weeks of the end of the course, as I sought a retrospective from participants on the total course experience to augment data gathered from journals throughout the study period. Due to the small sample size in my study, one-on-one interviews with all participants were necessary and appropriate. This ensured that each participant was afforded equal time to share their experience (Creswell, 2012). Thus, it was reasonable to rely on information gathered from the small number of participants (Denscombe, 2014). Furthermore—as discussed below—due to the impositions of the COVID-19 pandemic and the online delivery of the course, interviews were conducted remotely via Zoom. Although group interviewing is not necessarily precluded by this method (Janghorban et al., 2014), my research focus on the individual student experience would not have benefitted from the social dynamics of a group interview (Boateng, 2012).

Four weeks prior to the end of the course, participants were invited to interview and identify a date and time convenient for them within the remaining study period. Due to the online nature of the course, geographic distribution of participants, and the COVID-19 pandemic, interviews were conducted remotely via Zoom. While studies have shown that videoconference interviews lack the richness of information provided by in-person interviews (D. R. Johnson et al., 2019), they nonetheless offer a viable—and, at the time of this research, a necessary (Boland et al., 2021)—alternative to both telephone and in-person strategies (Hanna, 2012; Lo Iacono et al., 2016; Oliffe et al., 2021). Interviews were saved to Zoom servers, and automatically-generated transcriptions were imported into a word processor for cleaning.

Table 1*Data Collection and Types*

Quantitative		Qualitative	
Method of Collection	Data	Method of Collection	Data
Surveys	Numeric scores	Semi-structured interviews	Text data from transcribed interviews
		Documents	Text data from journals

Methods for Data Analysis***Quantitative Data***

Quantitative data generated by pre- and post-course surveys were downloaded in comma-separated values format and imported to Microsoft Excel and RStudio to facilitate analysis. Analysis began with building out basic and descriptive statistics (Creswell, 2012; Denscombe, 2014). These included amounts and frequency counts on categorical data (demographic items, previous experience with online learning, previous visits to Arboretum), measures of central tendency on ordinal Likert-type items (course enjoyment items, INS, place items) and Likert scales (CNS, identity scales [IDEA in pre-survey and EE21 identity items in post-survey]) that were treated as continuous.

Between pre- and post-surveys, INS, CNS, and environmental values data were tested for significant difference to determine if and how the course impacted these measures. Based on my own previous, unpublished pilot research, I did not anticipate detecting a significant difference in any of these measures between pre- and post-course (also see Salazar, Kunkle, & Monroe, 2020). Based on an $n < 20$, calculated mean scores for CNS and scores for INS and each environmental values item were not tested for normality (Rochon et al., 2012). Rather, I

relied on nonparametric testing and used the Kruskal-Wallis H test to find differences between categorical data and all ordinal and continuous measures. Inferential statistical analysis—while not precluded—is not central to constructivist research (Thompson, 2019). However, I have elected to integrate the results of H testing in keeping with the mixed methods approach to this research and in the interests of maintaining transparency and demonstrating rigor. As Morgan (2017) argues:

Pre[experimental] studies are a key stage of research, but their typically small sample sizes can complicate statistical analysis. When samples are large, assumptions for statistical tests may be formally assessed with hypothesis tests. This approach is not useful for small studies, but visual assessments and statistical rules of thumb can help guide statistical analysis. Through the careful selection of appropriate statistical tests, meaningful conclusions may be drawn from studies with small sample sizes. (p. L876)

Post analysis and interpretation, the data were summarized, explaining all major findings. These findings are general rather than specific, stating hypothesis rejections and/or support for the research questions (Creswell, 2012). These summaries were then abstracted, and the general theme of the finding identified, akin to the identification of thematic codes in qualitative analysis (R. E. Johnson et al., 2019). These themes then served as categories in the data merging/integration process.

Qualitative Data

Interview Data. Interviews were transcribed to textual data by the Zoom platform. Transcriptions were coded by hand using the in vivo method (Saldana, 2012). Forty-two first-cycle codes were generated. Analysis proceeded by way of thematic coding (Ayres, 2008; Gibbs, 2007; Saldana, 2012).

Journal Data. Participant journals data were coded by hand using the in vivo method (Saldana, 2012). Two-hundred and one first-cycle codes were generated. Again, analysis proceeded by way of thematic coding (Ayres, 2008; Gibbs, 2007; Saldana, 2012).

Merging Qualitative Data. Per Creswell's (2012) recommendations on educational research, my goal was to collapse codes to five to seven categories or themes; however, due to the data integration process as outlined below, I will use the term "category" to avoid confusion over terminology. Following an integrated mixed methods study required merging the qualitative data into categories prior to the development of final themes (Bazeley, 2020). In this instance, the iterative coding process was organized by the needs of the study (Locke et al., 2020), in that secondary coding proceeded by integrating first-cycle codes from both qualitative sources. Such a decision aligns with the conceptualization of coding as a "decision-making process, in which decisions about aspects of coding ... are all made by individual researchers in line with their methodological background, their research design and research questions, and the practicalities of their study" (Elliott, 2018, p. 2850).

Integrating Qualitative and Quantitative Data

Data integration began upon completion of quantitative and qualitative analysis. Bazeley (2020) advised that integration should be considered explicitly during the analysis stage, rather than being relegated to the final discussion. As integration of data is seen by Bazeley and others as the true challenge of mixed methods research (Bazeley, 2016; Fetters et al., 2013), my aim was to select the tool best aligned with my research purposes. To this end, I employed a joint display for my integrative analysis (Creswell & Plano Clark, 2017; Guetterman et al., 2015). As Plano Clark (2019) described:

Joint displays are visuals in the form of tables, matrices, or figures that explicitly relate quantitative and qualitative information. Because of their visual nature, creating joint displays is a fantastic strategy to communicate the integration that occurs in a mixed methods study to readers. However, in my experience, the real value of joint displays is the analytic and integrative thinking that must occur to create the visual display and interpret the joined quantitative and qualitative information contained within the display. (p. 110)

Though often presented in a tabular matrix format (Bazeley, 2020), there exists no single set of guidelines by which to articulate an effective joint display. I chose the pillar integration process (PIP), a novel approach developed by R. E. Johnson et al. (2019) to “address the lack of specific, transparent, well-defined analytical techniques to support an integrated, joint display approach” (p. 303).

Using the PIP approach (Table 4), I began with a selective listing of quantitative findings, proceeding “inward” towards the central column with the listing of categories generated by findings. On the far opposite column, I started the matching phase by selectively listing qualitative codes and proceeded inward listing the categories that emerged from the codes. The content of categories was horizontally matched together across columns; aligned categories “reflect[ed] patterns, parallels, similarities, or any other relational quality” (R. E. Johnson et al., 2019, p. 305). Matching categories were integrated into themes in the central column, or pillar. All themes integrated more than one pair of categories. Exploration of these themes serves as Chapter V of this dissertation.

Ensuring Quality and Rigor

Creswell (2014) described a rigorous mixed methods study as exhibiting rigor in both quantitative and qualitative aspects. Harrison, Reilly, and Creswell (2020) have since expounded upon this, arguing that the integrative nature of quality mixed methods research requires an *interdisciplinary* rigor. Their rigorous mixed methods (RMM) framework provides not only criteria for assessment but also points towards author tasks (Table 2). My research followed the RMM framework and demonstrates high levels of rigor as explained below.

First, I include the rationalization for a mixed methods approach in the first sections of this chapter. Second, I present the interview, survey, and journal data collection processes and

indicate which strands of data each tool and procedure provides, as well as report on the analysis of each strand individually. Next, I report on how the data strands are integrated, and present the integration in a joint display. Third, I report that the research is a convergent parallel design, cite multiple mixed methods studies (e.g., Lankenau, 2018; Rupprecht et al., 2015; Windhorst & Williams, 2015), and reference the mixed methods aspect of the research in the dissertation abstract.

In addition to concerns of rigor, are concerns of validity and reliability. Single-group before and after study designs are generally understood to inherently contain numerous threats to validity (Jimenez-Buedo, 2018); however, these assume a strictly quantitative, post-positivist approach. Onwuegbuzie and R. B. Johnson (2006) argued that the true threats to validity in integrative mixed methods research transcend concerns of their constituent quantitative and qualitative parts. Instead, they present nine criteria for assessing the validity—which they refer to as “legitimation”—of the meta-inferences (i.e., the themes generated by integrating quantitative and qualitative results) of the research (Table 3). My research addressed these criteria, and I provide a brief summary of each next.

First, by way of the PIP, I demonstrated the relationship between both the quantitative and qualitative strands of my research, and illustrated their convergence around the three final themes uncovered. I included analysis of my positionality within the research site and explore its benefits and drawbacks. The use of each research strand and data-collection procedure is explained in terms of how it enhances the overall research, while serving to minimize drawbacks within each component (e.g., the use of qualitative data to enhance understanding gained from quantitative data, and vice versa). Finally, by transparently integrating the data strands to arrive at my results, I am able to add broadly to the discourse on mixed methods research.

Table 2*Rigorous Mixed Methods Framework*

Rigorous Mixed Methods Elements	High levels of rigor	Medium levels of rigor	Low levels of rigor
Aims and purpose	<p>Includes a rationale for using mixed methods.</p> <p>Includes a mixed methods research question.</p> <p>Includes a discussion of the value of mixed methods.</p>	<p>Includes a rationale for using mixed methods.</p> <p>May include a mixed methods research question.</p> <p>May include a discussion of the value of mixed methods.</p>	<p>Includes no discussion of a rationale for using mixed methods, a mixed methods research question, or a discussion of the value of mixed methods.</p>
Data collection	<p>Includes the reporting of specific data collection procedures for both qualitative and quantitative data strands (e.g., sampling procedures, types of data to be collected, and instruments used in data collection).</p>	<p>Includes the collection of both qualitative and quantitative data strands, but limits the discussion of collection procedures for both data types.</p>	<p>Includes the collection of both qualitative and quantitative data strands, but does not discuss data collection procedures</p>
Data analysis	<p>Includes the reporting of analysis procedures for both qualitative and quantitative data strands that range from basic to more sophisticated approaches; from descriptive to inferential quantitative analysis, to coding and thematic development qualitative analysis.</p>	<p>Includes qualitative and quantitative analyses, but at least one is not well reported.</p> <p>It is unclear how mixed methods are used to support the overall analysis.</p>	<p>Includes the reporting of analysis procedures for only one, primary data strand.</p>

Table 2*Rigorous Mixed Methods Framework*

Rigorous Mixed Methods Elements	High levels of rigor	Medium levels of rigor	Low levels of rigor
Data integration	<p>Includes the linking of both data strands.</p> <p>Depending on the design type, both data strands are either merged or one data strand is used to explain, or build from, the other.</p> <p>Joint displays and/or data comparisons are utilized.</p>	<p>Includes the linking of both data strands, but researchers do not describe a clear plan or reason for doing so.</p> <p>Some discussion of how integration affects the overall study.</p>	<p>Includes little to no integration of both data strands.</p> <p>Little to no discussion of how integration affects the study.</p>
Mixed methods design type	<p>Includes a mixed methods design type (e.g., sequential explanatory).</p> <p>Uses a diagram to show the design type.</p>	<p>Includes no discussion of a mixed methods design type.</p> <p>Includes a discussion of qualitative and quantitative components individually.</p>	<p>Includes no discussion of a mixed methods design type.</p> <p>Either the qualitative or quantitative component is missing or significantly lacking.</p>
Elements of writing	<p>Includes references to mixed methods literature.</p> <p>Identifies the study as mixed methods in the title, abstract, and/or paper.</p>	<p>Includes a discussion of mixed methods, but fails to cite any mixed methods literature.</p> <p>Does not identify the study as mixed methods.</p>	<p>Includes no discussion of mixed methods or references to mixed methods literature.</p>

Table 3*Typology of Mixed Methods Legitimation Types (Validity)*

Legitimation Type	Description
Sample Integration	The extent to which the relationship between the quantitative and qualitative sampling designs yields quality meta-inferences.
Inside-Outside	The extent to which the researcher accurately presents and appropriately utilizes the insider's view and the observer's views for purposes such as description and explanation.
Weakness Minimization	The extent to which the weakness from one approach is compensated by the strengths from the other approach.
Sequential	The extent to which one has minimized the potential problem wherein the meta-inferences could be affected by reversing the sequence of the quantitative and qualitative phases.
Conversion	The extent to which the quantizing or qualitzing yields quality meta-inferences.
Paradigmatic Mixing	The extent to which the researcher's epistemological, ontological, axiological, methodological, and rhetorical beliefs that underlie the quantitative and qualitative approaches are successfully (a) combined or (b) blended into a usable package.
Commensurability	The extent to which the meta-inferences made reflect a mixed worldview based on the cognitive process of Gestalt switching and integration.
Multiple Validities	The extent to which addressing legitimation of the quantitative and qualitative components of the study result from the use of quantitative, qualitative, and mixed validity types, yielding high quality meta-inferences.
Political	The extent to which the consumers of mixed methods research value the meta-inferences stemming from both the quantitative and qualitative components of a study.

Ethical Considerations

As my research combined both quantitative and qualitative research aspects, ethical considerations encompass issues that appear in the two forms of inquiry (Creswell, 2012). The research was approved by the Institutional Review Boards at both Antioch University New England and my home university to independently ensure there was minimal risk to participants (Appendix E). Participants signed a letter of informed consent before the start of data collection (Appendix F).

It is important to note that, as I was the instructor of the course under study, there was an inherent power dynamic between myself and participants. It was essential that I enter into fieldwork with an understanding of my positionality as a researcher-practitioner (Rand, 2016). I expected this to manifest most readily as social desirability bias, in which participants (as students) respond to questions they believe I (as instructor) prefer (Miller, 2011). In order to address this dynamic and bias limitations, participants were assured that their responses to questions would in no way affect their grade or performance in the course, both in the letter of consent and during the introduction to interviewing. Furthermore, they were made aware that enrollment in the course was not contingent upon participation in the research, and that they could opt-out at any time. Of the 14 students in the course, two did not consent to participate in the research, while one did not indicate participation or non-participation. All three were excluded from this study.

Data Collection

The purpose of the research (to understand the impacts of the experience on CTN outcomes through a developmental lens) was conveyed to participants. It was important that I be aware of the power dynamics involved in this data collection, as an educator at the institution

that the student participants attended, as well as the instructor of the course. I was aware of these dynamics during the interview process and ensured awareness of how participants wished their statements to be interpreted. This was done through member checking of final transcriptions with participants, as outlined below in the section on data analysis. Participants were repeatedly assured that their responses in no way effected the final grade they received in the course.

Data Analysis

Because of the need to merge participants' data across time and datasets, each participant's responses had to be tracked. Confidentiality was protected through the use of numbers in reporting. In order to ensure accuracy in interpretation, I used member checking for qualitative data (Creswell, 2017). Participants were asked if they desired a final transcript of their interviews through their university email accounts and were given the opportunity to review for accuracy.

Limitations: The Role of Personal Bias

It is necessary to recognize the inherent tensions and biases present in this research. In this dissertation, I have a dual role as both the researcher and instructor for the course under study. This dual role served the interests of this research by allowing unique access to participants through a developed rapport (Glesne, 1989). However, such a dynamic necessitated that I be fully aware of—and transparent about—the role my own biases can play in accurately representing the participants' experiences (Onwuegbuzie, Leech, & Collins, 2008).

Lincoln & Guba (2005) addressed the potentially problematic dynamic of personal bias by noting that undertaking research within a constructivist paradigm allows for the researcher and participants to co-construct realities and co-create findings. A constructivist approach, such as the one taken in this research, allowed me to both recognize my personal biases as a

practitioner, while bracketing them within the context of the classroom (Rand, 2016). In this context—as an educator-researcher—the close relationships and rapport with students actively involved them as participants, rather than treating them as clinical data sources (Carpenter, 2018). Taking an even broader critical view of my positionality, as not only an educator-researcher but also a doctoral student, Pilkington (2009) posited that if the goal of the student is to strengthen both their research and teaching skills, then such practitioner research provides complimentary skill-building. Finally, Hammersly (1993) asserted that the role of educators as researchers offers a necessary challenge to the intellectual authority of pure researchers:

Researchers are not the only ones who can legitimately claim intellectual authority. The same is also true of teachers, on the grounds of their first-hand experience in schools and their understanding of what is involved in the process of education. That, surely, is a crucial element of what it means for teaching to be a profession. (p. 434)

Chapter Summary

In this chapter, I presented the methods used to conduct this research. The study employed a convergent parallel mixed methods design. In the quantitative data strand, a pre- and post-test survey was administered to participants, the students in an online section of BIO-315: Ecological Principles. The qualitative data strand involved the ongoing gathering of reflective journal entries, and semi-structured interviews with participants post-test. Both strands were merged through the joint display method, using the pillar integration process as the specific tool. Quality and rigor were ensured through application of the rigorous mixed methods framework. Ethical and validity concerns were addressed through the typology of mixed methods legitimation framework and the critical view of myself as an educator-researcher within a constructivist paradigm.

The next two chapters present the findings for this research. Chapter IV presents the findings of both the qualitative and quantitative research strands, the merging of these strands, and the themes emerging from their integration. Discussion of these themes is presented in Chapter V.

CHAPTER IV: RESULTS

Introduction

This chapter describes findings related to the school context and student participant demographics. Throughout this and the following chapters associated with findings and subsequent discussions, modifications to interviewee quotes were made to get at the essences of respondents' comments and for clarity of readers' understanding. To best ensure informant confidentiality, pseudonyms were used for interviewees, the university, and any community identifiers that might compromise confidentiality. In this chapter, the history and demographics of the university context, as well as an overview of the students interviewed as a part of this research, are provided.

Specific demographics of the participants was collected in the pre-test survey. Of the 14 students enrolled in the course, a total of 11 volunteered to participate in this study. Seven participants identified as female, three as male, and one as nonbinary. Additionally, seven participants identified as white, two as Asian, one as Alaska Native and white, and one did not specify a racial or ethnic background. Participant ages ranged from 19–53, with the median age being 22. Three participants indicated they were in their sophomore year of college, two indicated they were juniors, and six were seniors. All participants except one indicated majoring in Environmental Science, with the exception majoring in Law and Politics.

Quantitative Findings

Eleven pre-test surveys were completed by the end of the first week of the course, when the survey period closed. Six post-test surveys were completed by the end of the last week of the course, when the survey period closed. On the pre-test survey, all participants indicated that they had previously attended classes at the university's campus, and all but one participant had previously visited the Arboretum. When those who had visited the Arboretum were asked how

often they had visited while on campus, six reported visiting less than once per month, three reported once or twice per month, and one said about once a week. All participants reported spending their free time in nature at least once or twice a month. Four reported spending free time in nature about once per week, and four reported spending free time in nature several times per week.

Participant Experiences with Online Education

All participants ($n=11$) reported that they had previously taken an online course, with the majority (nine) having taken at least three online courses; of these, one reported having taken six to 10 courses and two reported having taken more than 10 (Figure 1). All participants described themselves as being at least somewhat familiar with online education, with the majority (six) describing themselves as at least very familiar (Figure 2). The two participants describing themselves as extremely familiar were the same two who reported taking more than 10 online courses previously.

Figure 1

Number of Online Courses Taken by Participants Prior to Study

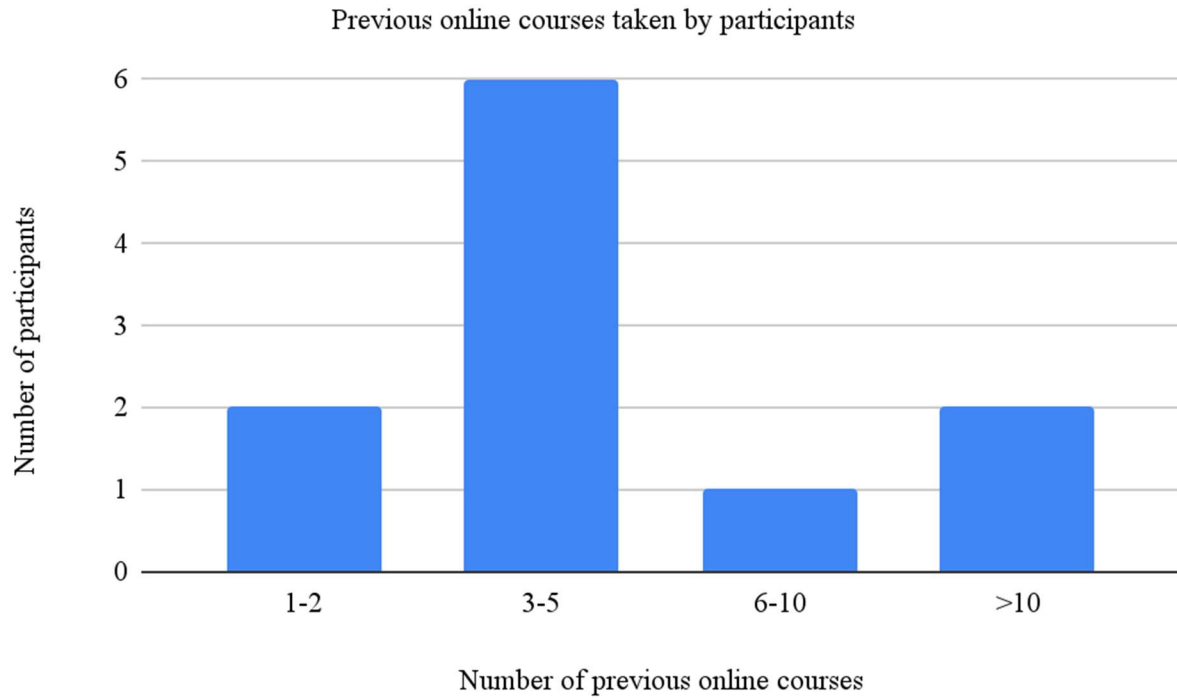
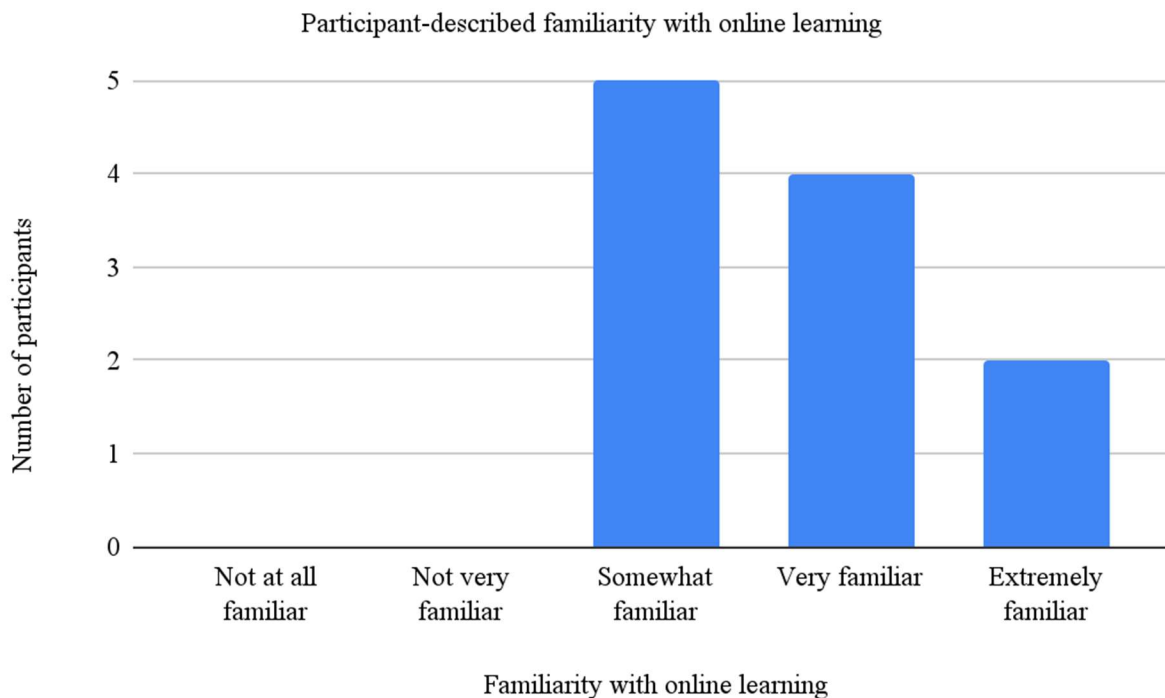


Figure 2*Self-Assessed Familiarity With Online Learning*

When asked to rate their previous experiences with online education, one participant rated it as very poor, three said below average, four rated average, two were above average, and one was excellent. No direct correlation was observed between participants' number of online courses taken previously, self-described familiarity with online courses, and rating of online education in general.

Participants were asked to rate their agreement with statements concerning online education. On the pre-test survey, one participant strongly agreed that online education is a viable alternative to face-to-face instruction, while five remained neutral, three agreed somewhat, and two disagreed somewhat. The highest variance was observed when participants were asked if environmental education can be effectively delivered online. Only one participant responded neutrally, while the remaining participants were evenly split between levels of agreement and

disagreement (four somewhat and one strongly, each). Finally, the largest amount of strong disagreement (three participants) was observed when participants were asked if online learning was an effective way to learn about nature. Participants were also asked to respond to these same statements in the post-test survey, where responses remained broadly statistically unchanged, although some participants were in stronger agreement with the statements, post-test.

Participant Experiences with the Course and University Context

Participants were also asked to respond to statements specifically about the undergraduate ecology course in the context of this study. All respondents agreed at varying levels with statements that the course was engaging, and that course materials and activities enhanced their learning, but that the course would have been more engaging had it been taught face-to-face. When asked to compare this course to other online courses they had taken, two participants responded that they learned about the same amount, two responded that they had learned more, and two responded that they had learned much more.

When presented with statements about feelings of attachment or connection to the university campus, the majority of participants (68%) responded neutrally (i.e., that they felt neither strong connection nor lack of connection) in the pre-test survey. When presented with these same statements on the post-test survey, a majority (77%) either somewhat or strongly agreed that they felt a connection to the campus.

No participant indicated strong agreement or disagreement to any statements about feelings of attachment or connection specifically to the Arboretum, with a neutral response comprising the majority of responses (54%). However, unlike responses to questions about the campus in general, there were five responses somewhat disagreeing when asked if the Arboretum was a part of their identity. When asked to respond to these same statements in the post-test

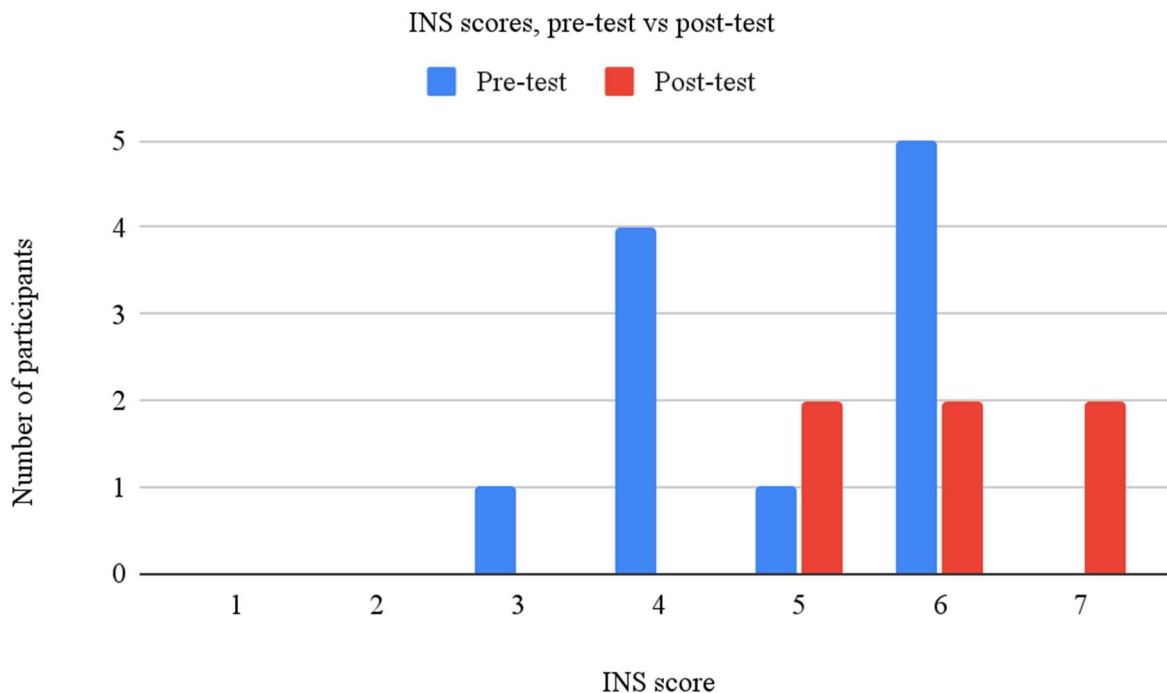
survey, half of the total responses remained neutral (nine of 18). However, the remainder indicated some level of agreement, with no disagreeing responses.

INS, CNS, and IDEA Scales Results

INS Scale. Pre-test, participants measured an average of 4.909 (out of 7) on the inclusion of nature in self scale (INS). One participant measured 3, four measured 4, one measured 5, and five measured 6. Post-test, participants measured an average of 6, with two participants each measuring 5, 6, and 7 (Figure 3). Because of a lower post-test response rate resulting in non-paired data and $n < 20$ —under which normalcy cannot be assessed—the two groups of measurements were compared using the Kruskal-Wallis H test. Analysis resulted in an H statistic of 2.919, with a corresponding p-value of 0.088. Thus, no significant difference was found in INS scores between pre- and post-test at a 0.05 level of significance.

Figure 3

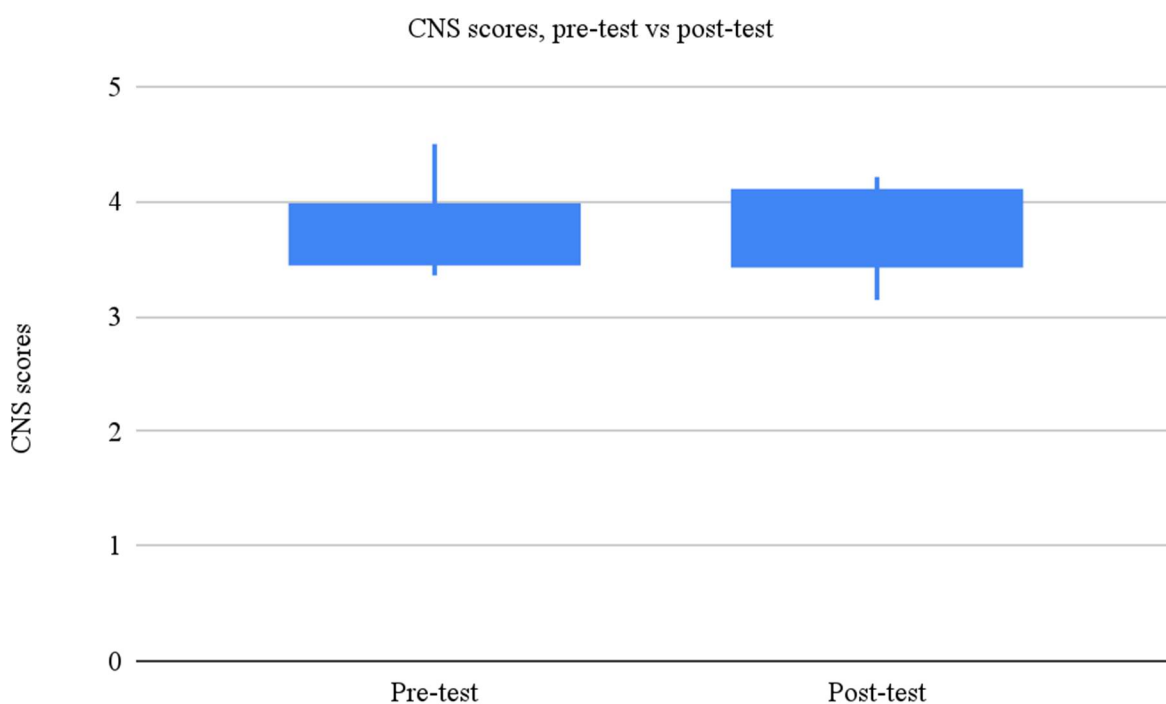
INS Scores Pre- and Post-Test



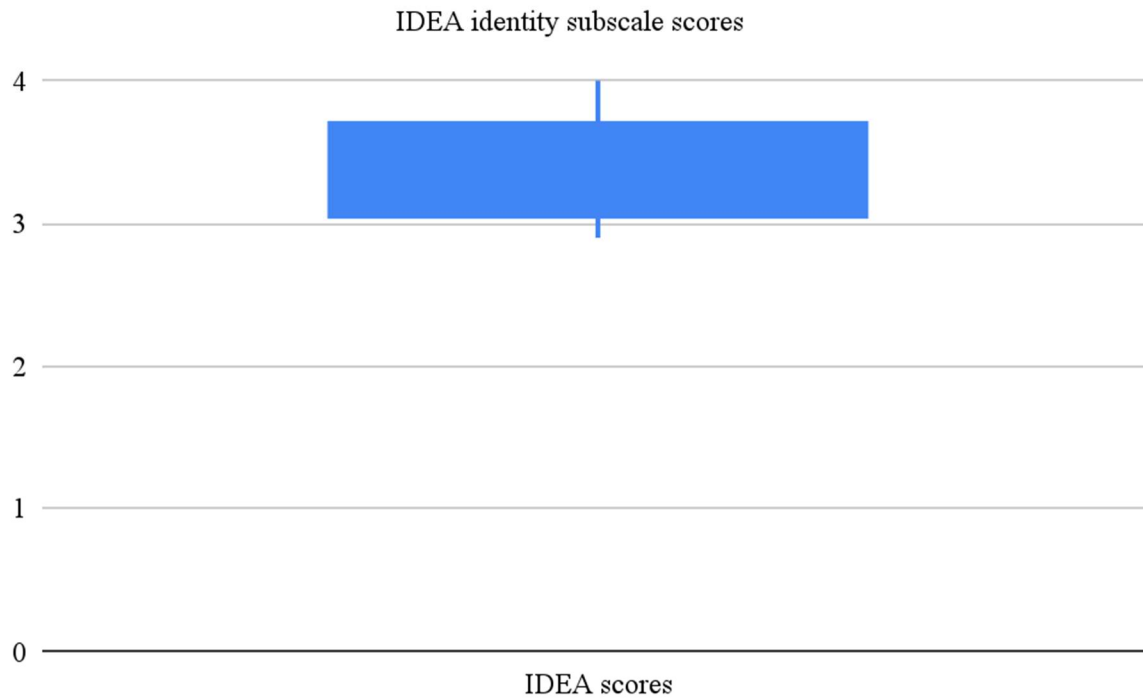
CNS Scale. Pre-test, participants measured an average of 3.805 (out of 5) on the CNS. Post-test, participants measured an average of 3.750 (Figure 4). Kruskal-Wallis H testing resulted in an H statistic of 0.063 and corresponding p-value of 0.802. Thus, no significant difference was found in CNS scores between pre- and post-test at a 0.05 level of significance.

Figure 4

CNS Scores Pre- and Post-Test



IDEA Scale. On the identity subscale of the IDEA scale, participants measured from a minimum of 2.857 to a maximum of 4, with an average measurement of 3.442 (Figure 5). There was no relationship found between IDEA score, age, and year in school. Participants were also asked to rate the importance of seven identity descriptors for themselves. The two descriptors of highest average importance to the participants were “Environmentalism” and “Scientist.” Of least average importance to participants was the descriptor “Young Adult.”

Figure 5*IDEA Identity Subscale Scores***Qualitative Findings****Interview & Journal Data**

Qualitative coding was completed using a hybrid inductive and deductive approach (Fereday & Muir-Cochrane, 2006). Primary coding was data-driven, using an inductive approach to generate codes from the data using the participants' own words (Saldana, 2012) This in vivo coding process is described below. During secondary and tertiary coding cycles I used a deductive or *a priori* approach, with categorization informed by the components of my theoretical framework. I used a deductive coding process to both maintain the focus on my

research questions as well as to facilitate data integration for final thematic analysis (Bingham & Witkowski, 2021).

Nine interviews were conducted, totaling three hours and 14 minutes. The average interview time was 22 minutes, with the shortest interview being 15 minutes, and the longest interview being 33 minutes. First cycle coding was accomplished using the in vivo method, with codes generated from participant quotes. In vivo coding was chosen given the constructivist paradigm in which I undertook this research, as using participants' own words honored and prioritized their voice in this work (Saldana, 2012). While code-generation was primarily deductive, I used Creswell and Báez's (2020) recommendation that "in vivo codes are best because they move you towards the voices of participants, which you want to reflect in your realistic final report (p.166)". Since there is no fixed protocol for number of codes per page or ratio of codes to text for in vivo coding, I applied a code as quotes stood out to me during the analysis phase (Saldana, 2012). From first cycle interview coding, 203 codes were generated.

A total of 42 journal entries were analyzed, totaling 76 pages. First cycle coding was again accomplished using the in vivo method, with codes generated from direct quotes. From first cycle coding 42 codes were generated.

Secondary & Tertiary Coding

A focused coding structure guided analysis of both interview transcripts and of participants' journals. For secondary and tertiary coding, I moved away from inductive, in vivo coding to deductive, *a priori* coding (Bingham & Witkowski, 2021). Data, in essence, were decontextualized during inductive coding, then recontextualized into themes present in my theoretical framework (Ayres, 2008).

Secondary thematic analysis of the initial 245 codes resulted in 15 codes, with a particular focus on how each code fit into the concepts included in my theoretical framework. In the final round of qualitative analysis, I focused on the redundancy inherent in some of the 15 codes. By comparing examples of text within each second-cycle code, and by clarifying the links among the codes, I concluded that some of the codes overlapped. Subsequently, these codes were combined into five major categories. While in vivo codes were kept at this stage in the analytic process, they were expanded with my own descriptions of the categories, and finally dropped at the final, thematic integration stage below. This follows Rapley's (2011) recommendation that "creating a list of key verbatim descriptions is not the end stage of analysis, it is the start (p. 282)".

Integrated Quantitative and Qualitative Findings

Upon completion of quantitative and qualitative analysis, final code categories were merged using the pillar integration process. From the integrated findings, three main themes emerged. These themes that I describe individually in the sub-sections below were (a) technology-enhanced online environmental education, (b) nature connection and natural experiences, and (c) identity formation as emerging adults and environmentalists. An overview diagram of the integrated data structure is presented in Table 4.

Table 4*Pillar Integration Process*



Qualitative Codes	Qualitative Categories	Pillar Themes	Quantitative Categories	Quantitative Findings	
					
<p>“A bigger experience for me”</p> <p>“It’s a shared space”</p> <p>“Something I normally don’t get to see”</p>	<p>“Something I normally don’t get to see:” Information technology presented novel opportunities for different perspectives into the ecological functioning of the Arboretum</p>	<p>Technology-enhanced online environmental education</p>	<p>Online learning is a ubiquitous aspect of participants’ college experience, but they were unsure about its efficacy in EE</p>	<p>All participants had taken at least one class online, with the majority (9) having taken at least 3. All self-described as at least somewhat familiar with online education</p>	
<p>“Just kind of limited”</p> <p>“Little bits and pieces”</p> <p>“Just looking at a bunch of numbers”</p>	<p>“Just kind of limited:” Technology offered drawbacks that needed to be overcome in the minds of participants</p>				<p>Varied, disagreeing assessments of the efficacy of online education and online EE specifically</p>

Table 4*Pillar Integration Process*

“A useful tool”				While the course experience was engaging, participants self-reported learning about the same as in a face-to-face course
“At least it wasn’t just ‘open a textbook’”				
“I’d really rather go to that place”	“I’d really rather go to that place:” The feelings participants get from being in nature showed up in their missing of the space and longing for body-on-landscape interactions	Nature connection and experiences with nature	Participants measured high on CTN scales and spent a lot of time in nature	Participants initially measured above average on INS (avg = 4.909) and CNS (avg = 3.805) tools, no change pre- to post-test
“Made me upset I’m not there”				
“You can think about stuff rather than school”				
“What we can do in our own backyard”	“What we can do in our own backyard:” Participants were environmental students seeking direct involvement and manipulation			All participants spent free time in nature at least once a month, with the majority (8) being at least once a week

Table 4*Pillar Integration Process*

“Hands on kind of thing”				Sense of place statistically unchanged
“You want to protect things you care about”	“You want to protect things you care about:” Course content connected and reinforced participant’s pursuit of broader, eco-focused life choices	Identity formation as emerging adults and environmentalists	Participants measured high in identity formation and viewed themselves through their professional and personal impact on environmental issues	Participants measured high (avg = 3.442 out of 4) on the identity formation subscale of IDEA scale
“It’s all connected”				Self-identification as environmentalists and scientists was of most importance to participants

Theme One: Technology-Enhanced Online Environmental Education

Quantitative and qualitative results converged around the drawbacks and opportunities participants encountered in the delivery of the course content. All participants had taken at least one online course prior to this one, and the majority had taken at least three online courses, which suggests that online delivery was made available and was a part of their overall student experience. Participant perception of online delivery—particularly online EE—was varied but averaged neutral and was statistically unchanged by the end of the course.

Participants related that the virtual field experiences were a standout in making the course engaging versus other courses they had taken. “It went well, like tying in the book with what was happening outside in the real world,” said Participant 5. Participant 2 recounted:

The little things outside of, like, the actual classroom, like the camera traps and the virtual Arboretum, although it’s, like, different, it was cool to kind of see that work. Because at least it wasn’t just ‘open a textbook and take out the answers.’

Participants often noted how these virtual experiences helped them feel more connected to the Arboretum. Of the environmental data-logging, Participant 1 wrote:

The entire experience made me feel more connected to the Arboretum, even being an entire state away. I feel like I’m taking care of the plot in a way, just by watching what is happening to it through the days. It’s like an environmental baby monitor.

However, not all of the virtual experiences were held in the same regard. Broadly, participants indicated the most dissatisfaction with the two virtual field trips, consisting of spherical imagery and recorded audio from multiple locations in the Arboretum. Participant 7 noted that “it was disappointing.” The majority of this sentiment centered on the lack of freedom of interaction these experiences offered, as described by Participant 9:

I think if I went to [the] Arboretum observing on my own I might stop at some locations and observe some details. Virtual access to [the] Arboretum prevents me from stopping at places that are not on the main road, it already has a route mapped out for me.

Conversely, technology that was used to give participants a novel perspective into the ecological functioning of the Arboretum—such as drone videography, camera trap imagery, and environmental data-logging—was highlighted by participants as an engaging aspect of the course. Of the drone videography, Participant 3 wrote:

If I were observing the forest community in person, I wouldn't be able to see above the canopy and see the mixture of coniferous and broadleaf trees. I would be looking up at the trees, not able to see the difference in heights or see the full picture ... The aerial version does a great job letting us see the big picture of the forest community.

Thus, participants often expressed needing to navigate the trade-off between freedom of interaction and gaining a novel perspective of the Arboretum, as described by Participant 5:

Well, being there in person, we could walk around, go see the different areas. And there's a whole bunch of different paths out there and stuff like that so we could see if there was, like, animal marks and stuff like that. But considering, like, the virtual cameras, they did a really nice job with capturing most of the stuff for us. And I bet if we were out there, we wouldn't have seen those animals or stuff. Because obviously there's people out there and they don't want to come close to us. So it was nice, like, to get a good balance there.

Overall, a majority of participants (66%) indicated that they learned more or much more in this course compared to other online courses, as well as indicating that virtual experiences made the course more engaging. Said Participant 4, “it was interesting to see, like, what each piece of technology could do for the same area.” These experiences served to highlight how interaction with nature impacted participants' feelings of connection, a pillar theme which is explored next.

Theme Two: Nature Connection and Experiences with Nature

Participants entered the course measuring above average on CTN scales. Qualitative findings offered additional insights in students' experiences of nature/CTN. On feeling

connected to nature, Participant 6 stated: “I think that it’s like one of the most important things in my life.” Participants often related that time in nature—particularly sensory and affective experiences—most impacted their feelings of nature connection. Participant 1 said of their nature connection:

I feel at home when I’m outside. I used to like ... I get anxiety. And when that happens, I like to go outside, and if I listen to the birds or if I, like, feel the wind or, like, something on my face, it just, like ... it calms me down. And I think it grounds me a lot. Like, going outside and just kind of having—I’m going to keep using it because it’s something that makes me feel better—but the sensory, about being outside and seeing the wildlife, whether it’s just birds or like a little ant, you know, it makes me feel like, okay, you know?

While CTN measurements remained statistically unchanged for participants by the end of the course, they often expressed that the course had provided them new knowledge of—or insights into—ecological connections. As Participant 8 said of the course:

I think it’s just given me a more structured, substantial, connect-the-dots type of thing from what I already understood. Filling in the gaps of how things are connected ... because I always knew everything was connected in this way ... but I never you know explored, you know, maybe this area or that area or this spot, you know, in that knowledge. So taking the course helped me realize, well, more about that.

Participant 6 likewise said:

I may have felt, like connected, emotionally or whatever before, but I also now have this knowledge of actually how it physically works and, like, the things that are going on around me, and I can think about, like, the individual little aspects of the ecosystem and the different individual organisms and like what’s happening around me. Even the things that I can’t see, like, you know, microorganisms or like underground animals or, you know, how the plants are growing around me, you know, so slowly that you can’t perceive it, but it’s happening. And it’s always happening around you.

Participants noted how the course’s technological interventions could not replicate a “true” nature experience for them. When asked to describe how much they felt connected to nature,

Participant 2 said:

I feel like seven out of ten, but not online. Um, just me personally, I like being outside. I like nature. But having to see it from a screen makes me upset because it's just ... it's just kind of a little bit ridiculous.

Similarly, Participant 4 recounted:

I got all these little bits and pieces of what it's like through the technology. And then I was like, but I want to be there. I want to, like, smell the soil, like, feel snow crunching beneath my feet, you know, that kind of stuff.

These feelings of dissatisfaction with the technology's inability to deliver a more full-sensory experience manifested in a broadly expressed desire to do more hands-on coursework outside.

During the interview process, Participant 8 asked "when you were designing the course for online, did you think about, you know, what we can do in our own backyard?" Participant 2 said:

I wish, you know, if we had more resources then we could probably have people, like, send a lab or something like they do for some other classes and stuff like that. If we could have our own little resources to do our own things and then bring it back into the classroom.

Participant 4 likewise expressed a desire for more hands-on, outdoor coursework:

I feel like maybe if there was an implementation of the class where you can be like, 'All right, well now that you've learned what to look for here, maybe you can go out and look for it near where you live,' that would be something that I think would be a cool aspect of it, and you could, like, report back in your in your journal like where you went, what you saw.

Finally, while there appeared no statistical difference between participants' answers to survey questions regarding their sense of place vis-à-vis the university campus and Arboretum, qualitative data indicate that the course bolstered appreciation of the spaces. Following the first virtual field experience, Participant 1 wrote, "This experience made me miss actually going to the Arboretum." Said Participant 6 of the course, "I think it reinforced, like, how much I appreciate having that space and, like, realizing what we get out of it. And, you know, what we lose when we don't have it." Such appreciation of nature, and concern over its loss and

degradation, inform the third pillar theme—participants’ identification as environmentalists—which is explored next.

Theme Three: Identity Formation as Emerging Adults and Environmentalists

In aggregate, participants measured an average of 3.442 on the identity subscale of the IDEA scale, indicating that they were in the process of forming stable and viable identities that could guide and sustain enduring life commitments (Schwartz & Côte et al., 2005). Accordingly, participants self-reported that identities involving their personal and professional agency in the world as scientists and environmentalists were most important to them.

These findings aligned with participant responses when asked how they thought their feelings of connection to nature impacted other aspects of their life. For example, Participant 5 noted, “I always wanted to do something that would help animals and try to help make the world a better place. So that’s initially why I went to the environmental science program.” Participant 3 related how their strong connection to nature impacted their personal agency, saying, “I look back at my own actions and like, see if I can, like, help the environment with my actions.”

Participant 1 said of their nature connection:

Well, it's affecting me to the point where I'm going to school to study it and hopefully to, you know, work in a job that is, almost, I mean, no job. I don't think it's like always in the field and nature, but that's what I want to do. And I want to work towards, like, you know ... to protect it. That's what I want to dedicate my career to. So I mean I love to be outside all day every day just sitting enjoying the breeze.

Some research participants related how the virtual experiences that presented novel perspectives connected them to course content. For instance, Participant 4 saw a convergence between overall course content, the environmental data-logging, and their future agency, stating that “it probably just ... more affirmed for me how I feel. I never really paid attention to soil before, until now, so I guess that’s a thing.”

Participant 2 noted how seeing wildlife behavior highlighted:

the fact that we are basically disturbing so much of that. Like, the real-world application is to kind of fight for that, and make sure that we do better at educating people as to why systems are the way that they are.

While all participants provided meaningful data to this research, two participants generated data that enabled me to link their pre-test and post-test surveys, as well as interviews. To elucidate on the above findings by providing a more in-depth analysis of the data generated by these participants, the following section contains detailed profiles of their course experience.

Select Participant Profiles

The purpose of this study was to explore the student experience around online environmental education (EE) and connection to nature (CTN), related specifically to technology-mediated nature and emerging adulthood. Due to attrition between pre- and posttest interviews, as well as data loss resulting from confidentiality of participant identification, I was unable to track and pair most data across the study period and participants. Below are profiles on two of the participants in this study whose data was able to be tracked across all pre- and posttest instruments. These profiles are condensed portraits of individual participants, based on their interviews, journals, and survey responses. These profiles are presented to provide insight into both the diversity of, and commonalities among, students in the course and their experiences related to it. In the following section, each participant will be described by the three themes uncovered during this study.

Participant 3

Participant 3 was a 19-year-old, female-identifying individual of Asian ethnicity. They were in their sophomore year of college, majoring in environmental science, with a concentration in wildlife conservation. Participant 3 is described by the three themes identified below.

Theme One: Technology-Enhanced Online Environmental Education

Prior to the course under study, Participant 3 indicated that they had taken between six and 10 online courses, and they described themselves as somewhat familiar with online learning. They rated their overall experience with online education as average. Participant 3 agreed somewhat initially that online education was a viable alternative to face-to-face instruction and that EE could effectively be delivered online, although somewhat disagreeing that learning about nature specifically could be done effectively online. After the course, Participant 3 indicated that they now strongly agreed that online education is a viable alternative to face-to-face, and they felt less in disagreement that online learning about nature is effective. They agreed that the course was engaging, and that the course content enhanced their learning, but strongly agreed that the course would have been more engaging if taught face-to-face. They indicated in their interview that this may have been because of their particular learning style. “I take very detailed notes,” Participant 3 said, “and it’s just, like, when we were doing the textbook assignments, they, like, took a little longer than I anticipated.” They continued “If we were in the classroom, I wouldn’t have, like, taken so many notes, or I would, like, hear you talk more and, like, take that in.”

During this particular course, Participant 3 noted that some of the technological interventions were responsible for an increased conceptual understanding. “I really liked the camera traps,” they said, “because like we actually got to see the animals, even though we couldn’t interact with them, like, the purpose of the camera traps [was] to see their natural behaviors in the wild.” They wrote of the drone videography that, “Seeing an aerial version of the Arboretum was something I have never seen before and it was really cool,” adding, “This helped to show the transition from one [ecological] community to another.” Ultimately, while

these experiences helped Participant 3 gain a more complete cognitive understanding, they also highlighted the components of CTN that were not fulfilled, specifically full-sensory contact.

They said of the virtual field trips, “This experience made me miss actually going to the Arboretum,” and that it made them “want to get outside and just be outside.”

Theme Two: Nature Connection and Experiences with Nature

Participant 3 had previously been a residential student on campus before COVID-19, had visited the Arboretum on occasion, and reported spending time in nature about once a week.

They felt strongly that the campus was a part of them, and that they felt a strong attachment to the campus. They were more neutral on their feelings of attachment to the Arboretum specifically. After the course, they reported that their feelings of attachment to the campus had decreased to neutral as well. Despite their unchanged assessment of their connection to the Arboretum from pre- to post-test, they reported that they appreciated the space more after the course. “I appreciated the Arboretum more, just because, like you’re stuck inside like all the time doing this virtually, like, you don’t really have time to go outside.”

Theme Three: Identity Formation as Emerging Adults and Environmentalists

While Participant 3’s score on the CNS remained unchanged pre- to post-test (3.929), their INS score increased slightly from 4 to 5. They attributed this slight change to a newfound appreciation for spending time outside, which was directly influenced by the increasing conceptual understanding gained by being in the environmental science program:

When I was young ... I never thought about, like, being outside. I always stayed inside and everything, but, like, as I understood how the environment works, like, gained insight and ... just being in this program, I felt more like, oh, I need to be outside and, like, either do something to help or just, like, be outside ... I guess [my CTN] grew more just because, like, I learned everything.

Finally, Participant 3 scored high on the IDEA identity subscale (3.4), and indicated that being identified as an environmentalist, outdoor enthusiast, and young adult was extremely important to them. Correspondingly, they stated their feelings of nature connection most impacted their personal actions. “I’m more aware of what I’m using or like doing ... I look back at my own actions and see if I can, like, help the environment with my actions.” Specific to the course under study, they thought that it had impacted their overall feelings of connection, saying “Just because of all the information I learned ... I was, like, even more aware of what I’m doing. Or, like, how I take part in the world, in a sense.”

Participant 5

Participant 5 was a 20-year-old, female-identifying individual of white race/ethnicity. They were in their sophomore year of college, majoring in environmental science. Participant 5 is described by the three themes identified below.

Theme One: Technology-Enhanced Online Environmental Education

Having taken between three to five online courses previously, Participant 5 described themselves as somewhat familiar with online learning, while saying that their overall experience with online education was average. They remained neutral from pre- to post-test on their assessments of the efficacy of online versus face-to-face learning and on online nature learning, and remained somewhat in agreement that EE can be delivered effectively online. After completion of the course, Participant 5 agreed that the course was engaging, that the course content enhanced their learning, and that the course would have been more engaging if taught face-to-face. They also indicated they learned about the same in this course as in other online courses they had taken. “I thought it went well,” they said during their interview, “like, tying in

the book with what was happening outside, like, in the real world and stuff like that. So no, it was good. I liked the class.”

Regarding the technologies employed during the course, Participant 5 noted that they all had value to them, but that there were a few standouts, which they felt increased their understanding of the space. Referring to the camera traps, they said “I got a better idea ... I didn’t know that some of those animals ended up going back there.” They wrote that the environmental monitoring network gave them “a better idea about the [rain]fall over an extended period of time.” When asked to describe the differences between their in-person and virtual experiences in the Arboretum, they said:

Being there in person, we could walk around, go see the different areas. And there’s a whole bunch of different paths out there and stuff like that, so we could see if there was, like, animal marks and stuff like that. But considering, like, the virtual cameras, they did a really nice job with capturing most of the stuff for us. And I bet if we were out there, we wouldn’t have seen, like, those animals or stuff. Because obviously there’s people out there and they don’t want to come close to us. So it was nice, like, to get a good balance there.

Theme Two: Nature Connection and Experiences with Nature

Participant 5 reported spending time in nature several times per week. Participant 5 was a residential student on campus prior to COVID-19 and had occasionally visited the Arboretum while there. They reported feeling neutral about their sense of attachment to the campus, while somewhat disagreeing with statements about attachment to the Arboretum specifically. Post-test, their agreement with statements in both categories increased slightly, to somewhat agreeing with statements on attachment to campus, and becoming neutral on statements about attachment to the Arboretum. They wrote in their final journal:

I enjoy taking these virtual visits into the Arboretum because I like seeing what is going on out there. I always enjoyed going out there when we were on campus, so it’s fun to keep up with what happens out there even when we are home.

Theme Three: Identity Formation as Emerging Adults and Environmentalists

Participant 3's score on the CNS remained unchanged pre- to post-test at 3.357, and their score on the INS decreased from 6 to 5. They described the factors that most impacted their feelings of CTN as primarily affective, encompassing interactive freedom and sensory experiences:

I love being outside ... I will be outside as much as I can. I love winter activities like skiing, you know, all that kind of stuff outside in the summer, I love boating and going to the beach, stuff like that. So I feel like every day I try to get outside. It doesn't matter what time of year, I know it's just relaxing, calming, you can think about other stuff rather than, like, school.

Finally, Participant 5 scored the highest possible value on the IDEA identity subscale (4), while indicating that no particular identity descriptor was any more important to them. When asked about how their feelings of nature connection impacted them, they drew from their experiences at home near the Atlantic coast, as well as the knowledge they gained in school:

I think the reason why, like, I went into the environmental science field was because of, like, how I live here. And like I see everything that goes into the ocean and all the pollution and stuff that's like on the beach, like with ropes and trash and plastics and all that kind of stuff. So I always wanted to do something that would help animals and try to help make the world a better place. So that's initially why I went to the environmental science program. And I thought, like, I definitely learned a lot, so that's awesome.

Chapter Summary

This chapter presented findings from both the quantitative and qualitative strands of my research, and the three pillar themes that emerged from the pillar integration process. These themes were technology-enhanced online environmental education, nature connection and experiences with nature, and identity formation as emerging adults and environmentalists. In addition, for the two participants whose quantitative and qualitative data could be fully tracked across pre- and post-test, in-depth profiles of their experiences were presented to illustrate the pillar themes. In Chapter V, I reintroduce my research questions, and align them to the three

pillar themes that emerged from analysis. Additionally, this final chapter explores and discusses implications of this study's findings for theory, research, and practice.

CHAPTER V: DISCUSSION AND CONCLUSION

Introduction

This study sought to capture and explore the experiences of college students enrolled in an online ecology course in relation to nature connection, technology, and emerging adulthood. This final chapter reestablishes my research questions and integrates discussion of the three pillar themes that emerged from analysis. These themes are explored regarding environmental education (EE) practitioners and future research and scholarship.

The outcomes of this study demonstrate how using the constructivist paradigm illuminated the unique experiences of these college students as emerging adults and environmentalists, and how an integrative mixed methods approach delivered a holistic overview that connected these experiences to connection to nature (CTN) theory. All these singular experiences add scholarly value to the study of CTN, EE, and online learning.

The essence of this study includes 11 pre-test surveys and six post-test surveys, 42 journal entries, and nine interviews, all of which captured various experiences of students. These students were enrolled in an online section of BIO-315: Ecological Principles, at the university during the fall 2020 semester. Analysis of these data provided insight into the students' experiences with information technology in online EE and how they understood it to impact their identity and future agency in the world. Each of the three pillar themes gleaned from analysis—technology-enhanced online EE, nature connection, and experiences in nature, and identity formation as emerging adults and environmentalists—build upon and contribute to theories related to CTN, EE, and emerging adulthood (EA).

Research Questions and Emergent Themes

Research Question One: How do College Students Enrolled in an Online Ecology Course Perceive and Experience their Connection to Nature?

Participants in this study comprised a sample of students in a required course for the university's Environmental Science degree program. As such, 10 of 11 of participants were Environmental Science majors, and correspondingly tended to measure above average on two CTN scales. Firstly, the inclusion of nature in self scale (INS), designed to measure the three components of CTN as Schultz (2002) sees them along a continuum, with cognitive preceding affective, and affective preceding behavioral. The INS is a seven-point scale, with seven being the highest or most connected level. Pretest, scores ranged from three to six; posttest, scores ranged from five to seven. Secondly, the connection to nature scale (CNS), a 14-item, five-point scale designed to rectify what Mayer & Frantz (2004) saw as reliability concerns with the INS. The average pretest score on the INS was 3.8, compared to the average score of 3.75 posttest. As predicted—due to both high initial levels and the intensity of the program under study (Salazar, Kunkle, & Monroe, 2020)—no gross statistical change was observed in these measurements upon completion of the course, although the range of scores was reduced around the higher end of the INS.

Despite a lack of statistical change in CTN metrics overall, however, participants self-reported gaining new knowledge of, and appreciation for, principles of ecological functioning, particularly in interviews. Participants often cited a new understanding of the interaction between the environmental and human factors of the Arboretum. “I didn’t, like, realize just ... how many other species used it,” said Participant 1 regarding camera trap data, “I didn’t realize there was that many animals because ... the Arboretum is kind of next to a busy road.” Participants

attributed much of this new knowledge to the integration of technology-mediated nature experiences in the course, which ties directly to my second research question. These outcomes also align with research showing that EE programs have the ability to positively impact information-based factors (Powell et al., 2019).

This positive impact on environmental knowledge—a fundamental component of CTN (Mayer & Frantz, 2004; Schultz, 2002)—was balanced by an expressed disappointment with lack of time learning in nature. Participant 5 noted:

I love being outside. Like, that's why I wanted to go into the environmental program, like, as a start ... I love connecting to nature, love just everything to do with that. So I'd rather be outside learning rather than sitting and staring at a board all day.

This converges with the broad participant view that their own connection to nature originates from—and is strengthened by—full-body, sensory experiences in natural environments. Once again, the course integration of technology-mediated nature experiences fore-fronted this understanding for participants, tying to my second research question. As Participant 6 said:

I just really like being around nature, like, I find a lot of peace in just being in the forest, and being surrounded by that, and you get ... information from standing there that you wouldn't get even from a virtual walkthrough, like the feeling of the air, the humidity you know, like, what you're smelling, what you're hearing.

The student experience of nature connection associated with this course can be summarized through a specific look at the students' experiences with the Arboretum. The integration of course material and virtual representations of the space broadly resulted in a greater ecological understanding of the Arboretum. As Participant 7 related, “I gained a lot more from the recorded lectures ... and then like with the integration from, you know, the tech from the Arboretum, so everything just kind of really seemed to relate to each other.” This, in turn, had a positive impact on participant connection or attachment to the space, as Participant 3 said of the Arboretum “along with, like, understanding everything about ecology of this semester, I

just, like, appreciated it more. Even though it's, like, virtually." This attachment manifested as a desire to actually learn in the space, and surfaced as a sense of longing for the full freedom and sensory experience of body-on-landscape contact with the Arboretum, as expressed by

Participant 1:

You just feel like you're more attached to the space when you're actually in it because ... because you're there, you're feeling it. You're a part of it. You can smell it, see it, hear it, feel it, touch it.

Ultimately, participants tended to view their connection to nature through the lens of new knowledge enabled by technology-enhanced online learning, coupled with a disappointment in not having a full-sensory, in-person experience. As summed up by Participant 6:

We have this technology and it's useful for people who are only online students and they don't have an Arboretum space, but I'm a little sad that I don't actually get to go and walk through the Arboretum for class time.

Such sentiments serve to illustrate participant experience with digital mediation of nature, which is explored next.

Research Question Two: What is the Student Experience with the Digital Mediation of Nature in the Course?

All participants in this study had taken at least one course online during their student careers, with all but two having taken at least three online courses. All participants were self-described as at least somewhat familiar with online learning. Thus, for this particular group, online learning is now ubiquitous. These findings align with research that shows, even prior to the COVID-19 pandemic, that 36% of all undergraduate learners in the US had enrolled in at least one online course (Irwin et al., 2021). Yet despite the pervasiveness of the delivery format, there exists a considerable range of educational experiences online (Bozkurt, 2019), not all of which include such virtual interactions as the course under study.

Broadly, participants related to technology-mediated nature embedded in the course in two ways. Firstly, they expressed appreciation for the technology's ability to provide a novel view of the Arboretum and its ecological functioning. After the community ecology course module featuring drone videography, Participant 2 said "sometimes technology is great and gives us an opportunity to learn [in] a different way." "This experience was different from the others," wrote Participant 1 of the module utilizing the environmental monitoring network, "because we're not only observing what is going on at the Arboretum, but we're getting hard data that is being tracked and graphed."

Consequently, participants often expressed that these virtual experiences increased their conceptual understanding of the space. Of the drone videography, Participant 5 wrote, "Seeing the different trees from the aerial view was really cool because we could see how much diversity is in that small area alone ... It gave us a different perspective and allowed us to observe in a different way." "I really liked the camera traps," Participant 3 recounted, "because we actually got to see the animals, even though we couldn't, like, interact with them, the purpose of the camera traps [was] to see, like, the natural behaviors in the wild."

Linking directly to my first research question, these experiences of increased conceptual understanding often served to foster a sense of nature connection in participants. Referring to camera trap data, Participant 5 wrote:

This experience made me feel connected to nature and more interested in the animals that were shown in the images. It was cool to see how much diversity we had in just the Arboretum alone within just one week of capturing images

The second way participants broadly related to these technology-mediated nature experiences was through frustration or disappointment regarding what the technology could not do. One of the most common experiences that elicited these sentiments was a lack of freedom of

interaction. “Not having any control over what I want to see can be frustrating,” wrote Participant 4 of the drone videography. When asked to reflect on the virtual field trips, consisting of 360 imagery and spatial audio, Participant 9 said “being there in person ... you can observe it, you know, fully ... like wherever you want to go. But virtually you kind of, like, go through a road, have a specific direction.”

The other most common experience related to these feelings of frustration or disappointment was the inability of technology to deliver a full sensory experience of the Arboretum. Participant 1 wrote of the virtual field trip:

Although the sound was caught in the virtual tour, I would've liked to be standing there instead, that's why I can never do those virtual national park tours. If I were there, I would be able to touch the leaves and pine needles and feel the wind that is making the trees sway. I could feel the bounciness of the ground below my feet and maybe see different birds make their way between branches.

Often, participants expressed desire for hands-on learning in the Arboretum specifically due to these sensory factors, since, as Participant 3 wrote, “We would also be able to feel the soil or feel the humidity in the air. Instead of reading only the measurements, we would be able to feel the difference as well.” Ultimately, Participant 2 wrote that a virtual field trip “does not capture the essence” of the space. The participants’ sentiments regarding a lack of full-sensory experience relate directly to their own feelings of connection to nature, as explored in my first research question.

Aside from needing to navigate the trade-offs inherent in technology-mediated nature, participants generally indicated that these experiences provided greater engagement in the course, as indicated in the post-test survey. Participant 5 reflected on the course saying “it went well, like tying in the book with what was happening outside, like, in the real world.” Likewise, Participant 2 expressed appreciation for these experiences, because “at least [the course] wasn't

just ‘open a textbook and take out the answers’.” In summation, balancing the drawbacks and opportunities of interactive, technology-mediated nature experiences provided a sort of half-step towards the hands-on learning participants expressed a desire for. This corresponded to participants’ desire for efficacy as environmentalists or activists in their future, an aspect of their identity development, which is explored next.

Research Question 3: How is Student Experience of Connection to Nature Related to Emerging Adulthood?

With a median age of 22, most participants fell into the age range for emerging adulthood (Arnett, 2000). This aligned with the indication from pre-test surveys that the majority of participants were in a heightened stage of identity formation (Reifman et al., 2007). Saliently, when asked what identity descriptors were most important to them, participants broadly indicated that “environmentalist” and “scientist” were of greatest importance.

In interviews, participants routinely expressed that their feelings of connection to nature impacted their identities involving their agency in the world. Some of these centered on personal agency, as individuals acting in an ecologically conscious way or encouraging others to do so. Participant 3 said, “I’m more aware of what I’m using or doing.” Participant 2 said that their feelings of connection to nature also impacted their actions:

I like to volunteer for campaigns, sometimes, like if it’s a specific one that I care for ... If I find like different ways that—in my life—that I can change some little habits that I have, you know, whether it’s not using certain products, or, like, actually ... using other products ... these are things that I actively think about, and I encourage in my conversations to others to care about.

Other participants expressed how connection to nature impacted their professional agency, in terms of their work and future careers. For example, when Participant 4 was asked if

their work in public education and citizen science helped them feel more connected to nature, they responded:

I think they are things I do because I already feel connected. It's part of my life. And ... you want to protect things that you care about. And so I feel like that's what I do, because that's what I'm connected to.

In summary, participants who were in the emerging adult stage of development felt that their high levels of CTN directly impacted their identities vis-à-vis personal and professional agency. Importantly, coursework that reinforced CTN had the subsequent effect of reinforcing their identity as environmentalists. Participant 5 said:

I always wanted to do something that would help animals and try to help make the world a better place. So that's initially why I went to the environmental science program. And I thought, like, I definitely learned a lot, so that's awesome.

Findings in Context

Resulting themes from this study reinforce the theoretical framework guiding this research. As all but one participant had self-selected into the university's environmental science program, it was hypothesized that they would demonstrate high levels of environmental concern (Gerstenberger et al., 2004; Lang, 2011), which would be reflected by high CTN scores across multiple psychometric scales (Mayer & Frantz, 2004; Schultz, 2001). This hypothesis was supported, and participants broadly reported that their high CTN was primarily influenced by experiences in nature (Chawla, 1998; Ewert et al., 2005; Kahn, 2002; N. M. Wells & Lekies, 2006).

Since the median age of participants was 22, it was hypothesized that they would be in a phase of heightened identity formation, coinciding with the theory of emerging adulthood (Arnett, 2000; Schwartz, Côté, & Arnett, 2005). This hypothesis was supported by high measurements on the Identity subscale of the Inventory of the Dimensions in Emerging

Adulthood scale (Reifman, Arnett, & Colwell, 2007). Participants reported that this development often centered on their identities as environmentalists (Mah, Matsuba, & Pratt, 2020; Matsuba, Alisat, & Pratt, 2017).

The course under study demonstrated that online education has the potential to increase cognitive understanding of nature (Aivazidis, Lazaridou, & Hellden, 2006; Wojick et al., 2016), a crucial component of EE for CTN (Oxarart & Monroe, 2016). This ability held true particularly when paired with technology-mediated nature, which was able to enhance cognitive understanding by allowing for new perspectives on the ecological functioning at the Arboretum (Ahn et al., 2016; Deringer & Hanley, 2021).

This research used the above frameworks to provide a novel perspective of a group of students forced into an online ecology course due to the COVID-19 pandemic. For this group, in the midst of emerging adulthood, the importance of effective EE was highlighted. The path from EE to lifelong PEB was explored in this research, with a focus on providing nature experiences to bolster CTN during a crucial stage in participants' development.

Recommendations and Implications for Practitioners

Online delivery of education is now such a convention that, even prior to the COVID-19 pandemic, 36% of all undergraduate learners in the US had enrolled in at least one online course (Irwin et al., 2021). Future college students will have been even more immersed in online learning before their first class begins. At the height of the pandemic in January 2021, 67% of US households with children in school reported that they had transitioned to online learning (U.S. Census Bureau, 2021). It is thus reasonable to assume that the pursuit of ambitious online endeavors begun by colleges and universities pre-pandemic (Lederman & Lieberman, 2019) will only accelerate.

However pervasive online learning, there is a considerable range of educational experiences embedded within this delivery medium. As the COVID-19 pandemic demonstrated (Gallagher & Palmer, 2020), much of the experience of US college students could be termed “distance learning” (Bozkurt, 2019), referring to simply delivering lectures via video conference. As the participants in this study indicated, such formats might ignore the potential for using information technology (i.e., technology-mediated nature) to foster CTN.

By using technology such as camera traps, environmental sensors, and drone photography to give students a novel view of ecological functioning, educators have the ability to “make the invisible visible.” If an outcome of effective EE is to provide new knowledge on the interrelationships between human society and the biosphere (Stapp, 1969), then the ability of information technology to make such relationships visible demonstrates its potential to be an effective EE tool. Furthermore, such interventions do not need to be limited to online delivery formats. None of the technologies that this study incorporated precluded use in an in-person class setting. Rather, it is incumbent upon practitioners to understand the use of technology to augment in-person experiences. As Participant 6 said of the drone imagery:

Even for in-person classes to take a look at this, you can see what’s going on with the forest as a whole because it is one whole unit and we can’t really think of it like that when we’re just walking through it, looking at each individual tree and organism.

Thus, investment in technology for EE could provide practitioners a set of adaptive and robust tools that have the potential to foster CTN outcomes regardless of delivery method.

It is important here to clarify that such technology could be utilized to augment natural experiences, when possible, as opposed to replacing them. Participants frequently described how these experiences—in addition to the benefits they supplied—drew attention to the factors they were incapable of replicating, namely interactive freedom and direct sensory contact. Regarding

the lack of freedom, Participant 4 wrote of the virtual field trips, “If this were a real tour and not virtual I would just walk out further and find out for myself. I am slightly annoyed that I can’t just do that.” Also referencing these virtual field trips, Participant 1 spoke to the lack of a full-sensory experience:

I think I would have, like, a much easier time talking about it if I was there, because I could talk about, like, what I heard. And what smelled different. Sensory things that, like, you can’t really get from just taking the virtual tour.

Given that both interactive freedom and direct sensory contact are crucial factors in developing the affective component of CTN (Barthel et al., 2018; Tseng & Wang, 2020), and that current, broadly accessible technologies are incapable of delivering these factors through in-home, online delivery (Ahn et al., 2016; Deringer & Hanley, 2021; Truong & Clayton, 2020), EE practitioners should exercise caution if relying on information technology to replicate natural experiences, especially if CTN is the intended goal. Rather, such interventions show their strength in enhancing information-based outcomes by way of augmenting natural experiences (Colding et al., 2020; McClain & Zimmerman, 2016).

Correspondingly, participants in this study—all but one of whom self-selected into the university’s Environmental Science degree program—routinely expressed their desire for outdoor, hands-on learning. “Honestly,” said Participant 5, “this class seems like, if we were in-person, we would be outside almost all the time, which would have been great.” Likewise, Participant 2 stated, “I like hands-on learning. For me, the online portion ... kind of took those things away.” These accounts highlight the idea that technology mediation may be one part of a suite of potential learning experiences in online EE.

One such component of these learning experiences could be at-home outdoor labs. These activities, during which students undertake remotely-guided fieldwork in their own backyards or

space of their choosing, have been shown to provide increased engagement and pedagogical efficacy (Shivam & Wagoner, 2020; Wolters & Lepcha, 2021; D. Wright, 2020). Such an approach is certainly not without its own specific challenges, including the potential variability in outdoor, natural spaces available to remote students. However, given that these activities at the very least provide full sensory contact and interactive freedom outdoors, they are worthy of investigation by EE practitioners.

Whatever combination of learning experiences and activities, participant experience in this study shows that online education designed to deliver CTN outcomes may be important for learners even if they demonstrate high, pre-existing levels of CTN. At the least, this study shows how even a program without integrated, body-on-landscape nature contact such as this course, could reinforce CTN in online students. More importantly for emerging adult populations, reinforcing CTN was shown to bolster participant convictions about life choices during a crucial phase of identity development. With a goal to “develop a world population ... which has ... the attitudes, motivations, and commitment to work ... towards solutions” (United Nations Environment Programme, 1975, p. 3), environmental educators at the college level—regardless of delivery format—have a unique opportunity to help shape and support environmental identity in emerging adults.

Recommendations and Implications for Future Scholarship and Research

This particular study used the constructivist paradigm to investigate a novel, specific educational issue by emphasizing multiple perspectives and highlighting contextual factors (Lincoln & Guba, 2013). With this unique perspective now added to a broader dialog, future research should aim for generalizability. Studies using larger and more diverse participant groups can begin to establish commonalities across bigger populations. Additionally, more experimental

approaches are warranted to identify and isolate specific effects of interventions and provide more causative explanations.

In addition to college settings, the COVID-19 pandemic has shown the necessity to investigate online EE across all educational settings and groups. As the incidence of global pandemics is projected to rise (Daszak et al., 2020), it is reasonable to assume that online delivery of education will become even more commonplace than it is now. Particularly among children and adolescents, who are at the most crucial stages for CTN development (Chawla, 2007), there is an urgent need to understand how environmental educators can best utilize online learning. From the research, best practices must be developed and disseminated.

To the best of my knowledge, this is the first study to specifically investigate CTN theory through the developmental lens of emerging adulthood. Given the compelling findings presented here, further research must be undertaken to understand CTN beyond a binary divide of formative versus adult experiences. With a demographic entering a heightened stage of identity development, eschewing CTN outcomes in college-level EE misses a significant opportunity to foster enduring, environmental identity in students. As Mah, Matsuba, & Pratt (2020) state: “While political beliefs in late adolescence predict environmental beliefs in adulthood, the association strengthens over emerging adulthood and so this may be an important time to engage people through environmental education and action” (p. 12).

Results from this study highlight a tension that occurred between the lack of freedom and agency in digital representations of the Arboretum, and the role of freedom and agency in emerging adulthood. Freedom of choice, especially away from constrained environments such as school, is an avenue for identity discovery and formation for emerging adults (Layland, Hill, & Nelson, 2018). This emerging identity exploration is more likely when individuals have more

agency (Schwartz, Côté, & Arnett, 2005). During this study, participants repeatedly expressed negative emotions about the lack of freedom in the technology-mediated nature interventions. “Not having any control over what I want to see was frustrating,” wrote Participant 4 of the drone imagery in the course. Future research could explore the complex interplay between lack of freedom in technology-mediated nature and the need for freedom in identity development in emerging adults.

There is also a need to link identity development with the reflective journals that participants provided in this study. Thomashow (1995) sees reflection in EE as crucial to forming a collective ecological identity; that is, an identity capable of bringing about positive ecological change. In EE practice, reflection has been shown to support this type of identity development in school age populations (Simms & Shanahan, 2019). In a broader context, it has been shown that emerging adults who engage in reflection are better at forming enduring commitments (Bundick, 2011). However, neurobiological growth in cognitive skills leads to an increasing ability to be reflective throughout emerging adult development (Wood et al., 2017). Such concerns may be validated as participants ranged in age across the emerging adult years, from 19 to 25 (and four participants beyond this threshold). While reflective journals were perhaps useful in the context of the course by supporting identity development, this growth of reflective ability may be considered a limitation in this study vis-à-vis qualitative data collection. However, further research is warranted before any definitive claims can be made.

Besides identity, the concept of “place” has a long history in CTN research and scholarship (Beery & Wolf-Watz, 2014; Salazar et al. 2021). While not a major component of this research, findings related to place provide a promising avenue for further studies in this context, particularly when participants indicated their sense of place was impacted by the course.

Future studies should incorporate research showing how information technology can augment (Coccoli, 2020; Olesky & Wnuk, 2016) or replicate (Benyon et al., 2006; Puhek, Perše, & Šorgo, 2012) place, and how information technology even creates novel places (Zook & Graham, 2007), particularly in online learning environments (Northcote, 2008).

Related to place, and in light of findings that participants expressed missing/a longing for full body contact with the Arboretum, a further line of research should expand on these results in the context of solastalgia. Solastalgia is a conservation psychology theory referring to the emotional distress caused by loss of natural spaces and ecological degradation (Albrecht et al., 2007). While the majority of research on solastalgia focuses on transformation of landscapes due to climate events or resource extraction, there is a small volume of research pertaining to individuals' removal *from* a place or landscape (Galway et al., 2019).

Conceptualizing solastalgia as a removal from place would help integrate findings from this research into the body of literature on the theory. Faced with the probability of increased pandemic events such as lockdowns (Baker et al., 2022), future research is warranted on the complex effects technology mediated nature may have on individuals. In this study, participants related that while digital mediation of the Arboretum increased their cognitive understanding and appreciation of the space, they also often felt reminded of a space they no longer had access to. Participant 2 recounted these conflicting feelings, stating after the course “I like [the Arboretum] less? Just the fact that it made me upset that I'm not there. I was suddenly reminded that ‘oh wow you're stuck at home. Look around. This is all you're getting.’”

From its formal inception, solastalgia has been closely linked with identity (Albrecht, 2005). Albrecht et al. (2007) recount how individuals' identities are challenged when landscapes they have a strong connection with are changed and degraded. Correlating with extant literature

on place (Hausman et al., 2016), participants in this study often related how their sense of identity was tied to certain places, such as the campus or their home environment. With a focus on identity development, the interface between solastalgia and emerging adulthood may yield a fruitful body of work.

It is worth noting that the specific places in this study (both the study site and remote locations of participants) occupy a privilege space. Much has been written on the unequal access to nature afforded by differing levels of privilege, particularly along racial and income lines (Boyce, Narain, & Stanton, 2007; Nesbitt et al., 2019; Strife & Downey, 2009). Three of the New England states are in the top ten states with the highest average income (Bureau of Economic Analysis, 2021), three are in the top four states with the highest percentage forest cover (Vogt & Smith, 2017), and notably, three New England states are included in the four with the least racial diversity (Jensen et al., 2021). In addition, college access itself remains a privilege, and gaps in both attendance and achievement persist between white non-Hispanic populations and minorities (Fatma, 2015). Finally, access to information technology is likewise unequal along income, race, and age lines (Fang et al., 2019). Taken together, the experiences in this research occupy a privileged space in the nexus of nature access, college attendance, and technology access.

However, this study indicates the opportunity for widespread collaboration across such privileged educational institutions and outdoor, community- and nature-based organizations such as parks, zoos, and nature centers (Kleespies et al., 2022). Such resource-sharing partnerships could leverage the technology infrastructure of colleges and universities with access to outdoor spaces to the mutual benefit of all parties involved. Within such collaborations, learners would benefit from the freedom and sensory experience provided by nature-based organizations, while

also receiving the knowledge and understanding gained from structured coursework and guided learning experiences.

Limitations

In this section, I present the limitations for this study. Additionally, I present recommendations for further research to address each limitation:

1. *Limitation:* Due to the sudden, unexpected impacts of COVID-19 on course delivery at the university, this study was undertaken with a pre-experimental design. As such, generalizability of the results is severely limited, at best. By using the constructivist paradigm, however, this limitation was explicitly counteracted by seeking to understand the particular experiences of the students in the course. However, there does exist an immediate need to establish best practices through a more generalizable research approach.

Recommendations: Future research should build from the results of this study by incorporating a true experimental design across multiple class sections. Within such experiments, constants could be held for technology-mediated nature exposure, age demographics, and course content. Such designs would offer both increased generalizability while also providing more nuance to the understandings of interplay between CTN, emerging adulthood, and technology-mediated nature.

2. *Limitation:* The study design comprised a convenience sample of students in the course under study, 11 of 14 of whom participated in the research. Convenience samples—particularly of undergraduate students—are often critiqued on their ability to produce generalizable results (Peterson & Merunka, 2014). This limitation was mitigated by the fact that my research was not undertaken to produce broadly generalizable results (see

Etikan, Musa, & Alkassim, 2016). Regardless, the small sample size limited the ability to perform advanced statistical analysis, instead relying on descriptive statistics to analyze quantitative data. While the drawbacks to this approach were mitigated by integration with qualitative data, there is also a need for much broader statistical understanding of CTN in emerging adults.

Recommendations: Future research should include larger populations of students. These populations might arise organically from an experimental design, as explored above, and might also use larger classes for study sites. Larger samples may even be derived from research spanning multiple universities and colleges. Such research would allow for more advanced statistical analysis of the concepts explored here, and also address the need for generalizable results to inform best practices.

3. *Limitation:* I undertook this study explicitly as an educator-researcher. I did so consciously, as I wish to inform dialogue within my communities of practice, including those at the university locally and EE practitioners globally. Because of the power dynamic inherent in my role as both researcher and course instructor, there is the probability that confirmation bias was introduced into the data.

Recommendations: While the limitations in this instance were necessary due to my interest in pursuing this study as an educator-researcher, additional, “pure” research would provide further insight into the included concepts. This insight would arise from the nuance provided from alteration of the power dynamic in this study, and subsequently reduce the potential for confirmation bias.

Conclusion

Is effective online environmental education (EE) possible, and is it capable of fostering nature connection in older populations? It is crucial to provide answers to this question as we face a world where the accelerating scale of the environmental crisis both (a) demands a citizenry cognitively, affectively, and behaviorally connected to planetary systems and (b) increasingly forces students out of the classroom into distance learning scenarios. Environmental educators are charged with delivering the first of these factors, while obligated to interface with the second. Ultimately, it is incumbent upon the field of EE to determine how best to leverage information technology to achieve CTN in less-than-ideal teaching and learning situations.

The findings from this research contribute to a rapidly growing body of literature (Ardoin & Bowers, 2020; Barrable, 2019; Ives & Giusti et al., 2017; Mullenbach et al., 2019; Pirchio et al., 2021; Salazar et al., 2021) which seeks to understand and promote CTN as an explicit outcome of EE. These findings make new and valuable contributions to the field of EE by specifically examining the 21st Century college student experiences of CTN in relation to online learning, technology-mediated nature, and emerging adulthood. This understanding of the elements of online EE that influence CTN can guide practitioners in better designing programs and making pedagogical decisions to reinforce and potentially increase CTN measures in their learners. Especially given the heightened stages of identity formation that college students are often in, college educators have the unique opportunity to make a lasting, positive, outsized impact on the lives of their students.

Based on the findings from this study, there are certain factors to consider when designing and teaching EE online. This research suggests that digital representation or mediation of complex natural systems could increase conceptual understanding in learners by rendering

invisible interconnections visible and interactive. This research also suggests that such interventions may be used to augment or enhance some form of outdoor experience, as these technologies are currently incapable of providing the full interactive freedom and direct sensory contact with nature that drives affective connections.

It is evident from the self-described experiences of participants in this study that their strong feelings of nature connection had a significant impact on their personal and professional identities. All participants rated high on CTN psychometrics and felt that the most important identity descriptors for them were those that described their agency in the world as environmentalists and scientists. Correspondingly, the majority anticipated either pursuing careers in the environmental field or continuing to engage personally with environmental issues through individual choices and community engagement. While, overall, the course under study did not statistically increase CTN measures, participants generally made it clear that their feelings of connection were reinforced by the experience.

None of the findings here refute any of the fundamental understanding of how CTN is developed (Chawla, 2007; Cleary et al., 2020). Rather, they serve to reinforce the understanding that experiences *in* nature are likely prerequisite for connecting *to* nature. In instances where formal, structured learning outdoors is impossible, however, this study illustrates the potential to impact at least the cognitive component of CTN in students.

As both an environmental educator and conservation practitioner—facing a world where students will increasingly be engaged in some form of distance learning—I have long wondered about the feasibility of connecting learners to nature when we (myself, students, and the landscape) are all separated by space. Findings from this research demonstrate that, as part of a suite of learning experiences, online technologies might be used to bolster CTN measures in

students, and that—even if the effectiveness is minimal—college educators owe it to their emerging adult students in order to strengthen their lifelong, environmental commitments.

REFERENCES

- Ahn, S. J., Bostick, J., Ogle, E., Nowak, K. L., McGillicuddy, K. T., & Bailenson, J. N. (2016). Experiencing nature: Embodying animals in immersive virtual environments increases inclusion of nature in self and involvement with nature. *Journal of Computer-Mediated Communication: JCMC*, 21(6), 399–419. <https://doi.org/10.1111/jcc4.12173>
- Aivazidis, C., Lazaridou, M., & Helldén, G. F. (2006). A comparison between a traditional and an online environmental educational program. *The Journal of Environmental Education*, 37(4), 45–54. <https://doi.org/10.3200/JOEE.37.4.45-54>
- Albrecht, G. (2005). “Solastalgia”: A new concept in health and identity. *PAN: Philosophy Activism Nature*, 3, 41–55. <https://doi.org/10.3316/informit.897723015186456>
- Albrecht, G., Sartore, G.-M., Connor, L., Higginbotham, N., Freeman, S., Kelly, B., Stain, H., Tonna, A., & Pollard, G. (2007). Solastalgia: the distress caused by environmental change. *Australasian Psychiatry: Bulletin of Royal Australian and New Zealand College of Psychiatrists*, 15 Suppl 1, S95–S98. <https://doi.org/10.1080/10398560701701288>
- Altbach, P. G., Reisberg, L., & Rumbley, L. E. (2009). *Trends in global higher education: Tracking an academic revolution*. UNESCO Publishing.
- Amemado, D. (2020). COVID-19: An unexpected and unusual driver to online education. *International Higher Education*, (102), 12–14. Amemado, D. (2020). https://www.academia.edu/download/63441303/COVID-19_An_Unexpected_and_Unusual_Driver_to_Online_Education_1374920200527-28390-1y0ipej.pdf
- Ardoin, N. M. (2006). Toward an interdisciplinary understanding of place: Lessons for environmental education. *Canadian Journal of Environmental Education (CJEE)*, 11(1), 112–126. <https://cjee.lakeheadu.ca/article/view/508>
- Ardoin, N. M., & Bowers, A. W. (2020). Early childhood environmental education: A systematic review of the research literature. *Educational Research; a Review for Teachers and All Concerned with Progress in Education*, 31, 100353. <https://doi.org/10.1016/j.edurev.2020.100353>
- Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. *Biological Conservation*, 241, 108224. <https://doi.org/10.1016/j.biocon.2019.108224>
- Ardoin, N. M., Bowers, A. W., Roth, N. W., & Holthuis, N. (2018). Environmental education and K-12 student outcomes: A review and analysis of research. *The Journal of Environmental Education*, 49(1), 1–17. <https://doi.org/10.1080/00958964.2017.1366155>
- Arendt, F., & Matthes, J. (2016). Nature documentaries, connectedness to nature, and pro-environmental behavior. *Environmental Communication*, 10(4), 453–472. <https://doi.org/10.1080/17524032.2014.993415>
- Arnett, J. J. (2000). Emerging adulthood: A theory of development from the late teens through the twenties. *American Psychologist*, 55(5), 469–480. <https://doi.org/10.1037//0003-066X.55.5.469>

- Arnett, J. J. (2007). Suffering, selfish, slackers? Myths and reality about emerging adults. *Journal of Youth and Adolescence*, 36(1), 23–29. <https://doi.org/10.1007/s10964-006-9157-z>
- Arnett, J. J. (2015). *The Oxford handbook of emerging adulthood*. Oxford University Press.
- Arnett, J. J. (2016). Does emerging adulthood theory apply across social classes? National data on a persistent question. *Emerging Adulthood*, 4(4), 227–235. <https://doi.org/10.1177/2167696815613000>
- Arnold, D. (1996). *The problem of nature: Environment and culture in a historical perspective*. Wiley-Blackwell.
- Aron, A., Aron, E. N., & Smollan, D. (1992). Inclusion of Other in the Self Scale and the structure of interpersonal closeness. *Journal of Personality and Social Psychology*, 63(4), 596–612. <https://doi.org/10.1037/0022-3514.63.4.596>
- Aron, A., Aron, E. N., Tudor, M., & Nelson, G. (1991). Close relationships as including other in the self. *Journal of Personality and Social Psychology*, 60(2), 241. <http://psycnet.apa.org/journals/psp/60/2/241.html?uid=1991-18305-001>
- Avci, D. E., & Karaca, D. (2012). An investigation of students' academic development, views, and feelings through journals. *Eurasia Journal of Mathematics, Science & Technology Education*. <https://www.ejmste.com/article/an-investigation-of-students-academicdevelopment-views-and-feelingsthrough-journals-4239>
- Ayress, L. (2008). Thematic coding and analysis. In L. M. Given (Ed.), *The SAGE encyclopedia of qualitative research methods* (p. 868). SAGE Publications.
- Azeiteiro, U. M., & Bacelar-Nicolau, P. (2016). Online teaching for biodiversity conservation. In P. Castro, U. M. Azeiteiro, P. Bacelar-Nicolau, W. Leal Filho, & A. M. Azul (Eds.), *Biodiversity and Education for Sustainable Development* (pp. 305–319). Springer International Publishing.
- Bader, V. (2001). Culture and identity: Contesting constructivism. *Ethnicities*, 1(2), 251–273. <https://doi.org/10.1177/146879680100100206>
- Bagust, P. (2008). “Screen natures”: Special effects and edutainment in “new” hybrid wildlife documentary. *Continuum*, 22(2), 213–226. <https://doi.org/10.1080/10304310701861564>
- Baker, R. E., Mahmud, A. S., Miller, I. F., Rajeev, M., Rasambainarivo, F., Rice, B. L., Takahashi, S., Tatem, A. J., Wagner, C. E., Wang, L.-F., Wesolowski, A., & Metcalf, C. J. E. (2022). Infectious disease in an era of global change. *Nature Reviews Microbiology*, 20(4), 193–205. <https://doi.org/10.1038/s41579-021-00639-z>
- Bao, W. (2020). COVID-19 and online teaching in higher education: A case study of Peking University. *Human Behavior and Emerging Technologies*, 2(2), 113–115. <https://doi.org/10.1002/hbe.2.191>
- Barnett, A. G., van der Pols, J. C., & Dobson, A. J. (2005). Regression to the mean: What it is and how to deal with it. *International Journal of Epidemiology*, 34(1), 215–220. <https://doi.org/10.1093/ije/dyh299>
- Barrable, A. (2019). Refocusing environmental education in the early years: A brief introduction to a

- pedagogy for connection. *Education Sciences*, 9(1), 61. <https://doi.org/10.3390/educsci9010061>
- Barthel, S., Belton, S., Raymond, C. M., & Giusti, M. (2018). Fostering children's connection to nature through authentic situations: The case of saving salamanders at school. *Frontiers in Psychology*, 9, 928. <https://doi.org/10.3389/fpsyg.2018.00928>
- Bashan, B., & Holsblat, R. (2017). Reflective journals as a research tool: The case of student teachers' development of teamwork. *Cogent Education*, 4(1), 1374234. <https://doi.org/10.1080/2331186X.2017.1374234>
- Bazeley, P. (2016). Mixed or merged? Integration as the real challenge for mixed methods. *Qualitative Research in Organizations and Management: An International Journal*, 11(3), 189–194. <https://doi.org/10.1108/QROM-04-2016-1373>
- Bazeley, P. (2020). Integrative Analysis for Mixed Methods Research. In P. Atkinson, S. Delamont, A. Cernat, Sakshaug, W. Joseph, & R. A. Williams (Eds.), *SAGE Research Methods Foundations*. SAGE Publications, Inc.
- Beery, T. H., & Wolf-Watz, D. (2014). Nature to place: Rethinking the environmental connectedness perspective. *Journal of Environmental Psychology*, 40, 198–205. <https://doi.org/10.1016/j.jenvp.2014.06.006>
- Beery, T. H., Jönsson, K. I., & Elmberg, J. (2015). From environmental connectedness to sustainable futures: Topophilia and human affiliation with nature. *Sustainability: Science Practice and Policy*, 7(7), 8837–8854. <https://doi.org/10.3390/su7078837>
- Benyon, D., Smyth, M., O'Neill, S., McCall, R., & Carroll, F. (2006). The place probe: Exploring a sense of place in real and virtual environments. *Presence: Teleoperators and Virtual Environments*, 15(6), 668–687. <https://doi.org/10.1162/pres.15.6.668>
- Berliner, R., & Masterson, T. L. (2015). Review of research: Promoting empathy development in the early childhood and elementary classroom. *Childhood Education*, 91(1), 57–64. <https://doi.org/10.1080/00094056.2015.1001675>
- Bertling, J. G. (2015). The art of empathy: A mixed methods case study of a critical place-based art education program. *International Journal of Education & the Arts*, 16(13). <http://www.ijea.org/v16n13/>
- Bingham, A. J., & Witkowsky, P. (2021). Deductive and inductive approaches to qualitative data analysis. In C. Vanover, J. Saldana, & P. Mihás (Eds.), *Analyzing and Interpreting Qualitative Research: After the Interview* (pp. 133–148). SAGE Publications, Inc.
- Boateng, W. (2012). Evaluating the efficacy of focus group discussion (FGD) in qualitative social research. *International Journal of Business and Social Science*, 3(7). http://www.ijbssnet.com/journals/Vol_3_No_7_April_2012/6.pdf
- Boland, J., Banks, S., Krabbe, R., Lawrence, S., Murray, T., Henning, T., & Vandenberg, M. (2021). A COVID-19-era rapid review: using Zoom and Skype for qualitative group research. *Public Health Research & Practice*, 1–9. <https://doi.org/10.17061/phrp31232112>
- Botetzagias, I., Dima, A.-F., & Malesios, C. (2015). Extending the theory of planned behavior in the

- context of recycling: The role of moral norms and of demographic predictors. *Resources, Conservation and Recycling*, 95, 58–67. <https://doi.org/10.1016/j.resconrec.2014.12.004>
- Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, 9(2), 27–40. <https://doi.org/10.3316/QRJ0902027>
- Boyce, J. K., Narain, S., & Stanton, E. A. (2007). *Reclaiming Nature: Environmental Justice and Ecological Restoration*. Anthem Press.
- Bozkurt, A. (2019). From distance education to open and distance learning: A holistic evaluation of history, definitions, and theories. In *Handbook of Research on Learning in the Age of Transhumanism* (pp. 252–273). IGI Global.
- Branchini, S., Meschini, M., Covi, C., Piccinetti, C., Zaccanti, F., & Goffredo, S. (2015). Participating in a citizen science monitoring program: Implications for environmental education. *PloS One*, 10(7), e0131812. <https://doi.org/10.1371/journal.pone.0131812>
- Breves, P., & Heber, V. (2019). Into the wild: The effects of 360° immersive nature videos on feelings of commitment to the environment. *Environmental Communication*, 1–15. <https://doi.org/10.1080/17524032.2019.1665566>
- Briggs, L., Trautmann, N., & Phillips, T. (2019). Exploring challenges and lessons learned in cross-cultural environmental education research. *Evaluation and Program Planning*, 73, 156–162. <https://doi.org/10.1016/j.evalprogplan.2019.01.001>
- Brinkmann, S. (2014). Unstructured and Semi-Structured Interviewing. In P. Leavy (Ed.), *The Oxford Handbook of Qualitative Research* (pp. 277–299). Oxford University Press.
- Bronack, S. C. (2011). The role of immersive media in online education. *The Journal of Continuing Higher Education*, 59(2), 113–117. <https://doi.org/10.1080/07377363.2011.583186>
- Brügger, A., Kaiser, F. G., & Roczen, N. (2011). One for all? Connectedness to nature, inclusion of nature, environmental identity, and implicit association with nature. *European Psychologist*, 16(4), 324. <https://doi.org/10.1027/1016-9040/a000032>
- Bruni, C. M., & Schultz, W. (2010). Implicit beliefs about self and nature: Evidence from an IAT game. *Journal of Environmental Psychology*, 30(1), 95–102. <https://doi.org/10.1016/j.jenvp.2009.10.004>
- Bundick, M. J. (2011). The benefits of reflecting on and discussing purpose in life in emerging adulthood. *New Directions for Youth Development*, 2011(132), 89–103, 10–11. <https://doi.org/10.1002/yd.430>
- Bureau of Economic Analysis. (2021). Regional data: GDP and personal income [Average income by state]. <https://apps.bea.gov/iTable/iTable.cfm?reqid=70&step=1&acrdr=2>
- Carpenter, D. (2018). Ethics, Reflexivity and Virtue. In R. Iphofen & M. Tolich (Eds.), *The SAGE Handbook of Qualitative Research Ethics* (pp. 35–50).
- Carter, R. L., & Simmons, B. (2010). The history and philosophy of environmental education. In A. M. Bodzin, B. Shiner Klein, & S. Weaver (Eds.), *The Inclusion of Environmental Education in*

- Science Teacher Education* (pp. 3–16). Springer Netherlands.
- Castree, N. (2014). *Making Sense of Nature*. Routledge.
- Čeřovský, J. (1976). International Workshop on Environmental Education held at the “Yugoslavia” Hotel, Belgrade, Yugoslavia, 13–22 October 1975. *Environmental Conservation*, 3(1), 76–77. <https://doi.org/10.1017/S037689290001794X>
- Chase, S. K., & Levine, A. (2018). Citizen science: Exploring the potential of natural resource monitoring programs to influence environmental attitudes and behaviors. *Conservation Letters*, 11(2), e12382. <https://doi.org/10.1111/conl.12382>
- Chawla, L. (1998). Significant life experiences revisited: A review of research on sources of environmental sensitivity. *The Journal of Environmental Education*, 29(3), 11–21. <https://doi.org/10.1080/00958969809599114>
- Chawla, L. (1999). Life paths into effective environmental action. *The Journal of Environmental Education*, 31(1), 15–26. <https://doi.org/10.1080/00958969909598628>
- Chawla, L. (2007). Childhood experiences associated with care for the natural world: A theoretical framework for empirical results. *Children, Youth and Environments*, 17(4), 144–170. <http://www.jstor.org/stable/10.7721/chilyoutenvi.17.4.0144>
- Chawla, L., & Cushing, D. F. (2007). Education for strategic environmental behavior. *Environmental Education Research*, 13(4), 437–452. <https://doi.org/10.1080/13504620701581539>
- Cheng, J. C.-H., & Monroe, M. C. (2012). Connection to nature: Children’s affective attitude toward nature. *Environment and Behavior*, 44(1), 31–49. <https://doi.org/10.1177/0013916510385082>
- Choy, S. (2002). *Nontraditional undergraduates*. National Center for Education Statistics.
- Cialdini, R. B., Brown, S. L., Lewis, B. P., Luce, C., & Neuberg, S. L. (1997). Reinterpreting the empathy–altruism relationship: When one into one equals oneness. *Journal of Personality and Social Psychology*, 73(3), 481–494. <https://doi.org/10.1037/0022-3514.73.3.481>
- Clayton, S. D. (2003). Environmental identity: A conceptual and an operational definition. In S. Clayton & S. Opatow (Eds.), *Identity and the Natural Environment: The Psychological Significance of Nature* (pp. 45–65). The MIT Press.
- Clayton, S. D., & Saunders, C. D. (2012). Introduction: Environmental and conservation psychology. In S. D. Clayton (Ed.), *The Oxford Handbook of Environmental and Conservation Psychology*. Oxford University Press.
- Cleary, A., Fielding, K. S., Murray, Z., & Roiko, A. (2020). Predictors of nature connection among urban residents: Assessing the role of childhood and adult nature experiences. *Environment and Behavior*, 52(6), 579–610. <https://doi.org/10.1177/0013916518811431>
- Clifton, L., & Clifton, D. A. (2019). The correlation between baseline score and post-intervention score, and its implications for statistical analysis. *Trials*, 20(1), 43. <https://doi.org/10.1186/s13063-018-3108-3>

- Coccoli, L. M. (2020). *Assessing the effectiveness of an electronic environmental education curriculum with applied use of trail camera photographs* [University of Montana].
<https://scholarworks.umt.edu/etd/11588/>
- Colding, J., Giusti, M., Haga, A., Wallhagen, M., & Barthel, S. (2020). Enabling relationships with nature in cities. *Sustainability: Science Practice and Policy*, 12(11), 4394.
<https://doi.org/10.3390/su12114394>
- Cosgriff, M. (2011). Learning from leisure: Developing nature connectedness in outdoor education. *Asia-Pacific Journal of Health, Sport and Physical Education*, 2(1), 51–65.
<https://doi.org/10.1080/18377122.2011.9730343>
- Côté, J. E. (2014). The dangerous myth of emerging adulthood: An evidence-based critique of a flawed developmental theory. *Applied Developmental Science*, 18(4), 177–188.
<https://doi.org/10.1080/10888691.2014.954451>
- Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Prentice Hall.
- Creswell, J. W. (2014). *A Concise introduction to mixed methods research*. SAGE Publications, Inc.
- Creswell, J. W. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches*. SAGE Publications, Inc.
- Creswell, J. W., & Báez, J. C. (2020). *30 Essential skills for the qualitative researcher*. SAGE Publications, Inc.
- Creswell, J. W., & Plano Clark, V. L. (2017). *Designing and conducting mixed methods research*. SAGE Publications, Inc.
- Croasmun, J. T., & Ostrom, L. (2011). Using Likert-type scales in the social sciences. *Journal of Adult Education*, 40(1), 19–22. <http://files.eric.ed.gov/fulltext/EJ961998.pdf>
- Cudworth, D. (2020). Promoting an emotional connection to nature and other animals via forest school: Disrupting the spaces of neoliberal performativity. *The International Journal of Sociology and Social Policy*, ahead-of-print(ahead-of-print). <https://doi.org/10.1108/IJSSP-09-2019-0188>
- Daszak, P., das Neves, C., Amuasi, J., Hayman, D., Kuiken, T., Roche, B., Zambrana-Torrel, C., Buss, P., Dunderova, H., Feferholtz, Y., Foldvari, G., Igbinsola, E., Junglen, S., Liu, Q., Suzan, G., Uhart, M., Wannous, C., Woolaston, K., Mosig Reidl, P., ... Ngo, H. T. (Eds.). (2020). *Workshop Report on Biodiversity and Pandemics of the Intergovernmental Platform on Biodiversity and Ecosystem Services*. IBPES.
- Dawadi, S., Shrestha, S., & Giri, R. A. (2021). Mixed methods research: A discussion on its types, challenges, and criticisms. *Journal of Practical Studies in Education*, 2(2).
<https://doi.org/10.46809/jpse.v2i2.20>
- Denscombe, M. (2014). *The Good research guide: For small-scale social research projects*. McGraw-Hill Education (UK).
- Deringer, S. A., & Hanley, A. (2021). Virtual reality of nature can be as effective as actual nature in

- promoting ecological behavior. *Ecopsychology*. <https://doi.org/10.1089/eco.2020.0044>
- Descola, P., & Pálsson, G. (1996). *Nature and society: Anthropological perspectives* (P. Descola & G. Pálsson (Eds.)). Taylor & Francis.
- Dickinson, E. (2013). The misdiagnosis: Rethinking “Nature-deficit Disorder.” *Environmental Communication*, 7(3), 315–335. <https://doi.org/10.1080/17524032.2013.802704>
- Dutcher, D. D., Finley, J. C., Luloff, A. E., & Johnson, J. B. (2007). Connectivity with nature as a measure of environmental values. *Environment and Behavior*, 39(4), 474–493. <https://doi.org/10.1177/0013916506298794>
- Edelman, A. J., & Edelman, J. L. (2017). An inquiry-based approach to engaging undergraduate students in on-campus conservation research using camera traps. *Southeastern Naturalist*. <https://bioone.org/journals/Southeastern-Naturalist/volume-16/issue-sp10/058.016.0sp1009/An-Inquiry-Based-Approach-to-Engaging-Undergraduate-Students-in-On/10.1656/058.016.0sp1009.short>
- Edwards, R. C., & Larson, B. M. H. (2020). When screens replace backyards: Strategies to connect digital-media-oriented young people to nature. *Environmental Education Research*, 26(7), 950–968. <https://doi.org/10.1080/13504622.2020.1776844>
- Elliott, V. (2018). Thinking about the coding process in qualitative data analysis. *The Qualitative Report; Fort Lauderdale*, 23(11), 2850–2861. <https://nsuworks.nova.edu/tqr/vol23/iss11/14>
- EPA (n.d.). *What is environmental education?* US Environmental Protection Agency. <https://www.epa.gov/education/what-environmental-education>
- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1–4. <https://doi.org/10.11648/j.ajtas.20160501.11>
- Erdogan, M. (2015). The effect of summer environmental education program (SEEP) on elementary school students’ environmental literacy. *International Journal of Environmental and Science Education*, 10(2), 165–181. <https://eric.ed.gov/?id=EJ1062929>
- Ernst, J., & Theimer, S. (2011). Evaluating the effects of environmental education programming on connectedness to nature. *Environmental Education Research*, 17(5), 577–598. <https://doi.org/10.1080/13504622.2011.565119>
- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1. <https://doi.org/10.11648/j.ajtas.20160501.11>
- Ewert, A., Place, G., & Sibthorp, J. (2005). Early-life outdoor experiences and an individual’s environmental attitudes. *Leisure Sciences*, 27(3), 225–239. <https://doi.org/10.1080/01490400590930853>
- Fang, M. L., Canham, S. L., Battersby, L., Sixsmith, J., Wada, M., & Sixsmith, A. (2019). Exploring privilege in the digital divide: Implications for theory, policy, and practice. *The Gerontologist*, 59(1), e1–e15. <https://doi.org/10.1093/geront/gny037>

- Fatma, A. (2015). Higher education and privilege: 21st century issues [special section]. *College Student Affairs Leadership*, 2(2). <http://scholarworks.gvsu.edu/csai/vol2/iss2/2>
- Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods*, 5(1), 80–92. <https://doi.org/10.1177/160940690600500107>
- Fetters, M. D., Curry, L. A., & Creswell, J. W. (2013). Achieving integration in mixed methods designs—principles and practices. *Health Services Research*, 48(6 Pt 2), 2134–2156. <https://doi.org/10.1111/1475-6773.12117>
- Fletcher-Flinn, C. M., & Gravatt, B. (1995). The efficacy of computer assisted instruction (CAI): A meta-analysis. *Journal of Educational Computing Research*, 12(3), 219–241. <https://doi.org/10.2190/51D4-F6L3-JQHU-9M31>
- Fletcher, R. (2017). Connection with nature is an oxymoron: A political ecology of “nature-deficit disorder.” *The Journal of Environmental Education*, 48(4), 226–233. <https://doi.org/10.1080/00958964.2016.1139534>
- Folke, C., Jansson, A., Rockström, J., Olsson, P., Carpenter, S. R., Chapin, F. S., 3rd, Crépin, A.-S., Daily, G., Danell, K., Ebbesson, J., Elmqvist, T., Galaz, V., Moberg, F., Nilsson, M., Osterblom, H., Ostrom, E., Persson, A., Peterson, G., Polasky, S., ... Westley, F. (2011). Reconnecting to the biosphere. *Ambio*, 40(7), 719–738. <https://doi.org/10.1007/s13280-011-0184-y>
- Frantz, C. M., Mayer, F. S., Norton, C., & Rock, M. (2005). There is no “I” in nature: The influence of self-awareness on connectedness to nature. *Journal of Environmental Psychology*, 25(4), 427–436. <https://doi.org/10.1016/j.jenvp.2005.10.002>
- Frantz, C. M., & Mayer, F. S. (2009). The emergency of climate change: Why are we failing to take action? *Analyses of Social Issues and Public Policy*, 9(1), 205–222. <https://doi.org/10.1111/j.1530-2415.2009.01180.x>
- Frantz, C. M., & Mayer, F. S. (2014). The importance of connection to nature in assessing environmental education programs. *Studies in Educational Evaluation*, 41, 85–89. <https://doi.org/10.1016/j.stueduc.2013.10.001>
- Fraser, G. (2018). Evaluating inclusive gender identity measures for use in quantitative psychological research. *Psychology & Sexuality*, 9(4), 343–357. <https://doi.org/10.1080/19419899.2018.1497693>
- Fung, F. M., Choo, W. Y., Ardisara, A., Zimmermann, C. D., Watts, S., Koscielniak, T., Blanc, E., Coumoul, X., & Dumke, R. (2019). Applying a virtual reality platform in environmental chemistry education to conduct a field trip to an overseas site. *Journal of Chemical Education*, 96(2), 382–386. <https://doi.org/10.1021/acs.jchemed.8b00728>
- Galanaki, E., & Leontopoulou, S. (2017). Criteria for the transition to adulthood, developmental features of emerging adulthood, and views of the future among Greek studying youth. *European Journal of Psychological Assessment: Official Organ of the European Association of Psychological Assessment*, 13(3), 417–440. <https://doi.org/10.5964/ejop.v13i3.1327>
- Gallagher, S., & Palmer, J. (2020, September 29). The pandemic pushed universities online. The change

- was long overdue. *Harvard Business Review*. <https://hbr.org/2020/09/the-pandemic-pushed-universities-online-the-change-was-long-overdue>
- Gardner, D. G., Cummings, L. L., Dunham, R. B., & Pierce, J. L. (1998). Single-item versus multiple-item measurement scales: An empirical comparison. *Educational and Psychological Measurement, 58*(6), 898–915. <https://doi.org/10.1177/0013164498058006003>
- Garner, L. C., & Gallo, M. A. (2005). Field trips and their effect on student achievement and attitudes: A comparison of physical versus virtual field trips to the Indian River Lagoon. *Journal of College Science Teaching, 34*(5), 14. <https://www.nsta.org/resources/research-and-teaching-field-trips-and-their-effect-student-achievement-and-attitudes>
- Geldhof, G. J., Warner, D. A., Finders, J. K., Thogmartin, A. A., Clark, A., & Longway, K. A. (2018). Revisiting the utility of retrospective pre-post designs: The need for mixed method pilot data. *Evaluation and Program Planning, 70*, 83–89. <https://doi.org/10.1016/j.evalprogplan.2018.05.002>
- Geng, L., Xu, J., Ye, L., Zhou, W., & Zhou, K. (2015). Connections with nature and environmental behaviors. *PLoS One, 10*(5), e0127247. <https://doi.org/10.1371/journal.pone.0127247>
- Gerstenberger, S. L., Kelly, W. E., & Cross, C. L. (2004). The influence of an introductory environmental science class on environmental perceptions. *Journal of Natural Resources and Life Sciences Education, 33*(1), 73–76. <https://doi.org/10.2134/jnrlse.2004.0073>
- Gibbs, G. R. (2007). Thematic coding and categorizing. In G. R. Gibbs (Ed.), *Analyzing Qualitative Data* (Vol. 703, pp. 38–56). SAGE Publications.
- Gkargkavouzi, A., Halkos, G., & Matsiori, S. (2019). A multi-dimensional measure of environmental behavior: Exploring the predictive power of connectedness to nature, ecological worldview and environmental concern. *Social Indicators Research, 143*(2), 859–879. <https://doi.org/10.1007/s11205-018-1999-8>
- Glaeser, B. (2001). *The changing human-nature relationship (HNR) in the context of GEC*. WZB Discussion Paper. <https://www.econstor.eu/handle/10419/48979>
- Glesne, C. (1989). Rapport and friendship in ethnographic research. *International Journal of Qualitative Studies in Education: QSE, 2*(1), 45–54. <https://doi.org/10.1080/0951839890020105>
- Golley, F. B. (1998). *A primer for environmental literacy*. Yale University Press.
- Goode, J. P., & Stroup, D. R. (2015). Everyday nationalism: Constructivism for the masses. *Social Science Quarterly, 96*(3), 717–739. <https://doi.org/10.1111/ssqu.12188>
- Gould, R., & Schultz, P. W. (2021). Challenges to understanding nonmaterial dimensions of human-nature connections, and how to address them. *Ecology and Society, 26*(3). <https://doi.org/10.5751/ES-12604-260314>
- Gulwadi, B. G. (2009). Using reflective journals in a sustainable design studio. *International Journal of Sustainability in Higher Education, 10*(1), 43–53. <https://doi.org/10.1108/14676370910925244>
- Granshaw, F. D., & Duggan-Haas, D. (2012). Virtual fieldwork in geoscience teacher education: Issues,

- techniques, and models. *Geological Society of America Special Papers*, 492, 285–303.
https://www.academia.edu/20868388/Virtual_fieldwork_in_geoscience_teacher_education_Issue_s_techniques_and_models
- Guba, E. G., & Lincoln, Y. S. (1994). *Competing paradigms in qualitative research* (Vol. 2, p. 105). SAGE Publications, Inc.
- Guckian, M., De Young, R., & Harbo, S. (2017). Beyond green consumerism: Uncovering the motivations of green citizenship. *Michigan Journal of Sustainability*, 5(1).
<https://deepblue.lib.umich.edu/handle/2027.42/138130>
- Guetterman, T. C., Fetters, M. D., & Creswell, J. W. (2015). Integrating quantitative and qualitative results in health science mixed methods research through joint displays. *Annals of Family Medicine*, 13(6), 554–561. <https://doi.org/10.1370/afm.1865>
- Hammersley, M. (1993). On the teacher as researcher. *Educational Action Research*, 1(3), 425–445.
<https://doi.org/10.1080/0965079930010308>
- Hanley, C., Freeman, R. L., Fryar, A. E., Sherman, A. R., & Edwards, E. (2019). Water in India and Kentucky: Developing an online curriculum with field experiences for high school classes in diverse settings. *Journal of Contemporary Water Research & Education*, 168(1), 78–92.
<https://doi.org/10.1111/j.1936-704X.2019.03322.x>
- Hanna, P. (2012). Using internet technologies (such as Skype) as a research medium: A research note. *Qualitative Research: QR*, 12(2), 239–242. <https://doi.org/10.1177/1468794111426607>
- Hansen, R. E. (1995). Teacher socialization in technological education. *Journal of Technology Education*, 6(2). <https://vtechworks.lib.vt.edu/bitstream/handle/10919/8579/hansenb.pdf?sequence=1>
- Harrison, R. L., Reilly, T. M., & Creswell, J. W. (2020). Methodological rigor in mixed methods: An application in management studies. *Journal of Mixed Methods Research*, 1-23.
<https://doi.org/10.1177/1558689819900585>
- Hart, C. M. D., Berger, D., Jacob, B., Loeb, S., & Hill, M. (2019). Online learning, offline outcomes: Online course taking and high school student performance. *AERA Open*, 5(1).
<https://doi.org/10.1177/2332858419832852>
- Hausmann, A., Slotow, R., Burns, J. K., & Di Minin, E. (2016). The ecosystem service of sense of place: benefits for human well-being and biodiversity conservation. *Environmental Conservation*, 43(2), 117–127. <https://doi.org/10.1017/S0376892915000314>
- Häyriinen, L., & Pynnönen, S. (2020). A review of the concepts and measurements for connection to nature and environmentally responsible behaviour—a call for research on human-forest relationships. *Current Forestry Reports*. <https://doi.org/10.1007/s40725-020-00131-6>
- Hendry, L. B., & Kloep, M. (2010). How universal is emerging adulthood? An empirical example. *Journal of Youth Studies*, 13(2), 169–179. <https://doi.org/10.1080/13676260903295067>
- Hess-Quimbita, G., & Pavel, M. (1996). *Assessing an environmental attitude development model: factors influencing the environmental attitudes of college students*.
<http://files.eric.ed.gov/fulltext/ED394438.pdf>

- Hill, J. M., Lalji, M., van Rossum, G., van der Geest, V. R., & Blokland, A. A. J. (2015). Experiencing emerging adulthood in the Netherlands. *Journal of Youth Studies, 18*(8), 1035–1056. <https://doi.org/10.1080/13676261.2015.1020934>
- Hochberg, Z. E., & Konner, M. (2019). Emerging adulthood, a pre-adult life-history stage. *Frontiers in Endocrinology, 10*, 918. <https://doi.org/10.3389/fendo.2019.00918>
- Hoover, B. K. (2017). Relating student perceptions of course interest, enjoyment, value, and ease with academic achievement in university agriculture courses. *NACTA Journal, 61*(4), 324–328.
- Irvine, A., Drew, P., & Sainsbury, R. (2013). “Am I not answering your questions properly?” Clarification, adequacy and responsiveness in semi-structured telephone and face-to-face interviews. *Qualitative Research: QR, 13*(1), 87–106. <https://doi.org/10.1177/1468794112439086>
- Irwin, V., Zhang, J., Wang, X., Hein, S., Wang, K., Roberts, A., York, C., Barmer, A., Bullock Mann, F., Dilig, R., & Parker, S. (2021). *The condition of education 2021* (NCES 2021-144). US Department of Education.
- Ismail, M., Rahim, M. R. A., Azmi, S. S. (2019). The impact of self-efficacy (online measure) on students grade point scores. *International Journal of Asian Social Science, 9*(3), 271–275. <https://doi.org/10.18488/journal.1.2019.93.271.275>
- Ives, C. D., Abson, D. J., von Wehrden, H., Dorninger, C., Klanięcki, K., & Fischer, J. (2018). Reconnecting with nature for sustainability. *Sustainability Science, 13*(5), 1389–1397. <https://doi.org/10.1007/s11625-018-0542-9>
- Ives, C. D., Giusti, M., Fischer, J., Abson, D. J., Klanięcki, K., Dorninger, C., Laudan, J., Barthel, S., Abernethy, P., Martín-López, B., Raymond, C. M., Kendal, D., & von Wehrden, H. (2017). Human–nature connection: A multidisciplinary review. *Current Opinion in Environmental Sustainability, 26-27*, 106–113. <https://doi.org/10.1016/j.cosust.2017.05.005>
- Jahn, M., Haspel, M., & Siegmund, A. (2010). Using remote sensing data in the context of education for sustainable development. *Proceedings of 30th EARSeL Symposium of Remote Sensing for Science, Education, and Natural and Cultural Heritage, 731–738*.
- Janghorban, R., Latifnejad Roudsari, R., & Taghipour, A. (2014). Skype interviewing: The new generation of online synchronous interview in qualitative research. *International Journal of Qualitative Studies on Health and Well-Being, 9*(2). <https://doi.org/10.3402/qhw.v9.24152>
- Jensen, E., Jones, N., Rabe, M., Pratt, B., Medina, L., Orozco, K., & Spell, L. (2021). *2020 U.S. population more racially and ethnically diverse than measured in 2010*. U. S. Census Bureau. <https://www.census.gov/library/stories/2021/08/2020-united-states-population-more-racially-ethnically-diverse-than-2010.html>
- Jimenez-Buedo, M. (2018). Pre-experimental designs. In B. B. Frey (Ed.), *The SAGE Encyclopedia of Educational Research, Measurement, and Evaluation* (pp. 1290–1291). SAGE Publications, Inc.
- Johnson, D. R., Scheitle, C. P., & Ecklund, E. H. (2019). Beyond the in-person interview? How interview quality varies across in-person, telephone, and Skype interviews. *Social Science Computer Review, 1-17*. <https://doi.org/10.1177/0894439319893612>

- Johnson, R. E., Grove, A. L., & Clarke, A. (2019). Pillar integration process: A joint display technique to integrate data in mixed methods research. *Journal of Mixed Methods Research, 13*(3), 301–320. <https://doi.org/10.1177/1558689817743108>
- Jormanainen, I., Toivonen, T., & Nivalainen, V. (2018). A smart learning environment for environmental education. *Challenges and Solutions in Smart Learning, 13–16*. https://doi.org/10.1007/978-981-10-8743-1_2
- Joshi, O., Chapagain, B., Kharel, G., Poudyal, N. C., Murray, B. D., & Mehmood, S. R. (2020). Benefits and challenges of online instruction in agriculture and natural resource education. *Interactive Learning Environments, 1–12*. <https://doi.org/10.1080/10494820.2020.1725896>
- Kahn, P. H. (1999). *The human relationship with nature: Development and culture*. MIT Press.
- Kahn, P. H., Jr. (2002). Children's affiliations with nature: Structure, development, and the problem of environmental generational amnesia. In P. H. Kahn Jr & S. R. Kellert (Eds.), *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations* (pp. 93–116). MIT Press.
- Kaiser, F. G., Brügger, A., Hartig, T., Bogner, F. X., & Gutscher, H. (2014). Appreciation of nature and appreciation of environmental protection: How stable are these attitudes and which comes first? *European Review of Applied Psychology, 64*(6), 269–277. <https://doi.org/10.1016/j.erap.2014.09.001>
- Kals, E., & Müller, M. M. (2012). Emotions and environment. In S. D. Clayton (Ed.), *The Oxford Handbook of Environmental and Conservation Psychology*. Oxford University Press.
- Karlin, M., & De La Paz, G. (2015). Using camera-trap technology to improve undergraduate education and citizen-science contributions in wildlife research. *The Southwestern Naturalist, 60*(2/3), 171–179.
- Kellert, S. R. (2006). Building for life: designing and understanding the human-nature connection. *Renewable Resources Journal*. https://www.researchgate.net/publication/40777405_Building_for_Life_Designing_and_Understanding_the_Human-Nature_Connection
- Kellert, S. R., & Wilson, E. O. (1993). *The biophilia hypothesis*. Island Press.
- Kleespies, M. W., Feucht, V., Becker, M., & Dierkes, P. W. (2022). Environmental education in zoos: Exploring the impact of guided zoo tours on connection to nature and attitudes towards species conservation. *Journal of Zoological and Botanical Gardens, 3*(1), 56–68. <https://doi.org/10.3390/jzbg3010005>
- Klein, S. A., & Hilbig, B. E. (2018). How virtual nature experiences can promote pro-environmental behavior. *Journal of Environmental Psychology, 60*, 41–47. <https://doi.org/10.1016/j.jenvp.2018.10.001>
- Kleinsmith, A., Rivera-Gutierrez, D., Finney, G., Cendan, J., & Lok, B. (2015). Understanding empathy training with virtual patients. *Computers in Human Behavior, 52*, 151–158. <https://doi.org/10.1016/j.chb.2015.05.033>
- Kolås, L., Eriksen, L. F., Hoem, J. Ø., Nygård, S. A., & Holand, I. S. (2020). Interactive virtual field trips.

- Proceedings of EdMedia + Innovate Learning 2020*, 556–565.
<https://www.learntechlib.org/p/217352>
- Kollmuss, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8(3), 239–260.
<https://doi.org/10.1080/13504620220145401>
- Kopnina, H. (2011). Applying the new ecological paradigm scale in the case of environmental education: Qualitative analysis of the ecological world view of Dutch children. *Journal of Peace Education and Social Justice*, 5(3), 374–388. <http://www.infactispax.org/journal/>
- Kossack, A., & Bogner, F. X. (2012). How does a one-day environmental education programme support individual connectedness with nature? *Journal of Biological Education*, 46(3), 180–187.
<https://doi.org/10.1080/00219266.2011.634016>
- Koutromanos, G., Tzortzoglou, F., & Sofos, A. (2018). Evaluation of an augmented reality game for environmental education: “Save Elli, save the environment.” In T. A. Mikropoulos (Ed.), *Research on e-Learning and ICT in Education: Technological, Pedagogical and Instructional Perspectives* (pp. 231–241). Springer International Publishing.
- Krasny, M., & Bonney, R. (2005). Environmental education through citizen science and participatory action research. In E. A. Johnson & M. Mappin (Eds.), *Environmental Education and Advocacy: Changing Perspectives of Ecology and Education* (p. 292). Cambridge University Press.
- Kudryavtsev, A., Stedman, R. C., & Krasny, M. E. (2012). Sense of place in environmental education. *Environmental Education Research*, 18(2), 229–250.
<https://doi.org/10.1080/13504622.2011.609615>
- Lacina, J. G. (2004). Designing a virtual field trip. *Childhood Education*, 80, 221.
https://link.gale.com/apps/doc/A116223416/AONE?u=nhc_main&sid=AONE&xid=f1bfdf8e
- Lam, T. C. M., & Bengo, P. (2003). A comparison of three retrospective self-reporting methods of measuring change in instructional practice. *American Journal of Evaluation*, 24(1), 65–80.
<https://doi.org/10.1177/109821400302400106>
- Lange, F., & Dewitte, S. (2019). Measuring pro-environmental behavior: Review and recommendations. *Journal of Environmental Psychology*, 63, 92–100. <https://doi.org/10.1016/j.jenvp.2019.04.009>
- Lang, K. B. (2011). The relationship between academic major and environmentalism among college students: Is it mediated by the effects of gender, political ideology and financial security? *The Journal of Environmental Education*, 42(4), 203–215.
<https://doi.org/10.1016/j.jenvp.2019.04.009>
- Lankenau, G. R. (2018). Fostering connectedness to nature in higher education. *Environmental Education Research*, 24(2), 230–244. <https://doi.org/10.1080/13504622.2016.1225674>
- Larson, L. R., Stedman, R. C., Cooper, C. B., & Decker, D. J. (2015). Understanding the multi-dimensional structure of pro-environmental behavior. *Journal of Environmental Psychology*, 43, 112–124. <https://doi.org/10.1016/j.jenvp.2015.06.004>
- Larson, L. R., Szczytko, R., Bowers, E. P., Stephens, L. E., Stevenson, K. T., & Floyd, M. F. (2019).

- Outdoor time, screen time, and connection to nature: Troubling trends among rural youth? *Environment and Behavior*, 51(8), 966–991. <https://doi.org/10.1177/0013916518806686>
- Layland, E. K., Hill, B. J., & Nelson, L. J. (2018). Freedom to explore the self: How emerging adults use leisure to develop identity. *The Journal of Positive Psychology*, 13(1), 78–91. <https://doi.org/10.1080/17439760.2017.1374440>
- Lederman, D., & Lieberman, M. (2019, March 20). *How many public universities can “go big” online?* Inside Higher Ed. <https://www.insidehighered.com/digital-learning/article/2019/03/20/states-and-university-systems-are-planning-major-online>
- Lee, C. G. (2012). Reconsidering constructivism in qualitative research. *Educational Philosophy and Theory*, 44(4), 403–412. <https://doi.org/10.1111/j.1469-5812.2010.00720.x>
- Li, C., & Lalani, F. (2020, April 29). *The COVID-19 pandemic has changed education forever. This is how.* World Economic Forum. <https://www.weforum.org/agenda/2020/04/coronavirus-education-global-covid19-online-digital-learning/>
- Li, D., Zhao, L., Ma, S., Shao, S., & Zhang, L. (2019). What influences an individual’s pro-environmental behavior? A literature review. *Resources, Conservation and Recycling*, 146, 28–34. <https://doi.org/10.1016/j.resconrec.2019.03.024>
- Liefländer, A. K., Fröhlich, G., Bogner, F. X., & Schultz, W. (2013). Promoting connectedness with nature through environmental education. *Environmental Education Research*, 19(3), 370–384. Liefländer, A. K., Fröhlich, G., Bogner, F. X., & Schultz, W. (2013). <https://doi.org/10.1080/13504622.2012.697545>
- Lincoln, Y. S., & Guba, E. G. (2005). Paradigmatic controversies, contradictions, and emerging confluences. In E. Guba & Y. S. Lincoln (Eds.), *The SAGE Handbook of Qualitative Research* (Vol. 3, pp. 191–215). SAGE Publications, Inc.
- Lincoln, Y. S., & Guba, E. G. (2013). *The constructivist credo*. Left Coast Press.
- Little, T. D., Chang, R., Gorrall, B. K., Waggenpack, L., Fukuda, E., Allen, P. J., & Noam, G. G. (2020). The retrospective pretest–post-test design redux: On its validity as an alternative to traditional pretest–post-test measurement. *International Journal of Behavioral Development*, 44(2), 175–183. <https://doi.org/10.1177/0165025419877973>
- Locke, K., Feldman, M., & Golden-Biddle, K. (2020). Coding practices and iterativity: Beyond templates for analyzing qualitative data. *Organizational Research Methods*. <https://doi.org/10.1177/1094428120948600>
- Lo Iacono, V., Symonds, P., & Brown, D. H. K. (2016). Skype as a tool for qualitative research interviews. *Sociological Research Online*, 21(2), 103–117. <https://doi.org/10.5153/sro.3952>
- Loo, R. (2002). A caveat on using single-item versus multiple-item scales. *Journal of Managerial Psychology*, 17(1), 68–75. <https://doi.org/10.1108/02683940210415933>
- Louv, R. (2005). *Last child in the woods: Saving our kids from nature deficit disorder*. Algonquin Books.
- Lumber, R., Richardson, M., & Sheffield, D. (2017). Beyond knowing nature: Contact, emotion,

- compassion, meaning, and beauty are pathways to nature connection. *PloS One*, *12*(5), e0177186. <https://doi.org/10.1371/journal.pone.0177186>
- Lu, S.-J., & Liu, Y.-C. (2015). Integrating augmented reality technology to enhance children's learning in marine education. *Environmental Education Research*, *21*(4), 525–541. Lu, S.-J., & Liu, Y.-C. (2015). Integrating augmented reality technology to enhance children's learning in marine education. *Environmental Education Research*, *21*(4), 525–541. <https://doi.org/10.1080/13504622.2014.911247/>
- Lytle, M. H. (2007). *The gentle subversive: Rachel Carson, Silent Spring, and the rise of the environmental movement*. Oxford University Press.
- Mackay, C. M. L., Cristoffanini, F., Wright, J. D., Neufeld, S. D., Ogawa, H. F., & Schmitt, M. T. (2021). Connection to nature and environmental activism: Politicized environmental identity mediates a relationship between identification with nature and observed environmental activist behaviour. *Current Research in Ecological and Social Psychology*, *2*. <https://doi.org/10.1016/j.cresp.2021.100009>
- Mackay, C. M. L., & Schmitt, M. T. (2019). Do people who feel connected to nature do more to protect it? A meta-analysis. *Journal of Environmental Psychology*, *65*. <https://doi.org/10.1016/j.jenvp.2019.101323>
- Magnussen, L., & Amundson, M. J. (2003). Undergraduate nursing student experience. *Nursing & Health Sciences*, *5*(4), 261–267. <https://doi.org/10.1046/j.1442-2018.2003.00158.x>
- Mah, A., Matsuba, M. K., & Pratt, M. W. (2020). The politics behind environmentalism: How political ideological development in emerging adulthood may play a role. *Journal of Environmental Psychology*, *69*. <https://doi.org/10.1016/j.jenvp.2020.101417>
- Marani, M., Katul, G. G., Pan, W. K., & Parolari, A. J. (2021). Intensity and frequency of extreme novel epidemics. *Proceedings of the National Academy of Sciences of the United States of America*, *118*(35). <https://doi.org/10.1073/pnas.2105482118>
- Markowitz, E. M., Goldberg, L. R., Ashton, M. C., & Lee, K. (2012). Profiling the “pro-environmental individual”: a personality perspective. *Journal of Personality*, *80*(1), 81–111. <https://doi.org/10.1111/j.1467-6494.2011.00721.x>
- Marsden, E., & Torgerson, C. J. (2012). Single-group, pre- and post-test research designs: Some methodological concerns. *Oxford Review of Education*, *38*(5), 583–616. <https://doi.org/10.1080/03054985.2012.731208>
- Martin, C., & Czellar, S. (2016). The extended inclusion of nature in self scale. *Journal of Environmental Psychology*, *47*, 181–194. <https://doi.org/10.1016/j.jenvp.2016.05.006>
- Matsuba, M. K., Alisat, S., & Pratt, M. W. (2017). Environmental activism in emerging adulthood. In L. M. Padilla-Walker & L. J. Nelson (Eds.), *Flourishing in Emerging Adulthood: Positive Development During the Third Decade of Life* (pp. 175–201). Oxford University Press.
- Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S. L., Péan, C., Berger, S., Caud, N., Chen, Y., Goldfarb, L., Gomis, M., Huang, M., Leitzell, K., Lonnoy, E., Matthews, J. B. R., Maycock, T., Waterfield, T., Yelekçi, O., Yu, R., & Zhou, B. (Eds.). (2021). *Climate change 2021: The*

- physical science basis. Contribution of working group i to the sixth assessment report of the Intergovernmental Panel on Climate Change.* IPCC.
- Mayer, F. S., & Frantz, C. M. (2004). The connectedness to nature scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology, 24*(4), 503–515. <https://doi.org/10.1016/j.jenvp.2004.10.001>
- McBride, B. B., Brewer, C. A., Berkowitz, A. R., & Borrie, W. T. (2013). Environmental literacy, ecological literacy, ecoliteracy: What do we mean and how did we get here? *Ecosphere, 4*(5), art67. <https://doi.org/10.1890/ES13-00075.1>
- McClain, L. R., & Zimmerman, H. T. (2016). Technology-mediated engagement with nature: Sensory and social engagement with the outdoors supported through an e-Trailguide. *International Journal of Science Education, Part B, 6*(4), 385–399. <https://doi.org/10.1080/21548455.2016.1148827>
- McMillan, E. E., Wright, T., & Beazley, K. (2004). Impact of a university-level environmental studies class on students' values. *The Journal of Environmental Education, 35*(3), 19–27. <https://doi.org/10.3200/JOEE.35.3.19-27>
- Michaelson, V., King, N., Janssen, I., Lawal, S., & Pickett, W. (2020). Electronic screen technology use and connection to nature in Canadian adolescents: A mixed methods study. *Canadian Journal of Public Health. Revue Canadienne de Sante Publique*. <https://doi.org/10.17269/s41997-019-00289-y>
- Miller, A. L. (2011). Investigating social desirability bias in student self-report surveys. *Association for Institutional Research (NJ1)*. <https://eric.ed.gov/?id=ED531729>
- “Ming” Kuo, F. E. (2013). Nature-deficit disorder: Evidence, dosage, and treatment. *Journal of Policy Research in Tourism, Leisure and Events, 5*(2), 172–186. <https://doi.org/10.1080/19407963.2013.793520>
- Minton, T. G. (1980). *The history of the nature-study movement and its role in the development of environmental education* [UMass Amherst]. https://scholarworks.umass.edu/cgi/viewcontent.cgi?article=4601&context=dissertations_1
- Morgan, C. J. (2017). Use of proper statistical techniques for research studies with small samples. *American Journal of Physiology-Lung Cellular and Molecular Physiology, 313*(5), L873–L877. <https://doi.org/10.1152/ajplung.00238.2017>
- Morgan, E. M. (2013). Contemporary issues in sexual orientation and identity development in emerging adulthood. *Emerging Adulthood, 1*(1), 52–66. <https://doi.org/10.1177/2167696812469187>
- Moseley, C. (2000). Teaching for environmental literacy. *The Clearing House, 74*(1), 23–24.
- Mullenbach, L. E., Andrejewski, R. G., & Mowen, A. J. (2019). Connecting children to nature through residential outdoor environmental education. *Environmental Education Research, 25*(3), 365–374. <https://doi.org/10.1080/13504622.2018.1458215>
- NAAEE. (2015, May 19). *About EE and why it matters*. North American Association for Environmental Education. <https://naaee.org/about-us/about-ee-and-why-it-matters>

- National Center for Education Statistics (n.d.). *Nontraditional undergraduates - Definitions and data..*
<https://nces.ed.gov/pubs/web/97578e.asp>
- Nelson, L., Badger, S., & Wu, B. (2004). The influence of culture in emerging adulthood: Perspectives of Chinese college students. *International Journal of Behavioral Development, 28*(1), 26–36.
<https://doi.org/10.1080/01650250344000244>
- Nesbitt, L., Meitner, M. J., Girling, C., Sheppard, S. R. J., & Lu, Y. (2019). Who has access to urban vegetation? A spatial analysis of distributional green equity in 10 US cities. *Landscape and Urban Planning, 181*, 51–79. <https://doi.org/10.1016/j.landurbplan.2018.08.007>
- Nguyen, T. (2015). The effectiveness of online learning: Beyond no significant difference and future horizons. *Journal of Online Learning and Teaching / MERLOT, 11*(2), 309–319.
https://jolt.merlot.org/Vol11no2/Nguyen_0615.pdf
- Nieuwkerk, P. T., & Sprangers, M. A. G. (2009). Each measure of patient-reported change provides useful information and is susceptible to bias: The need to combine methods to assess their relative validity. *Arthritis and Rheumatism, 61*(12), 1623–1625. <https://doi.org/10.1002/art.25030>
- Nisbet, E. K. L. (2005). *The human-nature connection: Increasing nature relatedness, environmental concern, and well-being through education* [Carleton University].
https://curve.carleton.ca/system/files/etd/8260ea0b-c901-4bab-81aa-f92b69072117/etd_pdf/4e49815f3b37dea6b7023f164683d226/nisbet-thehumannatureconnectionincreasingnaturerelatedness.pdf
- Nisbet, E. K. L., Zelenski, J. M., & Murphy, S. A. (2008). The nature relatedness scale: Linking individuals' connection with nature to environmental concern and behavior. *Environment and Behavior, 41*(5), 715–740. <https://doi.org/10.1177/0013916508318748>
- Nordlund, A. M., & Garvill, J. (2002). Value structures behind proenvironmental behavior. *Environment and Behavior, 34*(6), 740–756. <https://doi.org/10.1177/001391602237244>
- Norman, G. (2010). Likert scales, levels of measurement and the “laws” of statistics. *Advances in Health Sciences Education: Theory and Practice, 15*(5), 625–632. <https://doi.org/10.1007/s10459-010-9222-y>
- Northcote, M. (2008). Sense of place in online learning environments. *Hello! Where are you in the landscape of educational technology. Proceedings ascilite Melbourne 2008.*
<http://www.ascilite.org.au/conferences/melbourne08/procs/northcote.pdf>
- Oleksy, T., & Wnuk, A. (2016). Augmented places: An impact of embodied historical experience on attitudes towards places. *Computers in Human Behavior, 57*, 11–16.
<https://doi.org/10.1016/j.chb.2015.12.014>
- Oliffe, J. L., Kelly, M. T., Gonzalez Montaner, G., & Yu Ko, W. F. (2021). Zoom interviews: Benefits and concessions. *International Journal of Qualitative Methods.*
<https://doi.org/10.1177/16094069211053522>
- Oliver-Hoyo, M., & Allen, D. (2006). The use of triangulation methods in qualitative educational research. *Journal of College Science Teaching, 35*(4).

- Olivos, P., Aragonés, J. I., & Amérigo, M. (2011). The connectedness to nature scale and its relationship with environmental beliefs and identity. *International Journal of Hispanic Psychology; Hauppauge*, 4(1), 5–19.
- Onwuegbuzie, A. J., & Johnson, R. B. (2006). The validity issue in mixed research. *Research in the Schools*, 13(1), 48–63. <http://www.msra.org/docs/rits-v13n1-complete.pdf>
- Onwuegbuzie, A. J., & Leech, N. L. (2005). On becoming a pragmatic researcher: The importance of combining quantitative and qualitative research methodologies. *International Journal of Social Research Methodology*, 8(5), 375–387. <https://doi.org/10.1080/13645570500402447>
- Onwuegbuzie, A. J., Leech, N. L., & Collins, K. M. T. (2008). Interviewing the interpretive researcher: a method for addressing the crises of representation, legitimation, and praxis. *International Journal of Qualitative Methods*, 7(4), 1–17. <https://doi.org/10.1177/160940690800700401>
- Otto, S., & Pensini, P. (2017). Nature-based environmental education of children: Environmental knowledge and connectedness to nature, together, are related to ecological behaviour. *Global Environmental Change: Human and Policy Dimensions*, 47, 88–94. <https://doi.org/10.1016/j.gloenvcha.2017.09.009>
- Oxarart, A., & Monroe, M. (2016). A Cognitive Approach to Environmental Education. In M. C. Monroe & M. E. Krasny (Eds.), *Across the Spectrum: Resources for Environmental Educators* (pp. 127–140). North American Association for Environmental Educators.
- Palaigeorgiou, G., Malandrakis, G., & Tsolopani, C. (2017). Learning with drones: Flying windows for classroom virtual field trips. *2017 IEEE 17th International Conference on Advanced Learning Technologies (ICALT)*, 338–342. <https://doi.org/10.1109/ICALT.2017.116>
- Paul, J., & Jefferson, F. (2019). A comparative analysis of student performance in an online vs. face-to-face environmental science course from 2009 to 2016. *Frontiers Comput. Sci.*, 1, 7. <https://doi.org/10.3389/fcomp.2019.00007>
- Peppers, G. J. (2016). Higher education trends with focus on the future of teaching and learning. *National Teacher Education Journal*, 9(2).
- Pergams, O. R. W., & Zaradic, P. A. (2006). Is love of nature in the US becoming love of electronic media? 16-year downtrend in national park visits explained by watching movies, playing video games, internet use, and oil prices. *Journal of Environmental Management*, 80(4), 387–393. <https://doi.org/10.1016/j.jenvman.2006.02.001>
- Perrin, J. L., & Benassi, V. A. (2009). The connectedness to nature scale: A measure of emotional connection to nature? *Journal of Environmental Psychology*, 29(4), 434–440. <https://doi.org/10.1016/j.jenvp.2009.03.003>
- Peterson, R. A., & Merunka, D. R. (2014). Convenience samples of college students and research reproducibility. *Journal of Business Research*, 67(5), 1035–1041. <https://doi.org/10.1016/j.jbusres.2013.08.010>
- Pilkington, R. M. (2009). Practitioner research in education: The critical perspectives of doctoral students. *Studies in the Education of Adults*, 41(2), 154–174. <https://doi.org/10.1080/02660830.2009.11661579>

- Pirchio, S., Passiatore, Y., Panno, A., Cipparone, M., & Carrus, G. (2021). The effects of contact with nature during outdoor environmental education on students' wellbeing, connectedness to nature and pro-sociality. *Frontiers in Psychology, 12*. <https://doi.org/10.3389/fpsyg.2021.648458>
- Piumsomboon, T., Lee, Y., Lee, G. A., Dey, A., & Billinghamurst, M. (2017). Empathic mixed reality: Sharing what you feel and interacting with what you see. *2017 International Symposium on Ubiquitous Virtual Reality (ISUVR)*, 38–41. <https://doi.org/10.1109/ISUVR.2017.20>
- Plano Clark, V. L. (2019). Meaningful integration within mixed methods studies: Identifying why, what, when, and how. *Contemporary Educational Psychology, 57*, 106–111. <https://doi.org/10.1016/j.cedpsych.2019.01.007>
- Plews, R. (2017). Self-direction in online learning: The student experience. *International Journal of Self Directed Learning, 14*(1), 37–57.
- Powell, R. B., Stern, M. J., Frensley, B. T., & Moore, D. (2019). Identifying and developing crosscutting environmental education outcomes for adolescents in the twenty-first century (EE21). *Environmental Education Research, 25*(9), 1281–1299. <https://doi.org/10.1080/13504622.2019.1607259>
- Pratt, C. C., McGuigan, W. M., & Katzev, A. R. (2000). Measuring program outcomes: Using retrospective pretest methodology. *American Journal of Evaluation, 21*(3), 341–349. <https://doi.org/10.1177/109821400002100305>
- Prévoit, A.-C., Cheval, H., Raymond, R., & Cosquer, A. (2018). Routine experiences of nature in cities can increase personal commitment toward biodiversity conservation. *Biological Conservation, 226*, 1–8. <https://doi.org/10.1016/j.biocon.2018.07.008>
- Proctor, J. D. (1998). The social construction of nature: Relativist accusations, pragmatist and critical realist responses. *Annals of the Association of American Geographers. Association of American Geographers, 88*(3), 352–376. <https://doi.org/10.1111/0004-5608.00105>
- Protopsaltis, S., & Baum, S. (2019). *Does online education live up to its promise? A look at the evidence and implications for federal policy*. George Mason University. <http://mason.gmu.edu/~sprotops/OnlineEd.pdf>
- Puhek, M., Perše, M., & Šorgo, A. (2012). Comparison between a real field trip and a virtual field trip in a nature preserve: Knowledge gained in biology and ecology. *Journal of Baltic Science Education, 11*(2), 164. http://www.scientiasocialis.lt/jbse/files/pdf/vol11/164-174.Puhek_Vol.11.2.pdf
- Pyle, R. M. (2003). Nature matrix: Reconnecting people and nature. *Oryx: The Journal of the Fauna Preservation Society, 37*(2), 206–214. <https://doi.org/10.1017/S0030605303000383>
- Quay, J., Gray, T., Thomas, G., Allen-Craig, S., Asfeldt, M., Andkjaer, S., Beames, S., Cosgriff, M., Dymont, J., Higgins, P., Ho, S., Leather, M., Mitten, D., Morse, M., Neill, J., North, C., Passy, R., Pedersen-Gurholt, K., Polley, S., ... Foley, D. (2020). What future/s for outdoor and environmental education in a world that has contended with COVID-19? *Journal of Outdoor and Environmental Education, 23*(2), 93–117. <https://doi.org/10.1007/s42322-020-00059-2>
- Ramasundaram, V., Grunwald, S., Mangeot, A., Comerford, N. B., & Bliss, C. M. (2005). Development

- of an environmental virtual field laboratory. *Computers & Education*, 45(1), 21–34.
<https://doi.org/10.1016/j.compedu.2004.03.002>
- Rand, J. (2016). The emergence of open-logic sense-making: A practitioner-researcher's experience of openness and criticality. In J. McNiff (Ed.), *Values and Virtues in Higher Education Research. Critical Perspectives*. Routledge.
- Rapley, T. (2011). Some pragmatics of data analysis. In D. Silverman (Ed.), *Qualitative Research* (Vol. 3, pp. 273–290). SAGE Publications, Inc.
- Reifman, A., Arnett, J. J., & Colwell, M. J. (2007). Emerging adulthood: Theory, assessment and application. *Journal of Youth Development: Bridging Research and Practice*, 2(1).
<http://jyd.pitt.edu/ojs/jyd/article/view/359>
- Restall, B., & Conrad, E. (2015). A literature review of connectedness to nature and its potential for environmental management. *Journal of Environmental Management*, 159, 264–278.
<https://doi.org/10.1016/j.jenvman.2015.05.022>
- Reynders, G., Lantz, J., Ruder, S. M., Stanford, C. L., & Cole, R. S. (2020). Rubrics to assess critical thinking and information processing in undergraduate STEM courses. *International Journal of STEM Education*, 7(1), 9. <https://doi.org/10.1186/s40594-020-00208-5>
- Richardson, M., & Sheffield, D. (2015). Reflective self-attention: A more stable predictor of connection to nature than mindful attention. *Ecopsychology*, 7(3), 166–175.
<https://doi.org/10.1089/eco.2015.0010>
- Rickards, G., Magee, C., & Artino, A. R., Jr. (2012). You can't fix by analysis what you've spoiled by design: Developing survey instruments and collecting validity evidence. *Journal of Graduate Medical Education*, 4(4), 407–410. <https://doi.org/10.4300/JGME-D-12-00239.1>
- Rickinson, M., Lundholm, C., & Hopwood, N. (2010). *Environmental learning: Insights from research into the student experience*. Springer Science & Business Media.
- Ridener, L.R. (1999). Effects of college major on ecological worldviews: A comparison of business, science, and other Students. *Journal of Education for Business*, 75(1), 15–21.
<https://doi.org/10.1080/08832329909598984>
- Ritter, K. A., Stone, H. N., & Chambers, T. L. (2019). Empowering through knowledge: Exploring place-based environmental education in Louisiana classrooms through virtual reality. *The ASEE Computers in Education (CoED) Journal*, 10(1).
- Robson, L. S., Shannon, H. S., Goldenhar, L. M., & Hale, A. R. (2001). *Guide to evaluating the effectiveness of strategies for preventing work injuries: How to show whether a safety intervention really works*. US Department of Health and Human Services.
- Rochon, J., Gondan, M., & Kieser, M. (2012). To test or not to test: Preliminary assessment of normality when comparing two independent samples. *BMC Medical Research Methodology*, 12, 81.
<https://doi.org/10.1186/1471-2288-12-81>
- Rossmann, G. B., & Rallis, S. F. (2003). *Learning in the field: An introduction to qualitative research* (second). SAGE Publications, Inc.

- Roth-Hanania, R., Davidov, M., & Zahn-Waxler, C. (2011). Empathy development from 8 to 16 months: early signs of concern for others. *Infant Behavior & Development*, 34(3), 447–458. <https://doi.org/10.1016/j.infbeh.2011.04.007>
- Rowe, R. J., Koban, L., Davidoff, A. J., & Thompson, K. H. (2017). Efficacy of online laboratory science courses. *Journal of Formative Design in Learning*, 2(1), 56–67. <https://doi.org/10.1007/s41686-017-0014-0>
- Rupprecht, C. D. D., Byrne, J. A., Ueda, H., & Lo, A. Y. (2015). ‘It’s real, not fake like a park’: Residents' perception and use of informal urban green-space in Brisbane, Australia and Sapporo, Japan. *Landscape and Urban Planning*, 143(Supplement C), 205–218. <https://doi.org/10.1016/j.landurbplan.2015.07.003>
- Rybakova, A., Shcheglova, A., Bogatov, D., & Alieva, L. (2021). Using interactive technologies and distance learning in sustainable education. *E3S Web of Conferences*, 250, 07003. <https://doi.org/10.1051/e3sconf/202125007003>
- Salazar, G., Kunkle, K., & Monroe, M. (2020). *Practitioner guide to assessing connection to nature*. North American Association for Environmental Education.
- Salazar, G., Monroe, M. C., Jordan, C., Ardoin, N. M., & Beery, T. H. (2021). Improving assessments of connection to nature: A participatory approach. *Frontiers in Ecology and Evolution*, 8, 498. <https://doi.org/10.3389/fevo.2020.609104>
- Saldana, J. (2012). *The coding manual for qualitative researchers*. SAGE Publications, Inc.
- Sato, T., & Haegele, J. A. (2018). Undergraduate kinesiology students’ experiences in online motor development courses. *Online Learning*, 22(2). <https://doi.org/10.24059/olj.v22i2.1361>
- Saunders, C. D., Brook, A. T., & Myers, O. E., Jr. (2006). Using psychology to save biodiversity and human well-being. *Conservation Biology: The Journal of the Society for Conservation Biology*, 20(3), 702–705. <https://doi.org/10.1111/j.1523-1739.2006.00435.x>
- Schmitt, M. T., Mackay, C. M. L., Droogendyk, L. M., & Payne, D. (2019). What predicts environmental activism? The roles of identification with nature and politicized environmental identity. *Journal of Environmental Psychology*, 61, 20–29. <https://doi.org/10.1016/j.jenvp.2018.11.003>
- Schneider, J., & Schaal, S. (2018). Location-based smartphone games in the context of environmental education and education for sustainable development: Fostering connectedness to nature with Geogames. *Environmental Education Research*, 24(11), 1597–1610. <https://doi.org/10.1080/13504622.2017.1383360>
- Schuele, M. C. (2010). Demographics. In N. J. Salkind (Ed.), *Encyclopedia of Research Design*. SAGE Publications, Inc.
- Schultz, P. W. (2000). Empathizing with nature: The effects of perspective-taking on concern for environmental issues. *Journal of Social Issues*, 56(3), 391–406. <https://doi.org/10.1111/0022-4537.00174>
- Schultz, P. W. (2001). The structure of environmental concern: Concern for self, other people, and the biosphere. *Journal of Environmental Psychology*, 21(4), 327–339.

<https://doi.org/10.1006/jevp.2001.0227>

- Schultz, P. W. (2002). Inclusion with nature: The psychology of human-nature relations. In P. Schmuck & P. W. Schultz (Eds.), *Psychology of Sustainable Development* (pp. 61–78). https://doi.org/10.1007/978-1-4615-0995-0_4
- Schultz, P. W., & Kaiser, F. G. (2012). Promoting pro-environmental behavior. In S. D. Clayton (Ed.), *The Oxford Handbook of Environmental and Conservation Psychology*. Oxford University Press.
- Schultz, P. W., Shriver, C., Tabanico, J. J., & Khazian, A. M. (2004). Implicit connections with nature. *Journal of Environmental Psychology, 24*(1), 31–42. [https://doi.org/10.1016/S0272-4944\(03\)00022-7](https://doi.org/10.1016/S0272-4944(03)00022-7)
- Schultz, P. W., & Tabanico, J. (2007). Self, identity, and the natural environment: Exploring implicit connections with nature. *Journal of Applied Psychology, 37*(6), 1219–1247. <https://doi.org/10.1111/j.1559-1816.2007.00210.x>
- Schwartz, S. J., Côté, J. E., & Arnett, J. J. (2005). Identity and agency in emerging adulthood: Two developmental routes in the individualization process. *Youth & Society, 37*(2), 201–229. <https://doi.org/10.1177/0044118X05275965>
- Schwartz, S. J., Zamboanga, B. L., Luyckx, K., Meca, A., & Ritchie, R. A. (2013). Identity in emerging adulthood: Reviewing the field and looking forward. *Emerging Adulthood, 1*(2), 96–113. <https://doi.org/10.1177/2167696813479781>
- Sherburn, M., & Devlin, A. S. (2004). Academic major, environmental concern, and arboretum use. *The Journal of Environmental Education, 35*(2), 23–36. <https://doi.org/10.3200/JOEE.35.2.23-36>
- Shin, D. (2018). Empathy and embodied experience in virtual environment: To what extent can virtual reality stimulate empathy and embodied experience? *Computers in Human Behavior, 78*, 64–73. <https://doi.org/10.1016/j.chb.2017.09.012>
- Shivam, S., & Wagoner, K. (2020). How well do remote labs work? A case study at Princeton University. In *arXiv [physics.ed-ph]*. arXiv. <http://arxiv.org/abs/2008.04499>
- Simms, W., & Shanahan, M.-C. (2019). Using reflection to support environmental identity development in the classroom context. *Environmental Education Research, 25*(10), 1454–1478. <https://doi.org/10.1080/13504622.2019.1574717>
- Smith, D. C., Bahar, O. S., Cleeland, L. R., & Davis, J. P. (2014). Self-perceived emerging adult status and substance use. *Psychology of Addictive Behaviors: Journal of the Society of Psychologists in Addictive Behaviors, 28*(3), 935–941. <https://doi.org/10.1037/a0035900>
- Smith, M. D., Getchell, S., & Weatherly, M. (2018). Human connectedness to nature: Comparison of natural vs. virtual experiences. *Innovative Technologies and Learning, 215–219*. https://doi.org/10.1007/978-3-319-99737-7_22
- Sneed, J. C., Deringer, S. A., & Hanley, A. (2020). Immersive technology and nature connection. *Journal of Outdoor Recreation, Education, and Leadership, 12*(2). <https://js.sagamorepub.com/jorel/article/view/9871>

- Sobel, D. (2004). Place-based education: Connecting classroom and community. *Nature and Listening*, 4, 1–7.
- Soliman, M., Peetz, J., & Davydenko, M. (2017). The impact of immersive technology on nature relatedness and pro-environmental behavior. *Journal of Media Psychology*, 29(1), 8–17. <https://doi.org/10.1027/1864-1105/a000213>
- Somerville, M. (2016). Environmental and sustainability education: A fragile history of the present. In D. Wyse, L. Hayward, & J. Pandya (Eds.), *The SAGE Handbook of Curriculum, Pedagogy and Assessment* (pp. 506–521). SAGE Publications, Inc.
- Spurlock, D. R. (2018). The single-group, pre- and post-test design in nursing education research: It's time to move on. *The Journal of Nursing Education*, 57(2), 69–71. <https://doi.org/10.3928/01484834-20180123-02>
- Stapp, W. B. (1969). The concept of environmental education. *Environmental Education*, 1(1), 30–31. <https://doi.org/10.1080/00139254.1969.10801479>
- Steffen, W., Rockström, J., Richardson, K., Lenton, T. M., Folke, C., Liverman, D., Summerhayes, C. P., Barnosky, A. D., Cornell, S. E., Crucifix, M., Donges, J. F., Fetzer, I., Lade, S. J., Scheffer, M., Winkelmann, R., & Schellnhuber, H. J. (2018). Trajectories of the Earth system in the Anthropocene. *Proceedings of the National Academy of Sciences of the United States of America*, 115(33), 8252–8259. <https://doi.org/10.1073/pnas.1810141115>
- Stevenson, S. (2001). Discover and create your own field trips. *MultiMedia Schools*, 8(4), 40–45. <https://eric.ed.gov/?id=EJ635388>
- Stewart, A. (2008). Whose place, whose history? Outdoor environmental education pedagogy as “reading” the landscape. *Journal of Adventure Education & Outdoor Learning*, 8(2), 79–98. <https://doi.org/10.1080/14729670801906125>
- Stoppa, T. M., & Lefkowitz, E. S. (2010). Longitudinal changes in religiosity among emerging adult college students. *Journal of Research on Adolescence: The Official Journal of the Society for Research on Adolescence*, 20(1), 23–38. <https://doi.org/10.1111/j.1532-7795.2009.00630.x>
- Strauss, A., & Corbin, J. M. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. SAGE Publications, Inc.
- Strife, S., & Downey, L. (2009). Childhood development and access to nature: A new direction for environmental inequality research. *Organization & Environment*, 22(1), 99–122. <https://doi.org/10.1177/1086026609333340>
- Sullivan, G. M., & Artino, A. R. (2013). Analyzing and interpreting data from Likert-type scales. *Journal of Graduate Medical Education*, 5(4), 541–542. <https://doi.org/10.4300/JGME-5-4-18>
- Syed, M. (2016). Emerging adulthood: Developmental stage, theory, or nonsense. In J. J. Arnett (Ed.), *The Oxford Handbook of Emerging Adulthood* (pp. 11–25). Oxford University Press.
- Tam, K.-P. (2013a). Concepts and measures related to connection to nature: Similarities and differences. *Journal of Environmental Psychology*, 34, 64–78. <https://doi.org/10.1016/j.jenvp.2013.01.004>

- Tam, K.-P. (2013b). Dispositional empathy with nature. *Journal of Environmental Psychology, 35*, 92–104. <https://doi.org/10.1016/j.jenvp.2013.05.004>
- Tam, K.-P., Lee, S.-L., & Chao, M. M. (2013). Saving Mr. Nature: Anthropomorphism enhances connectedness to and protectiveness toward nature. *Journal of Experimental Social Psychology, 49*(3), 514–521. <https://doi.org/10.1016/j.jesp.2013.02.001>
- Tanner, J. R., Noser, T. C., & Totaro, M. W. (2019). Business faculty and undergraduate students' perceptions of online learning: A comparative study. *Journal of Information Systems Education, 20*(1), 5. <https://aisel.aisnet.org/jise/vol20/iss1/5/>
- Terenzini, P. T., & Pascarella, E. T. (1998). Studying College Students in the 21st Century: Meeting New Challenges. *The Review of Higher Education, 21*(2), 151–165. <https://muse.jhu.edu/article/30045/>
- Thomashow, M. (1995). *Ecological Identity : Becoming a Reflective Environmentalist*. The MIT Press.
- Thompson, P. (2019). *Foundations of Educational Technology*. Oklahoma State University Libraries. <https://doi.org/10.22488/okstate.19.000002>
- Truong, M.-X. A., & Clayton, S. (2020). Technologically transformed experiences of nature: A challenge for environmental conservation? *Biological Conservation, 244*, 108532. <https://doi.org/10.1016/j.biocon.2020.108532>
- Tseng, Y.-C., & Wang, S.-M. (2020). Understanding Taiwanese adolescents' connections with nature: rethinking conventional definitions and scales for environmental education. *Environmental Education Research, 26*(1), 115–129. <https://doi.org/10.1080/13504622.2019.1668354>
- Tudor, A.-D., Minocha, S., Collins, M., & Tilling, S. (2018). Mobile virtual reality for environmental education. *Journal of Virtual Studies, 9*(2), 25–36.
- United Nations Environment Programme. (1975). The Belgrade Charter: A Framework for Environmental Education. *International Workshop on Environmental Education*.
- United Nations Environment Programme. (1977). The Tbilisi Declaration. *Intergovernmental Conference on Environmental Education*.
- U.S. Census Bureau. (2021, Feb. 10). *Week 23 Household Pulse Survey* [Data set]. <https://www.census.gov/data/tables/2021/demo/hhp/hhp23.html>
- Vasconcelos, C. (2012). Teaching environmental education through PBL: Evaluation of a teaching intervention program. *Research in Science Education, 42*(2), 219–232. <https://doi.org/10.1007/s11165-010-9192-3>
- Vining, J., & Ebreo, A. (1990). What makes a recycler?: A Comparison of recyclers and nonrecyclers. *Environment and Behavior, 22*(1), 55–73. <https://doi.org/10.1177/0013916590221003>
- Vogt, J. T., & Smith, W. B. (2017). *Forest inventory and analysis: Fiscal year 2016 business report*. United States Department of Agriculture.
- Wagner, Z. M. (1999). Using student journals for course evaluation. *Assessment & Evaluation in Higher Education, 24*(3), 261–272. <https://doi.org/10.1080/0260293990240301>

- Walker, G. J., & Chapman, R. (2003). Thinking like a park: The effects of sense of place, perspective-taking, and empathy on pro-environmental intentions. *Journal of Park & Recreation Administration, 21*(4).
- Walker, M., & Iverson, E. (2016). Identity development and political self-regulation in emerging adult political attitudes and behavior. *Emerging Adulthood, 4*(3), 153–160. <https://doi.org/10.1177/2167696815585052>
- Walker, R., Clary, R. M., & Wissehr, C. (2017). Embedding sustainability instruction across content areas: best classroom practices from informal environmental education. *Journal of Geoscience Education, 65*(2), 185–193. <https://doi.org/10.5408/16-167.1>
- Walker, S. L., & Fraser, B. J. (2005). Development and validation of an instrument for assessing distance education learning environments in higher education: The distance education learning environments survey (DELES). *Learning Environments Research, 8*(3), 289–308. <https://doi.org/10.1007/s10984-005-1568-3>
- Warner, L. A., & Diaz, J. M. (2021). Amplifying the theory of planned behavior with connectedness to water to inform impactful water conservation program planning and evaluation. *The Journal of Agricultural Education and Extension, 1–25*. <https://doi.org/10.1080/1389224X.2020.1844771>
- Wells, N. M., & Lekies, K. S. (2006). Nature and the life course: Pathways from childhood nature experiences to adult environmentalism. *Children, Youth and Environments, 16*(1), 1–24.
- Wells, R., & Zeece, P. D. (2007). My place in my world: Literature for place-based environmental education. *Early Childhood Education Journal, 35*(3), 285–291. <https://doi.org/10.1007/s10643-007-0181-8>
- Whitburn, J., Linklater, W., & Abrahamse, W. (2020). Meta-analysis of human connection to nature and proenvironmental behavior. *Conservation Biology: The Journal of the Society for Conservation Biology, 34*(1), 180–193. <https://doi.org/10.1111/cobi.13381>
- Windhorst, E., & Williams, A. (2015). Growing up, naturally: The mental health legacy of early nature affiliation. *Ecopsychology, 7*(3), 115–125. <https://doi.org/10.1089/eco.2015.0040>
- Wojcik, D., Biedenweg, K., McConnell, L., & Iyer, G. (2016). Current Trends in Environmental Education. In M. C. Monroe & M. E. Krasny (Eds.), *Across the Spectrum: Resources for Environmental Educators* (pp. 47–64). North American Association for Environmental Education.
- Wolters, B., & Lepcha, I. (2021). Unexpected shift to introductory soil field activity at home: Teacher and student experience. *Natural Sciences Education, 50*(1). <https://doi.org/10.1002/nse2.20059>
- Wood, D., Crapnell, T., Lau, L., Bennett, A., Lotstein, D., Ferris, M., & Kuo, A. (2017). Emerging Adulthood as a Critical Stage in the Life Course. In N. Halfon, C. B. Forrest, R. M. Lerner, & E. M. Faustman (Eds.), *Handbook of Life Course Health Development*. Springer. <https://doi.org/10.1007/978-3-319-47143-3>
- Wright, D. (2020, December). Conducting science labs in a virtual world. *Science Scope; Washington, 44*(2), 10–15.

- Wright, J. M. (2008). Web-based versus in-class: An exploration of how instructional methods influence postsecondary students' environmental literacy. *The Journal of Environmental Education*, 39(2), 33–46. <https://doi.org/10.3200/JOEE.39.2.33-46>
- Wright, T. (2004). The evolution of sustainability declarations in higher education. In P. B. Corcoran & A. E. J. Wals (Eds.), *Higher Education and the Challenge of Sustainability: Problematics, Promise, and Practice* (pp. 7–19). Springer Netherlands.
- YuekMing, H., & Manaf, L. A. (2014). Assessing learning outcomes through students' reflective thinking. *Procedia - Social and Behavioral Sciences*, 152, 973–977. <https://doi.org/10.1016/j.sbspro.2014.09.352>
- Yu, T.-K., Lin, F.-Y., Kao, K.-Y., & Yu, T.-Y. (2019). Encouraging environmental commitment to sustainability: An empirical study of environmental connectedness theory to undergraduate students. *Sustainability: Science Practice and Policy*, 11(2), 342. <https://doi.org/10.3390/su11020342>
- Zelenski, J. M., Dopko, R. L., & Capaldi, C. A. (2015). Cooperation is in our nature: Nature exposure may promote cooperative and environmentally sustainable behavior. *Journal of Environmental Psychology*, 42, 24–31. <https://doi.org/10.1016/j.jenvp.2015.01.005>
- Zook, M. A., & Graham, M. (2007). Mapping DigiPlace: Geocoded internet data and the representation of place. *Environment and Planning. B, Planning & Design*, 34(3), 466–482. <https://doi.org/10.1068/b3311>
- Zylstra, M. J., Knight, A. T., Esler, K. J., & Le Grange, L. L. L. (2014). Connectedness as a core conservation concern: An interdisciplinary review of theory and a call for practice. *Springer Science Reviews*, 2(1), 119–143. <https://doi.org/10.1007/s40362-014-0021-3>

APPENDIX A: BIO-315 COURSE SYLLABUS

Campus Undergraduate Syllabi

Course: BIO-315-11707: Ecological Principles

Course Meeting Times: Asynchronous

Term: 20FADAY

Faculty Name: Mike Weinstein

Email Address: ---

Virtual Office Hours: By appointment

Phone/Text: ---

REQUIRED [TEXTBOOK](#)(s) and Supplemental Materials:

Volume 6 *Ecology and Behavior* – From *Biology: The Unity and Diversity of Life*.

Starr, C., Taggart, R., Evers, C., and Starr, L. (2016)

Brooks/Cole Publishers, 14th edition. ISBN 978-1-305-25129-8

COURSE PREREQUISITES: ENV-101 or SCI-219

COURSE DESCRIPTION: This course introduces students to the principles of ecology and practical methods used in the field. Students will explore theoretical topics in the ecological systems including the level of the population, community and ecosystem; energy flow and biogeochemical cycles; and the concept of sustainability. Students will read literature and conduct research projects in the field and will use critical thinking to evaluate research, design studies, present findings and debate on the issues. Students will spend time in the field observing and journaling, while reflecting on their role on the planet as humans, scientists, and decision makers.

COURSE OBJECTIVES: The first objective of this course is to provide a survey of the field of ecology as it relates to the individual, population, community and ecosystem. The second objective is to transform student awareness of their role within planetary systems, and develop a deeper, more meaningful connection to the environment. Students will be introduced to ecological principles and will take part in designing, conducting and writing up field studies. Through field experiences and reflection, students will gain a deeper understanding of ecological functioning and their place within it. At the end of the course students should be confident in being able to describe terms, employ the scientific method, critically evaluate research, and feel more empowered to solve environmental problems and connect others to the environment.

COURSE OUTCOMES:

Students leave the course with the ability to:

1. explain and describe ecological concepts as they apply to the functioning of the world;
2. apply the scientific method to investigate and solve ecological problems;
3. describe ecological relationships at the level of the organism, population, community and ecosystem;
4. integrate their knowledge and understanding of how their environment works, especially in regard understanding the role of the human species in a biological and social context; and
5. commit to and take positive action for the environment by drawing on a deep well of connection, and be able to employ their knowledge and passion to foster that connection in others in their community.

Meeting Basic Needs

Students sometimes face challenges that negatively impact their lives (no access to a computer/internet, homelessness, food insecurity, financial emergencies, academic problems, mental health concerns, substance abuse issues, etc.). If you experience such a hardship, contact ----- for campus and community supports; the CARE Team helps students remain healthy and safe.

EXPECTATIONS and ASSIGNMENTS:

Assignments

Assignment	Number of Graded Items	Point Value Per Item	Total Points
Journal	5	10	50
Reading Responses	7	5	35
Final Project	1	10	10
Exams	2	10	20
Total Course Points Possible			115

COURSE SCHEDULE:

Week	Topic and Activities	Assignments Due
Week 1	What Exactly is Ecology?	Introductory Survey
Week 2	Our Place on the Planet I	Journal 1
Week 3	The Organism	Reading 1 Response

Week 4	Camera Traps	Journal 2
Week 5	The Population	Reading 2 Response
Week 6	Our Place on the Planet II	Journal 3
Week 7	The Community	Reading 3 Response
Week 8	Midterm	Midterm Exam
Week 9	The Ecosystem	Reading 4 Response
Week 10	Environmental Sensors	Journal 4
Week 11	Our Place on the Planet III	Journal 5
Week 12	The Biosphere	Reading 5 Response
Week 13	The Human Impact	Reading 6 Response
Week 14	Ecological Thinking for Transformative Solutions	Reading 7 Response
Week 15	Final	Final Exam
Week 16	Final Projects	Final Project

**Course schedule is subject to change at the discretion of the instructor. Please refer to Brightspace for all updates.*

Academic Policies

ADA/504 Compliance Statement ----- is dedicated to providing equal access to individuals with disabilities, including intellectual disability, in accordance with Section 504 of the Rehabilitation Act of 1973, Title III of the Americans with Disabilities Act (ADA) of 1990, and the Americans with Disabilities Act Amendments Act of 2008. The University prohibits unlawful discrimination on the basis of disability and takes action to prevent such discrimination by providing reasonable accommodations to eligible individuals with disabilities.

At the beginning of each term, or as soon as you become aware of a disability, we encourage you to contact the Campus Accessibility Center (CAC) to discuss accommodations for which you may be qualified. Reasonable accommodations are established through an interactive process between the student and the CAC. Please note that accommodations are not retroactive and that disability accommodations are not provided until acceptable documentation of disability and its impact is received and an accommodation letter has been processed.

For questions concerning support services, documentation guidelines, or general disability issues, please visit the Campus Accessibility Center's webpage: [Campus Accessibility Center's webpage](#)
Campus Accessibility Services,

If you feel you have been denied appropriate disability related accommodations, including appropriate auxiliary aids and services, you may file a grievance in the ADA/504 Grievance [ADA/504 Grievance policy](#).

Attendance Policy: The major responsibility for education belongs to the student. An assumption of responsibility is at the center of learning and accomplishment. Each student is expected to arrange a class schedule in such a way

that conflicting employment or personal activities are held to a minimum. Attendance is required in all courses. Excessive absences may result in failure or dismissal. More than three absences may be considered excessive. Each student is responsible for all assignments and class work regardless of attendance requirements. Faculty office hours have been established to provide extra class assistance for students. These faculty office hours are not intended to make up missed class time.

Academic Honesty Policy: ----- requires all students to adhere to high standards of integrity in their academic work. Activities such as plagiarism and cheating are not condoned by the university. Students involved in such activities are subject to serious disciplinary action. Plagiarism is defined as the use, whether by paraphrase or direct quotation, of the published or unpublished work of another without full and clear acknowledgment. Cheating includes the giving or receiving of unauthorized assistance on quizzes, examinations or written assignments from any source not approved by the instructor.

Class Cancellations: Class cancellations will be announced in person at the classroom by either a faculty or staff member of the university or posted on official forms issued by the school's dean's office. When in doubt as to whether a class has been cancelled, students should check with the school administrative staff. Unofficial cancellation notices attached to doors or information posted on blackboards should be disregarded.

Copyright Guide & Policy:----- abides by the provisions of United States Copyright Act (Title 17 of the United States Code). Any person who infringes the copyright law is liable. Questions regarding copyright may be addressed to the Dean of the University Library.

Course Add and Drop: Undergraduate day students who wish to change their schedules must do so during add/drop period beginning with registration and ending at the end of the fifth class day. Students who miss the first two sessions of a class may be dropped by that instructor without prior notice.

Grade Scale and GPA: This policy impacts all ----- students, regardless of delivery system, or major and creates a consistency throughout the University regarding the numeric grades that equate to the different tiers of letter grades.

Inclusivity & Non-Discrimination Policy:-----values and promotes social diversity, inclusivity, and social justice.

Library Resource Statement: In addition to [intellectual resources](#) available on site and online, ----- makes available group and one-on-one instruction in information literacy, enabling students to define and articulate what knowledge-based resources are relevant to their research interests. Library staff are available to assist students in effectively and efficiently accessing information from credible sources, to compare new knowledge with prior beliefs, and to consider the related ethical, legal, and socio-economic issues that are inherent in scholarly investigation.

Student Academic Complaint: If a student in ----- has a complaint about an instructor or course, then they should speak first to the instructor. If the student is not satisfied or cannot resolve the issue at that level, then they should speak to the Program Coordinator/Department Chair. If the student is still not satisfied, then they should speak to the school Dean or Program Director. If the student wishes to pursue the matter further, then they should speak to the Provost, who will review the matter and make a final decision.

More information about policies can be found on the policy ----- Policy page.

APPENDIX B: PRE-TEST SURVEY**BIO-315 Pre-course Survey****Start of block: INTRO BLOCK**

[intro_text] Thank you for agreeing to take part in this research study. The purpose of this study is to understand college student perceptions of nature connection in an online environmental course. I am interested in hearing your thoughts and experiences pertaining to online education and your relationship with nature, among other questions. As you work through the survey, please note that there are no right or wrong answers. I am only interested in hearing about your opinion and experiences, thus please try to answer as honestly and openly as you can. This survey will take approximately 10 minutes to complete.

[code] In order to track your data across the current survey and the second survey, which will be administered at the end of the semester, we will generate a unique code using your street address number and day of birth. Please enter your street number for your current address followed by your day of birth. For example, if you live at '123 Main Street' and you were born on the '24th', your code would be 12324.

End of block: INTRO BLOCK

Page break -----

Start of block: ONLINE EDUCATION BLOCK

[fam_online] How familiar or unfamiliar are you with online education?

- Not at all familiar (1)
- Not very familiar (2)
- Somewhat familiar (3)
- Very familiar (4)
- Extremely familiar (5)

[exp_online] Have you taken any online courses before this course?

- Yes (1) [courses]
- No (2) [attitude_online_ed]

Page break -----

[courses] How many online courses have you taken?

- 1-2 (1)
- 3-5 (2)
- 5-10 (3)
- More than 10 (4)

[online_rate] Generally speaking, how would you rate your experience with online education?

- Very poor (1)
- Below average (2)
- Average (3)
- Above average (4)
- Excellent (5)

Page break -----

[attitude_online_ed] Listed below are a series of statements about online education. How much do you agree or disagree with each of the following? {matrix, randomized item order}

- a) Online education is a viable alternative for learning compared to face-to-face instruction
 - b) Environmental education can be delivered effectively online.
 - c) Online education is an effective way to learn about nature
-
- Strongly disagree (1)
 - Somewhat disagree (2)
 - Neither agree nor disagree (3)
 - Somewhat agree (4)
 - Strongly agree (5)

End of block: ONLINE EDUCATION BLOCK

Page break -----

Start of block: NATURE EXPERIENCE + PLACE BLOCK

[time_nature] In general, how often do you spend free time in nature? This includes things like going to a park, going for a hike, or going to the beach. This does not include activities like organized sports such as basketball or baseball.

- Never (1)
- Less than once a month (2)
- Once or twice a month (3)
- About once a week (4)
- Several times a week (5)

Page break -----

[campus] Have you ever been to the ----- campus?

- Yes (1) [arb]
- No (2) [CONNECTION TO NATURE BLOCK]

[arb] Have you ever visited the ----- Arboretum?

- Yes (1) [freq_arb]
- No (2) [place_campus]

Page break -----

[freq_arb] When on campus, how frequently did you visit the ----- Arboretum?

- Never (1)
- Less than once a month (2)
- Once or twice a month (3)
- About once a week (4)
- Several times a week (5)

Page break -----

[place_campus] When thinking about ----- **campus**, to what extent do you agree or disagree with the following statements {matrix, randomized item order}:

- a) I feel that this place is a part of me.
- b) I identify strongly with this place.
- c) I am very attached to this place.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)

[place_arb] {SHOW IF [arb] = Yes} When thinking about ----- **Arboretum**, to what extent do you agree or disagree with the following statements {matrix, randomized item order}:

- a) I feel that this place is a part of me.
- b) I identify strongly with this place.
- c) I am very attached to this place.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)



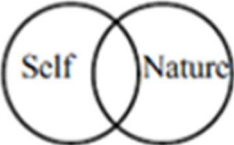




End of block: NATURE EXPERIENCE + PLACE BLOCK

Page break -----

Start of block: CONNECTION TO NATURE BLOCK

{Randomized question order}

[ins]Please choose the picture below which best describes your relationship with the natural environment. How interconnected are you with nature?

-  (1)
-  (2)
-  (3)
-  (4)
-  (5)
-  (6)
-  (7)

[c2n] Please answer each of these questions in terms of the way you generally feel. There are no right or wrong answers. Simply indicate as honestly and candidly as you can what you are presently experiencing. {matrix}

- a) I often feel a sense of oneness with the natural world around me.
 - b) I think of the natural world as a community to which I belong.
 - c) I recognize and appreciate the intelligence of other living organisms.
 - d) I often feel disconnected from nature.
 - e) When I think of my life, I imagine myself to be a part of a larger cyclical process of living.
 - f) I often feel kinship with animals and plants.
 - g) I feel as though I belong to the Earth as equally as it belongs to me.
 - h) I have a deep understanding of how my actions affect the natural world.
 - i) I often feel part of the web of life.
 - j) I feel that all inhabitants of Earth, human, and nonhuman, share a common "lifeforce".
 - k) Like a tree can be part of a forest, I feel embedded within the broader natural world.
 - l) When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature.
 - m) I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.
 - n) My personal welfare is independent of the welfare of the natural world.
-
- Strongly disagree (1)
 - Somewhat disagree (2)
 - Neither agree nor disagree (3)
 - Somewhat agree (4)
 - Strongly agree (5)

End of block: CONNECTION TO NATURE BLOCK

Page break -----

Start of block: IDENTITY BLOCK

[idea] For this question, please think about this time in your life. By “time in your life,” we are referring to the present time, plus the last few years that have gone by, and the next few years to come, as you see them. In short, you should think about a roughly five-year period, with the present time right in the middle. For each phrase shown below, please indicate the degree to which you agree or disagree that the phrase describes this time in your life.

Is this period of your life a...

- a) time of finding out who you are?
- b) time of separating from parents?
- c) time of defining yourself?
- d) time of planning for the future?
- e) time of seeking a sense of meaning?

- Strongly disagree (1)
- Somewhat disagree (2)
- Somewhat agree (3)
- Strongly agree (4)

Page break -----

[identity] People differ in terms of how important various ideas, groups, or characteristics are to their sense of self. How important or unimportant is each of the following to your sense of who you are as a person? {matrix, randomized item order}

- a. Environmentalist
- b. College student
- c. Young adult
- d. Outdoors enthusiast
- e. Independent thinker
- f. Scientist
- g. Tech savvy

- Not at all important (1)
- Not very important (2)
- A little bit important (3)
- Moderately important (4)
- Very important (5)
- Extremely important (6)

End of block: IDENTITY BLOCK

Page break -----

Start of block: DEMOGRAPHICS BLOCK

[age] Please indicate your year of birth

[college_year] What year are you in college (choose one that best describes your current status)?

- Freshman (1)
- Sophomore (2)
- Junior (3)
- Senior (4)

[major] What is your major?

[gender] What is your gender?

- Female (1)
 - Male (2)
 - Transgender (3)
 - A gender not listed (please specify) (4)
-
- Prefer not to answer (5)

[race] Which of the following best describes your racial or ethnic background? Choose all that apply.

- Alaska Native (1)
- American Indian (2)
- Asian (3)
- Black (4)
- Hispanic/Latinx (5)
- Middle Eastern/North African (6)
- Native Hawaiian/Pacific Islander (7)
- White (8)
- Not listed (please specify) (9) _____

End of block: DEMOGRAPHICS BLOCK

APPENDIX C: POST-TEST SURVEY

BIO-315 Post-course Survey Fall 2020

Start of Block: INTRO BLOCK

intro_text Thank you for agreeing to take part in this research study. The purpose of this study is to understand college student perceptions of nature connection in an online environmental course. I am interested in hearing your thoughts and experiences pertaining to this course and your relationship with nature, among other questions. As you work through the survey, please note that there are no right or wrong answers. I am only interested in hearing about your opinion and experiences, thus please try to answer as honestly and openly as you can. This survey will take approximately 5 minutes to complete.

Page
Break

code In order to track your data across the initial survey, please re-input the unique code you initially generated using your street address number and day of birth. Please enter your street number for your current address followed by your day of birth. For example, if you live at '123 Main Street' and you were born on the '24th', your code would be 12324. If you have moved since the initial survey, please enter the street number of the address where you resided *at that time*.

Page
Break

End of Block: INTRO BLOCK

Start of Block: PLACE BLOCK

place_campus When thinking about ----- **campus**, to what extent do you agree or disagree with the following statements:

	Strongly disagree (18)	Somewhat disagree (19)	Neither agree nor disagree (20)	Somewhat agree (21)	Strongly agree (22)
I feel that this place is a part of me. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I identify strongly with this place. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am very attached to this place. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

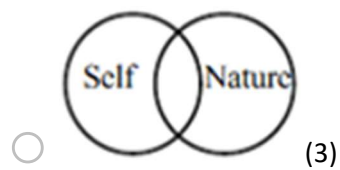
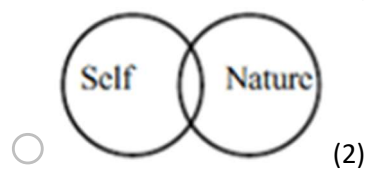
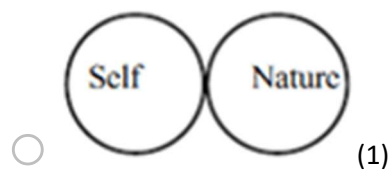
place_arb When thinking about the ----- **Arboretum**, to what extent do you agree or disagree with the following statements:

	Strongly disagree (18)	Somewhat disagree (19)	Neither agree nor disagree (20)	Somewhat agree (21)	Strongly agree (22)
I feel that this place is a part of me. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I identify strongly with this place. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am very attached to this place. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

End of Block: PLACE BLOCK

Start of Block: CONNECTION TO NATURE BLOCK

ins Please choose the picture below which best describes your relationship with the natural environment. How interconnected are you with nature?



cns Please answer each of these questions in terms of the way you generally feel. There are no right or wrong answers. Simply indicate as honestly and candidly as you can what you are presently experiencing.

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
I often feel a sense of oneness with the natural world around me. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think of the natural world as a community to which I belong. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I recognize and appreciate the intelligence of other living organisms. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often feel disconnected from nature. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I think of my life, I imagine myself to be a part of a larger cyclical process of living. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often feel kinship with animals and plants. (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel as though I belong to the Earth as equally as it belongs to me. (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have a deep understanding of how my actions affect the natural world. (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I often feel part of the web of life. (9)

I feel that all inhabitants of Earth, human, and nonhuman, share a common "lifeforce". (10)

Like a tree can be part of a forest, I feel embedded within the broader natural world. (11)

When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature. (12)

I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees. (13)

My personal welfare is independent of the welfare of the natural world. (14)

Start of Block: ONLINE EDUCATION BLOCK

attitude_online_ed Listed below are a series of statements about online education. How much do you agree or disagree with each of the following?

	Strongly disagree (18)	Somewhat disagree (19)	Neither agree nor disagree (20)	Somewhat agree (21)	Strongly agree (22)
Online education is a viable alternative for learning compared to face-to-face instruction (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Environmental education can be delivered effectively online. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online education is an effective way to learn about nature (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

End of Block: ONLINE EDUCATION BLOCK

Start of Block: COURSE EVAL BLOCK

course_eval Listed below are a series of statements about this class specifically, BIO-315. How much do you agree or disagree with each of the following?

	Strongly disagree (38)	Disagree (39)	Somewhat disagree (40)	Neither agree nor disagree (41)	Somewhat agree (42)	Agree (43)	Strongly agree (44)
This course was engaging. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Course materials and activities enhanced my learning. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This course would have been more engaging if taught face-to-face. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

learning Compared to other online courses, would you say you learned more or less in this course?

- Much less (1)
- Less (2)
- Somewhat less (3)
- About the same (4)
- Somewhat more (5)
- More (6)
- Much more (7)
- Not applicable, this is the only online course I have taken (8)

End of Block: COURSE EVAL BLOCK

APPENDIX D: INTERVIEW GUIDE

Interview Guide

[Introduction] Thank you for agreeing to be interviewed. I am going to ask you a series of questions about your experiences with this course and in nature. There are no right or wrong answers, I am simply interested in hearing about your experiences and perceptions. Your answers to these questions have no bearing on the grade you will receive in this course. This interview should take between 30-60 minutes.

I'm going to record just the audio of this interview

1. Tell me about your experience with the course.
 - a. What was the best thing about the course for you?
 - b. What was the most challenging thing about the course for you?
 - c. Is there anything you would change in the course?
2. In what ways was this course different from the way you learn things in face-to-face classes?
3. During this course we interacted virtually with the Arboretum; was there any experience in this regard that you really liked?
 - a. Was there any experience in this regard that you didn't like, or didn't resonate with you?
 - b. If you have been in the space previously, can you describe the differences between being there in person versus virtually?
4. In what way(s) have your feelings towards the Arboretum changed with the course?
 - a. Were there any course experiences that you think had more of an impact on this change?
5. To what extent do you feel a connection to the natural world?
 - a. What influences how connected you feel?
 - b. Is connection to nature a general feeling or specific to a particular place, or both?
 - c. In what ways does your feeling of connection/lack of connection to nature affect other aspects of your life?
6. In what way(s) have your feelings towards nature changed with the course? (If they have changed)

- a. Were there any course experiences that you think had more of an impact on this change?
7. What do you see yourself doing in the future with the experiences you had in the course?

[Closing] I appreciate the time you took for this interview. Is there anything else you think would be helpful for me to know, or anything else you'd like to tell me?

I should have all the information I need. Would it be alright to email you if I have any more questions?

APPENDIX E: PRIMARY AND SECONDARY QUALITATIVE CODES

Secondary Code	Primary Code	Participant	Source
“Something I don’t normally get to see”	“I love seeing the stuff that lived around there”	1	Interview
	“I didn’t realize there was that many animals”		
	“Even though I can’t see them doesn’t mean they’re not there”		
	“Actually got to see the animals”	3	
	“In the wild”		
	“Never really paid attention to the soil before”	4	
	“I like be able to still see what was going on on campus, even though we weren’t there”	5	
	“I didn’t know that some of those animals ended up going back there”		
	“If we were out there, we wouldn’t have seen those animals”		
	“Still cool to see what was going on”		
	“We wouldn’t have that perspective”	6	
	“We can’t really think of it like that when we’re just walking through it”		
	“Even the things I can’t see”		
	“You can look after the fact”	7	
	“Real time stuff”		
	“Kind of see how we fuck it up”	9	
	“What’s going on with the animals”		
	“You can imagine what’s going on there”		
	“I never saw real view [like that]”	2	
	“an opportunity to learn a different way”		
seeing the changes over time	3		
something I normally don’t get to see	4		
I was able to view a subject within the arboretum which honestly more fun	5		
get a better idea about the water fall over an extended period of time			
I like seeing what is going on out there	6		
it reminds me that they are going about their lives			
“A bigger experience for me”	“Before, it was just a piece of woods with hiking trails”	1	Interview
	“Delve a little bit deeper”	3	
	“I just appreciated it more”		
	“Gained insight”		

	“It was a bigger experience for me”		
	“I have more of an appreciation of it being there”	4	
	“I learned a lot”		
	“I just know more”	5	
	“Little space that’s kind of untouched”		
	“I appreciate having that space”		
	“What we lose when we don’t have it”	6	
	“Brings me more appreciation”		
	“Have this knowledge”		
	“we could see how much diversity is in that small area”	2	Journal
“It’s a shared space”	“We’re like actually walking into someone’s house”		
	“It’s a shared space”		
	“I’m coming into its space and I’m moving stuff around and not even realizing”	1	
	“Feeling like we’re stepping into someone’s house”		
	“We’re still living in the world”		
	“We are basically disturbing so much of that”	2	Interview
	“It’s a learning disconnect”		
	“I wish I was there to witness it”	3	
	“I’m more aware”		
“I will be outside as much as I can”	5		
“Effects the world around us”	7		
“Just kind of limited”	“Just kind of limited”		
	“Very limited space”	2	
	“Go further than the technology allowed me to”		
	“I can’t fly”	4	Interview
	“Things I can’t do with a screen”		
	“We could walk around, go see the different areas”	5	
	“Not a still picture”	7	
	“Wherever you want to go”	9	
	“I might stop somewhere”		
	“limiting experience”	2	
	“If this were a real tour and not virtual I would just walk out further”		
	“Not having any control over what I want to see can be frustrating”	4	Journal

	“being In Arboretum cannot be replaced with a virtual walk”	7	
	“virtual access to Arboretum prevents me from stopping at places”	9	
“Little bits and pieces”	“Some things you can’t get from the virtual tour”	1	Interview
	“It’s more sensory”		
	“I listen to the birds”		
	“I feel the wind on my face”		
	“Just sitting enjoying the breeze”		
	“You have more of your senses in the space”	2	
	“The mosquito factor”	3	
	“Being in nature was obviously different”		
	“You can hear, touch, smell”		
	“Virtual wasn’t enough”	4	
	“Little bits and pieces”		
	“I want to smell the soil, feel the snow”		
	“The feeling”	6	
	“Such a different feeling”		
	“I miss being able to walk outside”		
	“Very sensory for me”		
	“I can just hear the cars”	7	
	“The smells, the air”	8	
	“Sound pollution”		
		“we would feel more if we were there”	
	“Instead of reading only the measurements, we would be able to feel the difference”	3	
	“the audio recording really highlighted the background noise”	6	
	“we can learn a lot about an environment just by looking at it and listening even without being able to utilize other senses.”		
	“The overall feeling of the environment is lost to the statistical data”	7	
“Just looking at a bunch of numbers”	“What am I looking at right now?”	1	Interview
	“It’s a little bit ridiculous”	2	
	“Had trouble interpreting”	3	
	“If I understood how technology worked a little better”	4	
	“Not knowing how to use it”		
	“Just looking at a bunch of numbers”	6	
	“A little bit more lost”		
	“Disappointing”		

	“It did not feel right looking at it from my computer screen”	2	Journal
	“I am overwhelmed by all this data”	4	
	“disappointed that it did not offer a more significant learning experience”	8	
“A useful tool”	“What each piece of technology could do”	4	Interview
	“It’s important to learn technology”		
	“The virtual visits stuck with me”	5	
	“a useful tool.”	6	
	“With the monitoring aspect from the Arboretum, you have enough information to understand the conditions”	7	Journal
	“it did what it was supposed to do”	8	
“At least it wasn’t just ‘open a textbook’”	“Didn’t have to worry”	1	Interview
	“It was easy”		
	“Laid back”		
	“I didn’t know how much to say about how I felt”		
	“I can actually take in the information without worrying”		
	“I thought it was going to be more doing work outside”	2	
	“At least it wasn’t just ‘open a textbook’”		
	“Just felt really repetitive”	3	
	“I take a lot of notes”		
	“Work at my own pace”		
	“Easier to stay on track”	4	
	“More flexibility”	5	
	“Good balance”		
	“Struggle coming up with content”	6	
	“Class time is really important for my daily structure”		
“My own time and my own place”			
“Everything was really clear”	7		
“Time management”	8		
“You want to protect things you care about”	“I want to work to protect it”	1	Interview
	“It makes me realize it a bit more”		
	“I like to volunteer for campaigns”	2	
	“I can change some little habits”		
	“I encourage in my conversations”		
	“Showing them ‘here’s where we are’”	3	
	“I need to be outside to do something to help”		
“I learned everything”			

	“You would be more appreciative or concerned”		
	“Help the environment with my actions”		
	“How I take part in the world”		
	“That’s where I spend a great time of my life”		
	“Protect them from any harm”		
	“Being immersed helps me appreciate it”		
	“You want to protect things that you care about”		
	“Everything I do is part of who I am”	4	
	“I want to live here”		
	“No matter where I am”		
	“Once its gone, its gone”		
	“Affirmed for me”		
	“Towards plants and animals”		
	“I always wanted to do something that would help”		
	“It’ll help a little bit”	5	
	“I’ll try to do as best as I can”		
	“Be a positive impact”	7	
	“I’ve always been interested”	8	
	“makes me want to protect places like the arboretum”	1	Journal
“It’s all connected”	“You feel like you’re more attached to the space”	1	Interview
	“It was cool to see that work”	2	
	“Understanding the concepts”	3	
	“Tying in the book with what was happening outside”	5	
	“Just to read and get an idea”		
	“It’s all connected”	6	
	“Applications from the reading”		
	“Made it work well together”		
	“Seem to relate to each other”		
	“How it related”	7	
	“Connect the material”		
	“Without having to be there”		
	“Connect the material”		
	“Without having to be there”		
	“Connect the dots”	8	
	“Everything was connected”		
“Made me understand more”	9		
“Learning the whole thing”			

	“I can have a better look at how its connected”		
	“I’m definitely part of nature”		
	“made me feel connected to nature”		Journal
	“made me feel connected to nature and more interested in the animals”	5	
	“each resource provides different information”	6	
	“a better idea of the general composition of a small ecological community”	9	
“What we can do in our own backyard”	“Have people send a lab”	2	Interview
	“Do our own things”		
	“More activities where you interact”		
	“Look for it near where you live”	4	
	“Incorporate working in areas around us”		
	“What we can do in our own backyard”		
“Hands on kind of thing”	“I like hands on learning”	2	Interview
	“They were more hands on”	3	
	“Hands on kind of thing”	4	
	“You get the experience”		
	“A learning experience”	8	
	“Not going to a real environment”	9	
“I’d really rather go to that place”	“I would have a much easiest time if I was there”	1	Interview
	“I wish that we were on campus because that would have added more to it”	2	
	“The chance to interpret them”		
	“Then you can see what’s going on”		
	“I still go outside”		
	“Sick and tired of being at home”		
	“Even though we couldn’t go outside”		
	“You’re stuck inside all the time”		
	“Being in the environment makes it a little easier for me”	5	
	“If we were in person we would be outside almost all the time”		
	“I’d rather be outside learning”	6	
	“Just me sitting in front of my computer screen”		
	“There wasn’t as much conversation”		
	“It’s not the same”	9	
	“We can talk to classmates, to the professor”		
	“Discussing is more fun”		

	“I would’ve liked to be standing there instead”		
	“if I were in person, I think I would be able to grasp what is going on there a little better”	1	Journal
	“I have to focus my attention more inside than outside”	3	
	“If I could visit in person it would have been a better experience”	4	
	“ I’d rather really go to that place”	9	
	“Made me upset I’m not there”	2	
“Made me upset I’m not there”	“Made me miss being able to walk through the Arboretum”	6	
	“I’m a little sad”		
	“made me miss actually going to the Arboretum”		Journal
	““Looking” up at the sky was refreshing because it reminded me of the time when I was able to do that in person”	3	
	“leaves me with missing the outdoors”	7	
“You can think about stuff rather than school”	“I feel more at home when I’m outside than when I’m inside”		Interview
	There’s greater things than the problems going on right now”	1	
	“It’s more just being involved in being a part of that environment in that ecosystem at that moment”		
	“I can always find something that I appreciate”	4	
	“I love being outside”		
	“You can think about stuff rather than school”	5	
	“It’s relaxing”		
	“Probably where I live”		
	“I find a lot of peace just being in the forest”		
	“General feeling”	6	
	“Emotional and spiritual connection”		
	“I feel more alive”	8	
“It just feels good”		Journal	
“Woods like these always have a magical effect on me”	8		

APPENDIX F: IRB AUTHORIZATION

IRB #: IRB-FY2020-33

Title: Exploring the Potential of Online Education and College Students'

Connection to Nature Creation Date: 8-25-2020

End Date:

Status: **Approved**

Principal Investigator: Michael Weinstein

Review Board: University Campus Board

Sponsor:

Study History

Submission Type Initial Review Type Expedited Decision **Approved**

Key Study Contacts

Member Michael Weinstein Role Principal Investigator Contact Member Michael Weinstein

Role Primary Contact Contact

Initial Submission

About Cayuse IRB

Cayuse IRB is an interactive web application. As you answer questions, new sections relevant to the type of research being conducted will appear on the left-hand side. Therefore not all numbered sections may appear. You do not have to

finish the application in one sitting. All information can be saved.

Additional information has been added throughout the form for guidance and clarity. That additional information can be found by clicking the question mark in the top-right corner of each section.

For more information about the IRB submission Process, IRB Tracking, and Cayuse IRB Tasks, please refer to the [Cayuse IRB Procedures Manual](#).

Getting Started

Throughout the submission, you will be required to provide the following:

- Detailed Study Information
- Informed Consent Forms
- Study Recruitment Document (Participants)
- Add Copies of proposed instruments: including questionnaires/survey, guiding questions, tests, debriefing materials

IRB

You cannot begin data collection until a formal approval letter from the Vice President of UC Academic Affairs chair of the IRB has been received.

The IRB meets as needed during the regular academic year. Please submit the application as soon as possible.

Please plan for extra time?an exempt or expedited review 10-15 business days, 4-6 weeks for a full review

I have read the information above and I am ready to begin my

submission. Yes

What type of activity is this submission for?

Research Study with Human Subjects

Activities Without a Plan to Conduct Research (Case Report or Quality Improvement project)

What is your level at ---?

Faculty/ Staff (Main Campus or Vermont Campus)

Please select your Dean or Supervisor:

If your Dean or Supervisor is not listed, please provide their name and email address below:

I certify that my Dean or Supervisor has given me permission to submit this study to IRB. Please note that inaccurate or false information will result in dismissal of your application.

ACCEPT

Please explain.

Study Personnel

Note: If you cannot find a person in the people finder, please contact the IRB Office immediately.

Principal Investigator (Faculty, Staff, Graduate Student, Doctoral Student)

Provide the name of the Principal Investigator of this study.

Co-Principal Investigator(s)

Provide the name(s) of Investigator(s) for this study. If you are an Undergraduate student, please list yourself as a Co-Principal Investigator.

Primary Contact (For Undergraduate Students, your Principal Investigator is the Primary Contact)

Provide name of primary contact usually Principal Investigator

Assurance of Principal Investigator

Please read the statement below and check off if you accept or decline to uphold these guidelines. (Note that marking decline removes your proposal from consideration). -I CERTIFY as follows concerning the above-named research proposal in which I am the Principal investigator:

- (1) The rights and welfare of the subjects will be adequately protected.
- (2) Risks or discomfort (if any) to subject(s) have been clearly indicated and it has been shown how they are outweighed by potential benefits to the subject or by the importance of the knowledge to be gained.
- (3) The informed consent of subjects will be obtained by appropriate methods

that meet the requirements of the university's general assurance procedures.

-(4) Any proposed changes in research activity will be reported to the Institutional Research Review Board. Those changes may not be initiated without Institutional Research Review Board review and approval except where necessary to eliminate apparent immediate hazards to the subjects.

-(5) Any unanticipated problems involving risks to human subjects or others will promptly be reported to the Institutional Research Review Board.

-(6) If the study is approved, the duration is one year unless an extension in writing is received. After one year a report on the progress of the research will be submitted to the Institutional Research Review Board, and each year until completion of the project. The Status Report Form will be used for this purpose.

✓ ACCEPT

DECLINE

Study Site

Please select the location of the study.

External Site/Participants (indicate any external locations and participants such as other Colleges/Universities, Elementary/Secondary Schools, Organizations, and/or Institutions?)

International site

Study Dates

Please provide the intended study start and

end dates. Start Date

09/06/2020

End Date

12/20/2020

Subject Enrollment

Participants and Methodology:

1. Explain the source of participants, any inclusion or exclusion criteria, how they will be recruited, and whether they will be provided any incentive or compensation for participation (and, if so, the process for doing so).
2. Explain the procedures for obtaining informed consent from adults. If applicable, explain how assent will be secured for children or others who, by definition cannot legally give consent (e.g., adults with legal guardians). Informed consents must address the risk and benefits of the study.
3. Describe the timeframe of the study, duration of participant activities, materials and procedures.
4. Surveying of all on-campus or all global-campus students is prohibited and reserved for institutionally-sponsored surveys and assessments only. Any exceptions require approval.

Do you intend to collect data from students and employees?

✓ Yes

One of the primary responsibilities of the IRB is to ensure that a participant's decision to participate in research will be voluntary and that consent will be sought only under circumstances that

provide sufficient opportunity to consider whether to participate and that minimize, the possibility of or undue Influence.

"Students and employees may be vulnerable to subtle inducements to participate".

The researcher who plans to recruit either population must define clearly the participants to be enrolled and the rationale for their participation. In

addition, the mode and timing of recruitment must be explained.

Another special consideration for employee and student populations is the issue of confidentiality of research data. Depending on the nature of the research and the data collected, a break of confidentiality could affect a person's employment, career path, educational plans, or social relationship

with the hospital/ academic community. Therefore, the researcher should protect the subjects' identity document carefully the methods to and

research data (e.g., coding, storage of research files, limits of accessibility to research data, etc.).

Please enter the number of subjects that will be enrolled at ---

15

No

Total Study Enrollment

Please enter the total number of subjects to be enrolled at all study sites. 15

Ages

Select the age range of subjects that will be enrolled in this study. Check all that apply.

18 years and older

Under 18 years of age (Any proposals with participants under 18 years of age will require a full board review).

Vulnerable Populations

Subjects who are unable to read should not be excluded from research on the grounds of illiteracy. If a subject is unable to read or if a legally acceptable representative is unable to read, an impartial witness should be present during the entire informed consent discussion.

After the written consent form and any other written information to be provided to subjects is read and explained to the subject or the subject's legally acceptable representative, and after the subject or the subject's legally acceptable representative has orally consented to the subject's participation in the trial, and if capable of doing so, has signed and personally dated the consent form, the witness should sign and personally date the consent form. By signing the consent form, the witness attest that the information in the consent form and any other written information was accurately explained to, and apparently understood by, the subject or the subject's legally acceptable representative, and that informed consent was freely given by the subject or the subjects legally acceptable representative.

Cognitively Impaired Adult Subjects

Minors with Parental Consent

Minors Who can Consent Themselves

Pregnant Women

Prisoners

Illiterate

✓ Other / None

Please describe.

None

Study Abstract

Summarize the background, rationale and significance of the proposed study. Refer to SNHU IRB Handbook Manual for further clarification. (250 maximum characters)

The purpose of this project is to examine the experiences and perceptions of college students taking an online ecology course. Specifically, this study will examine how and to what extent students' experience in the course shapes their connection to nature, environmental identity, and place attachment to the Arboretum. Connection to nature [CTN] is a conservation psychology construct that represents an individual's feelings of communion with the natural environment. Because individuals who measure highly on CTN metrics exhibit greater levels of pro-environmental behavior, including political activism, there exists growing interest in the capability of environmental education [EE] in fostering CTN. Much of the research examining the efficacy of EE programming on CTN development has examined the influence of formative, outdoor experiences. What remains unclear, however, is whether and how alternative experiences, such as online environmental education may promote similar outcomes. This is particularly important given the sudden shift to online and blended learning imposed by the COVID-19 pandemic. Thus, this research aims to enhance our understanding of online environmental education to foster CTN. Specifically, this research will explore the potential impact of an online environmental ecology course on CTN outcomes, environmental identity, and place attachment among college students. The specific research questions being addressed are:

- How do college students enrolled in an online ecology course perceive and experience their connection to nature?

- What is the student experience with the digital mediation of nature in the course? • How is student experience of connection to nature mediated through/related to emerging adulthood?

Hypothesis/Objectives

Provide the study hypothesis and/or objectives of the study in outline form. The purpose of this study is to examine the experiences and perceptions of ----- undergraduate students taking an online, introductory ecology course, BIO-315-11707: Ecological Principles. Additionally, this study aims to contribute to our understanding of the intersection of connection to nature and online, college-level environmental education.

Inclusion/Exclusion Criteria

Provide a detailed description of inclusion and exclusion criteria for study participants. The only criterion for selection is enrollment in the course under study. Participation will opt-in to the course, and student enrollment in the course is not contingent upon participation with the study, BIO-315-: Ecological Principles. That is, students enrolled in the course may elect to not participate in the study, without penalty. Students are self-enrolled in the course, either as part of their major (Environmental Science; Biology) or for general education science credits.

Additional information and guidance can be found by clicking the question mark in the top-right corner of each section.

Describe all study procedures.

The study will examine student experiences in the course, BIO-315, Ecological Principles, which will be taught online during the fall 2020 semester at ---- to University College (i.e. “residential”) students. The course will attempt to virtually replicate or represent field experiences that students participate in when the course has been taught in-person. Some of these replications will include 360-degree photography, camera trap data, sound recordings, and the use of real-time environmental and climate data.

At the start of the course, participants will be provided the consent form (see attached form, ‘consent’) and asked to indicate their agreement (or not) to participate in the study. For students indicating their agreement, they will then receive the first survey/questionnaire, which will be administered electronically (see attached, ‘questionnaire 1’). Participants will respond to a series of questions, including demographics, familiarity Arboretum, environmental identity as well as questions pertaining to connection to nature.

During the course and study period, participants will also complete five reflective journal assignments, pertaining to course topics and themes. Students will receive a written prompt for each journal entry (see attached, ‘journal prompts’). Journal entries will be submitted electronically and then downloaded to a password-locked computer, where pseudonyms will replace any personally identifiable information. Journal entries will be coded thematically using the qualitative analysis platform, Nvivo.

Upon conclusion of major course activities (anticipated 1-2 weeks before end of term) participants will be issued the second online questionnaire (see attached, ‘questionnaire 2’). The second questionnaire will, in many ways, mirror the first questionnaire in order to gauge pre- and post-course measures on certain constructs, including connection to nature. Additionally, other items will be included to assess students’ experiences, perceptions, and evaluation of the course.

At the conclusion of the course, I will conduct one-on-one interviews with each participant via Zoom. Interviews will be approximately 30-60 minutes in duration, and I will coordinate with each participant to arrange a time convenient for them. Interviews will be semi-structured, informed and adapted from related studies (see attached, ‘interview guide’). Interviews will solicit feedback from participants around the themes of connection to nature, course experience, identity, and the Arboretum (e.g., place attachment). Interviews will be recorded and transcribed by Zoom, at which point both the recording and transcription will be downloaded to a password-protected computer in a locked office.

Describe your recruitment procedures and any material inducements given for participation

No students outside of those in the course under study will be recruited.

No material inducements will be offered to participants.

Study Documents

If applicable, this includes flyers used for recruitment.

Describe the duration of study participation, the length and number of study visits, and the timetable for study completion.

The study period is projected to run from September 9, 2020 through

December 20, 2020. Results will be analyzed and written up by late summer,

2021.

Describe the information to be gathered and the means for collecting and recording data.

Participants will be asked to complete two online questionnaires, engage in journaling exercises and an interview. The questionnaires will be administered at the start and completion of the semester. The questionnaires will ask participants to read some brief statements and respond by indicating their level of agreement. Each questionnaire should take approximately 10 to 15 minutes to complete. Survey questionnaires will assess demographics, familiarity with the Arboretum, environmental identity as well as questions pertaining to connection to nature.

Journals completed for class assignments will be analyzed as part of this study. Journals are reflective in nature, and will ask participants to reflect on a technological mediation of nature,

such as a virtual tour of the Arboretum.

Participants will take part in one interview at the end of the semester. Interviews will be conducted remotely via Zoom, at a time that is convenient for participants. Interviews will run approximately 30-60 min in length. Interviews will solicit feedback from participants around the themes of connection to nature, course experience, identity, and the Arboretum (e.g., place attachment). I will invite participants to verify the interview transcripts to check for accuracy.

Survey, Questionnaire, or Interview

Will the study utilize surveys, questionnaires, or interviews?

Yes

Attach all copies of surveys, questionnaires, or interviews.

[BIO-315_Pre-course_Survey.docx](#)

[BIO-315_Post-course_Survey.docx](#)

[Weinstein_Interview_Guide.pdf](#)

[Weinstein_Journal_prompts.docx](#)

No

If applicable, please justify why the survey, questionnaire, or interview needs to record identifiable information.

No identifiable information collected

Will the study involve administering any of the following?

Device, e.g. Assistive Technology, Robotic Device, Artificial Intelligence
Please describe.

None of the above

Will the survey, questionnaire, or interview record any information that can identify the participants?

Yes

No

Safeguarding Subjects' Identity.

Will data will be linked to participant names?

Yes

No

What uses will be made of the information obtained from the subjects?

Please check below:

Publication e.g. Journal, Dissertation,Conference

UG Research Day

Program Evaluation/Improvement

Honors Module

Course Improvement

Other

Please describe your use of information obtained from the subjects Will data be stored

longer than three years ?

Yes

No

If video/audio recordings are created in this study, would they be erased/destroyed by the end of the study?

Yes

Please describe erasure or destruction process

Participant interviews will be conducted remotely via Zoom. Interviews will be recorded and transcribed via the Zoom platform. Both the recording and transcription will be downloaded to a password-protected computer in a locked office. These recordings will be kept for one year after final publication of work, and then destroyed by deletion.

No

Not Applicable

Do you anticipate study participants will be subject to any risks?

Yes

No

Expected Benefits

Describe the expected benefits for subjects (if any) and/or society that will arise from this study.

There are no anticipated benefits for participants, other than the opportunity to provide direct and granular feedback on the course. Broadly, this study represents a novel contribution to the field of EE, particularly given the rapid transition to online delivery presented by the challenges of COVID-19. Additionally, the need to address CTN outcomes via technological interventions represents a nascent but growing field of research, which this study will also contribute to. Finally, this study will add to the connection to nature by examining the experiences and perceptions of an underrepresented population within the literature: emerging adults.

Will deception be used as a method of data gathering?

Yes

No

Informed Consent

Describe the procedures for obtaining informed consent. Explain the procedures for obtaining informed consent from adults. If applicable, explain how assent will be secured for children or others who, by definition cannot legally give consent (e.g., adults with legal guardians). Informed consents must address the risk and benefits of the study.

At the start of the course, participants will be provided the consent form (see attached form) and asked to indicate their agreement (or not) to participate in the study.

Informed Consent Form (suggested template is in the Attachments section below) [Weinstein_Informed_consent.pdf](#)

Waiver of Consent due to safety of Study

Participants Please attach below

Do you or any investigator(s) participating in this study have a financial interest related to this research project?

Yes

No

Study Procedures

Study Documents

If applicable, this includes flyers used for recruitment.

Study Instruments

Attach all instruments (i.e. personality scales, questionnaires, evaluation

blanks, etc) to be used in the study.

[BIO-315 Pre-course Survey.docx](#)

[BIO-315 Post-course Survey.docx](#)

[Weinstein Interview Guide.docx](#)

[Weinstein Journal prompts.docx](#)

Participant Protection

Informed Consent Form

[Weinstein Informed consent.pdf](#)

APPENDIX G: LETTER OF INFORMED CONSENT

INFORMED CONSENT INFORMATION SHEET

Please read this form carefully, and feel free to ask questions you might have.

Research study title: “Exploring the Potential of Online Learning and College Students’ Connection to Nature”

Researcher:

Mike Weinstein, PhD Candidate, Environmental Studies Department, Antioch University New England, Keene NH 03431 USA

Purpose: The purpose of this study is to examine the experiences and perceptions of undergraduate students taking an online, introductory ecology course. Additionally, this study aims to contribute to our understanding of the intersection of connection to nature and online, college-level environmental education. The research will be conducted from September 1, 2020, through December 20, 2020.

Study Procedures: If you agree to take part in this study, you will be asked to complete two online questionnaires, engage in journaling exercises and an interview. The questionnaires will be administered at the start and completion of the semester. The questionnaires will ask you to read some brief statements and respond by indicating your level of agreement. Each questionnaire should take approximately 10 to 15 minutes to complete. Journals completed for class assignments will be analyzed as part of this study. Additionally, you will be asked to participate in one interview at the end of the semester. Interviews will be conducted remotely via Zoom, at a time that is convenient for you. Interviews will run approximately 30-60 min in length. Direct quotations from the interviews may be used in presentation of the research, with all references to names, locations, or other identifying features removed. The researcher will invite participants to verify the interview transcripts to check for accuracy. Once the study is complete, the researcher will make the findings available to participants and the larger community. The findings may also be published in the researcher’s dissertation, in academic journals, or presented at conferences.

Potential Benefits: You may not directly benefit from your participation in this study; however we hope that your participation in the study may help the researcher better understand students’ experiences with online environmental education.

Potential Risks and Confidentiality: We believe there are no known or foreseeable risks associated with your participation in the study; however, as with any online activity the risk of a breach of confidentiality is always possible. To the best of our ability, your answers to this study will remain confidential. We will minimize risks by working with de-identified data. You will not be identified by name in any publication of the study findings. All recordings and transcripts will be analyzed only by the researcher. In addition, all data collected as part of this research project will be maintained on a password protected computer kept in a locked office.

Right to Withdraw: Your participation is completely voluntary. You may withdraw from the research project for any reason, at any time, without penalty of any sort. You may also skip any question that you choose. If you withdraw from the research project at any time, any data that you will have contributed will be destroyed at your request.

Contact for Information about the Study: If you have any questions about this project or if you have a research-related problem, you may contact the researcher, Mike Weinstein, at ---.

Contact for Concerns about the Rights of Research Participants: If you have any questions about your rights as a participant in this study, you may contact ---.

Consent to Participate: By selecting “I agree” below you are indicating that you are at least 18 years old, have read and understood this consent form and agree to participate in this research study. Please print a copy of this page for your records. By selecting ‘I consent to recording the individual interviews’, you are indicating that you are permitting the research to record interviews.

I agree to participate. I do not agree to participate.

I consent to recording the individual interviews.

Print Your Name _____
Signature _____ Date _____