SUSTAINABILITY LITERACY COMPETENCIES IN COURSEWORK
FOR PRESERVICE TEACHER PREPARATION

by Elizabeth M. Potter-Nelson

A dissertation submitted in partial fulfillment
of the requirements for the degree of
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University of Wisconsin – Stevens Point
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Abstract

The purpose of this study was to identify the prevalence of four categories of sustainability literacy competencies; sustainability knowledge; systems thinking; social justice; and futures thinking, throughout coursework in a teacher preparation program. A mixed-methods case study was conducted in four courses at one university to identify the prevalence of these categories and the role they had on preservice teachers’ reported understanding of sustainability literacy. Data were collected in the form of faculty surveys, faculty interviews, course materials, and student surveys and analyzed using a sustainability literacy framework. Although the courses were not designed as sustainability courses, findings indicated the prevalence of at least one sustainability literacy category in each course. In addition, findings also showed that student participants recognized sustainability literacy categories in their coursework. A major conclusion was that the prevalence of at least one sustainability literacy category in each course has potential to serve as a leverage point where sustainability education could be readily integrated into teacher education. Recommendations were made for future conversations on this topic and policy changes in teacher education.
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Dedication

For Zoe, Isla, and Cael.
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Chapter 1. Introduction

People turn to education as a way to change current trajectories to new pathways that address current concerns (Darling-Hammond, 2006; Orr, 2004; Sterling, 2011). Scholars have articulated a need for educational sustainability to change the current trajectories towards something more sustainable; something that meets the needs of the current population, while preserving and maintaining resources for future generations (Lange, 2018; Nolet, 2009; Orr, 2004; Sterling, 2011, Wiek et al., 2016). This need for educational sustainability can be fulfilled by taking steps to create a more sustainability literate populace. Sustainability literacy is where people embody the attitude, dispositions, and skills to live sustainably (Stibbe & Luna, 2009). Although the goal is a sustainability literate populace, this study looks at sustainable education in the classroom and how teachers, and preservice teachers are educated to address sustainability for all.

The following section addresses the need for a sustainability literate populace, how sustainability literacy is currently taught in teacher preparation programs and uncover the understanding preservice teachers have about sustainability literacy in their coursework.

Problem Statement

The goal of education appears straightforward to educate students. However, this goal becomes highly nuanced when one considers the numerous stakeholders in, and pathways to, the actual act of educating students. Orr (2004) argued that current work being done in education is not enough given the unprecedented environmental changes that are impacting the social, political, economic, and ecological lives of all humans on Earth, and advocates for education of a different kind (IPCC, 2018). This desire to change education has been echoed by numerous individuals striving to change the education system in an attempt to create a more
The idea of sustainability began to gain momentum after the release of the *Our Common Futures* report, colloquially referred to as the Brundtland Report, which articulated that sustainability is the idea of meeting the needs of those currently around while preserving resources so that future generations can survive (WCED, 1987). The Brundtland Report led into the creation of the Earth Charter and served as a foundation for the current understanding of sustainability (Nolet, 2016). Following the completion of the Millennium Development Goals (MDGs) which were focused on eliminating worldwide poverty, the United Nations started the Sustainable Development Goals (SDGs), which shifted the focus to sustainable living worldwide (UN General Assembly, 2015; UNESCO, 2017). *Quality Education* was the fourth of the seventeen SDGs outlined in the *2030 Agenda for Sustainable Development* (UN General Assembly, 2015). Throughout the documentation supporting the SDGs, the underlying message was that to achieve worldwide sustainability there needs to be a dramatic shift in the way people think and act (Nolet, 2016; UNESCO, 2017). This sentiment was also articulated in the Earth Charter that outlined a vision and principles that foster a sustainability literate populace (Earth Charter Commission, 2000). Educational sustainability is a route forward to change existing systems of thinking and learning (Wals & Jickling, 2002).

The achievement of such a dramatic shift in the thoughts and actions of people worldwide will require a profound change in how education is delivered. There is an understanding that educators and teachers are the ones who will be instrumental in this change (UNESCO, 2017). Yet many educators are not currently prepared to infuse sustainability into their curricula (Green, Medina-Jerez & Bryan, 2016). Pre-service and in-service teachers will need to not
only understand sustainability but will also need to be able to teach their students how to become literate in sustainability (Falkenberg & Babiuk, 2014; UNESCO, 2017). This will require teachers to not only learn about sustainability, but also have a deeper understanding of what allows them to design and interact with learning experiences for their classrooms (Bransford, Darling-Hammond & LePage, 2005; Falkenberg & Babiuk, 2014).

Veteran teachers are often resistant to changing their practices (Ghaith & Shaaban, 1999), but preservice teachers may be more amenable to change. Although current research indicates that participating in one unit of instruction or taking one course can have an overall positive impact on a preservice teachers’ understanding of sustainability, this singular experience does also not guarantee lasting change within the education system (Andersson, 2017; Mintz & Tal, 2018). Holistic integration of sustainability competencies within existing frameworks of teacher education may or may not lead to lasting sustainable change in preservice teachers, and their students.

**Purpose Statement**

This study examined how four categories of sustainability competencies were taught in a teacher preparation program and what role these competencies had on preservice teachers' reported understandings of sustainability literacy. Specific focus was given to expanding sustainability to be more holistic, encompassing social and economic understandings, in addition to environmental understandings.

This study addressed the following questions:

1. How are preservice teachers currently being educated on the knowledge, skills, and dispositions associated with sustainability literacy?
2. What understanding of sustainability literacy are preservice teachers developing based on their education?

**Positionality**

Although certain aspects of my life have remained constant, my life experiences continue to shape how I view the world. Specifically, my experiences as a classroom teacher and department chair have had a profound impact on how I view learning for both children and adults. In addressing my positionality, it is necessary to look at who I am and how I identify myself, before explaining how my experiences have shaped my worldview.

I am a white, female, mother, and wife. I am college educated, earning my bachelor’s and master’s degrees at a large, R1 research institution (Carnegie Classifications, 2017). My degrees are in physics and secondary science education, respectively. I continued my education at a smaller university to earn a graduate certificate in educational leadership, which fulfilled the state’s requirements for my administrative licensure.

I believe that people are inherently good and trying to do the best with the resources they have, even if those resources or the logic they use are faulty. I believe in the positive power of people in the education system. I believe in the power of teachers and educators to change the lives of their students. I believe that each student deserves a teacher who will see the best in them. I believe in public education yet acknowledge its many faults. I believe in the power of science, research, and facts. I believe that using by logic, creative thinking, and compassion we can address the problems within public education, making public education, as a whole, more sustainable.

These beliefs are fundamental to who I am as a person, teacher, and student. However, it is important for me to share that I never intended to be a K-12 teacher. And, once I was in
the classroom, I never thought I would make it past the first five years of the profession, when 40-50% of new teachers often leave the profession (Clandinin, et al., 2009; Green, et al., 2016; Seidel, 2014). Yet, over a decade later, I am a proud teacher, coach, and administrator, and could not imagine a different pathway for myself.

One of my first lessons as I was going through my teacher preparation program came from Lewis Carroll’s *Alice’s Adventures in Wonderland* (1865). At one point in the book, Alice is engaged in a brief dialogue with the Cheshire Cat. Alice is lost and asks where she should go. She is told, “that depends a good deal on where you want to go” (p. 89). When Alice responds that she is indifferent to where she wants to go, the Cheshire Cat responds, “then it doesn’t matter which way you walk” (p. 89). Although straightforward, this exchange of dialogue was used to explain the need for teachers to have goals for their lessons and their students.

This process of identifying goals and moving towards understanding is linear and arguably reductionistic in nature. I set goals for my students and my lessons. I identify action steps for achieving these goals. I put into place these action steps and my students succeed. But teaching is not actually this linear. As I taught in the classroom, I realized my goals and lessons needed time to breathe and evolve, and that goals could be achieved in a non-linear fashion. This shift in thinking for me echoes how Sauvé (1998) explained postmodernism, where she states, “postmodernity weaves itself in a context of changes, including abolition of earlier forms of order, in a questioning and searching process” (p. 12).

Students in my classroom learned complex ideas in physics and chemistry through guided-inquiry experiences. My instruction was informed by a variety of learning theories.
However, I most closely identified with constructivism as a way for students to engage with and learn science. Driver, Squires, Rushworth, and Wood-Robinson (1994) stated

From the earliest days of their lives children have developed ideas or schemes about the natural world around them. They have experiences of what happens when they drop, push, pull or throw objects, and in this way, they build up ideas and expectations relating to the way objects feel and move (p. 1).

As a classroom teacher, I facilitated experiences for students that forced them to interact with their current understandings to scaffold and build new understandings. There were times, however, when constructivism was not the ideal learning theory for the goals of a lesson to be achieved. Being in the classroom gave me the opportunity to see the value of multiple learning theories guiding and informing instruction, based on the goals for that specific lesson (Darling-Hammond, 2006).

When I became the science department chair my education world expanded past my classroom and my students. Due to the nature of my role I was forced to consider the how various subsystems interact with each other ultimately impacting the systems as a whole. Every decision made had a ripple effect from one system to another. I began to more fully understand the complexities inherent in education, from systems of oppression which favored some students over others, to hiring practices, to large curricular impacts. It was in this role that my frame of reference shifted from a science view to a broader educational viewpoint.

At the start of the doctoral program, I stood with my peers and articulated my profound belief in public education for all students, recognizing its many failings, but also placing hope in a system that has the potential to educate all students for sustainable change. I also know
that there are kind-hearted individuals in this system who whole-heartedly know that we can and will do better for our students.

**Theoretical Framework**

Educational sustainability is an emergent, cross-curricular field, building from different experiences and theoretical frameworks. Nolet (2016) and Sterling (2010) articulated that three different perspectives support sustainability education, as follows:

- Instrumental;
- Intrinsic; and
- Critical (p. 87).

These perspectives appear to have inherent contradictions and overlap in areas of focus, yet all three perspectives capture the complexity that exists within sustainability education (Nolet, 2016; Sterling, 2010). Individual teachers may find that the importance they place with each view shifts throughout their professional growth (Nolet, 2016). However, it is likely that all three perspectives will remain at the forefront of their theoretical perspective.

An instrumental perspective has its foundations in pragmatism and behaviorism (Nolet, 2016; Sterling 2010). At its core, an instrumental perspective responds to urgency for change. that is called for within sustainability education by viewing education as a means to an end (Nolet, 2016; Sterling, 2010; UNDESD, 2009). Sterling (2010) asserted that education can provide individuals with knowledge about a certain topic and that knowledge can be used to change the behaviors of individuals. Nolet (2016) asserted that providing students with information about sustainability content and abilities will change the behaviors of these individuals, making them live lives that are more sustainable, thus making a more sustainability literate population and addressing the concerns of an unsustainable world. Both assertions hold that
education can have an influence larger societal issues in mechanistic ways that negate complexities in moving people to becoming more sustainability literate (Nolet, 2016; Sterling, 2010). An instrumental perspective tends towards pragmatism.

An intrinsic perspective tends toward idealism (Nolet, 2016). Instead of viewing outcomes, an intrinsic perspective looks toward the process for the learner (Nolet, 2016). An intrinsic perspective sees sustainability education as providing context for a broader set of learning, with the learner’s behavioral change as a secondary focus for the learner to engage with (Sterling, 2010). With groundings is social constructivism, the intrinsic perspective encourages the learner to become a systematic, critical thinker (Sterling, 2010). Often critiqued for being overly optimistic, the dispositions encouraged through an intrinsic perspective are often the same outcomes of an instrumental perspective to sustainability education (Nolet, 2016). Adding further complexity to the discussion of instrumental and intrinsic perspectives is the critique that both perspectives view education as innocuous (Nolet, 2016; Sterling, 2010). This perspective is harmful given that the current education systems continue to support and perpetuate structures which have segregated and suppressed specific groups of learners, with roots in racism and colonialism (Grande, 2015; hooks, 1994; Holmes & González, 2017; Paris & Alim, 2014).

A critical perspective can address these concerns (Nolet, 2016). The desire to change or perturb education systems to be more socially just can be traced back to critical theory, defined by Nolet (2016) as follows: “Education based on a critical perspective is focused on helping people become aware of and overcome those patterns of dominance and injustice. The critical perspective is frequently concerned with empowering those directly affected by oppression and with pedagogies that promote agency and self-determination” (p. 89). Critical
theory looks to create education systems where all voices are heard and advocated for (Freire, 2018; Grande, 2015; hooks, 1994; Ladson-Billings, 1998). In the process of challenging the current system there should be a focus on creating sustainable education systems through reflecting on current and past practices, democratic decision making, futures thinking, and collaborative planning.

As one moves through their professional career, experience and growth may lead an individual to more closely align with one perspective over others. However, all three should continue to inform the theoretical backings for sustainability education. (Nolet, 2016). Nolet (2016) reminds teachers that this interplay between three different perspectives is not a bad thing, but instead, addresses the wide knowledge base and multiple perspectives needed to fully embrace and truly live as a sustainability literate individual.

Each of these perspectives has a direct link to support sustainability education, however, neither on its own fully addresses the inherent complexities within the reality of educating for sustainability. As such, this study pulled from each theory, attempting to address this complexity. At its fundamental core, this study is based in an instrumental perspective, assuming a pragmatic solution to sustainability literacy by studying how teacher preparation programs prepare preservice teachers; if preservice teachers are education in sustainability, then their future students will become sustainability literate. However, recognizing the limitations in this perspective, the intrinsic perspective is used to begin how students are processing the information they learned in class related to sustainability. Finally, the critical perspective was necessary in the holistic view of sustainability, and was crucial in data analysis, as current educational trends address education for all students.
Significance of the Study

This study expanded on current understandings, which are predominantly limited to sustainability through an ecological and environmental lens, to encompass a more holistic approach to sustainability. Information from this study can serve as a base-level of understanding which can then be used to develop and enhance teacher preparation programs moving forward. Individuals can begin leveraging the existing knowledge to better design more holistic learning experiences which will ultimately encourage action towards a more sustainability literate population.

Summary

There is a need to develop a sustainability literate populace, but the creation of this populace will call into question deeply held beliefs and norms including, but not limited to how people are educated. To enact the necessary changes in the education system needed to foster sustainability literacy, teachers and educators will need to make a fundamental shift in how they educate students, taking a more holistic, interdisciplinary approach. To understand how to make this shift, this study examined sustainability literacy in a teacher education program in the United States. It identified how sustainability literacy was taught and understood by preservice teachers.
Chapter 2. Literature Review

This review of literature builds a bridge between sustainability and teacher education. It consists of four parts. The first part reviews publications that articulate needs for sustainability literacy. The second part reviews literature about sustainability literacy competencies, and groups key competencies into four categories. The third part connects the four sustainability literacy categories to teacher education programs. Finally, the fourth part identifies preservice teachers as vital connection points where teacher education programs implement sustainability literacy.

Publications were analyzed that reinforce the use of each perspective from the theoretical framework. When considering the instrumental perspective literature about the need of education of a different kind, in addition to identification of sustainability literacy competencies and its ties to teacher education were reviewed. For the intrinsic perspective publications about teacher education programs were reviewed. For the critical perspective literature around asset-based pedagogies was reviewed.

Need for Sustainability Literacy

The roots of using education as a way to accomplish sustainability initiatives has its roots reaching back to the 1987 World Commission on Environment and Development’s report entitled Our Common Future, which is colloquially referred to as the Brundtland Report (Nolet, 2016). There have been numerous initiatives working to address sustainability and education, many driven by the United Nations. In 2015 the United Nations General Assembly adopted the 2030 Agenda for Sustainable Development, outlining 17 Sustainable Development Goals (SDGs) of which education is the fourth goal (UN, 2015; UNESCO, 2017). The 2030 Agenda for Sustainable Development builds from the completion of the Millennium
Development Goals (MDGs) (UNESCO, 2017; UN General Assembly, 2000; UN General Assembly, 2015). Initially started at the turn of the millennium, the MDGs were not focused specifically on climate change but were established to address and potentially end worldwide poverty (UN, 2015). The eight MDGs covered topics ranging from maternal health to ensuring environmental sustainability to achieving universal primary education while promoting development and growth (UN, 2015). At the completion of the MDGs in 2015, then Secretary General of the United Nations, Ban Ki-Moon identified the action towards accomplishing the MDGs as a successful movement in working to eliminate extreme poverty, but also acknowledged areas for continued growth (UN, 2015).

There were a number of global initiatives that started after the release of the MDGs in 2000. Many of these initiatives focused on some combination of education and sustainability and lasted for about a decade before informing new initiatives. The United Nations Decade of Education for Sustainable Development (DESD) began in 2005 and concluded in 2014 with a goal of working with various agencies, organizations, and governmental entities to incorporate sustainable development into education systems worldwide (UNDESD, 2009; UNESCO, 2014b). To achieve this goal the DESD focused on increasing awareness of sustainable development in education systems and on increasing awareness of education in sustainable development systems (UNESCO, 2014b). After the World Conference in 2009, the DESD shifted its focus for the second half, going past just awareness and toward deliberate integration of education for sustainable development (ESD), specifically on topics of climate change, biodiversity, and disaster risk reduction (UNDESD, 2009). Although successful at bringing awareness to ESD, at the completion of the DESD, there was still a need to move past awareness and into improving and evaluating the ESD that had been implemented (UNESCO, 2014b). The
completion of the DESD in 2014 informed aspects of the SDGs and lead directly into the start of the Global Action Program on ESD (GAP) (UNESCO, 2014a; UNESCO, 2014b).

The GAP on ESD continued the DESD’s goal to bring education into sustainable development and to bring sustainable development into education by identifying five priority action areas (UNESCO, 2014a; UNESCO, 2014b). These priority action areas range in topic from policy to training preservice and in-service teachers to empowering youth and are designed to support the SDGs (UNESCO, 2014a, UNESCO, 2014a). The GAP on ESD identifies four strategies: building new momentum, harnessing partnerships, fostering a global community of practice, and showcasing good practice as methods to help direct success in the priority action areas (UNESCO, 2014a, UNESCO, 2014a). The intention is that work done toward the GAP on ESD will help accomplish the SDGs, specifically with respect to how interconnected and necessary education is to the success of all of the other SDGs (UNESCO, 2014a; UNESCO, 2014b).

The argument made in Education for Sustainable Development Goals: Learning Objectives (2017) about the SDGs is that achieving sustainability worldwide will require a radical change in how people think and act (UNESCO, 2017). This profound change can be achieved through ESD (UNESCO, 2017). Although there are 17 unique SDGs, the goal of education, specifically, is unique because it not only is its own goal, but it also addresses how the other goals will be achieved, adding to its significance (UNESCO, 2017). Without education, the other goals cannot be achieved (UNESCO, 2017). Yet, for education to meet the learning objectives outlined in Education for Sustainable Development Goals: Learning Objectives (2017), both for itself as a SDG and to assist the other SDGs, there needs to be a focus on
changing the education system to become more sustainable. The priority action areas outlined in the GAP for ESD also supports this focus (UNESCO, 2014a).

Looking toward the future, the year 2030 takes on an increased level of importance. By this time the Intergovernmental Panel on Climate Change is urging drastic changes of how people live to curtail catastrophic changes to the environment (IPCC, 2018). This is also the year when the SDGs come to a close. For some this upcoming decade is a quantifiable long time, where much can be accomplished. For others, who know the resistant nature of education systems, a decade is far too little time to make the necessary changes to foster a sustainability literate population. Regardless, there is a need to transform our education system (Orr, 2004; Sterling, 2011). Numerous scholars (Bransford et al., 2005; Cortese, 2003; Lange, 2018; Nolet, 2009; Orr, 2004; Sterling, 2011) concluded that if people are going to address and survive within our everchanging world, education systems will need to change dramatically. Orr (2004) asserted as follows:

But there are better reasons to reform education, which have to do with the rapid decline in habitability of the earth. The kind of discipline-centric education that enabled us to industrialize the earth will not necessarily help us heal the damage caused by industrialization (p. 2).

Although the SDGs are valid for a definitive amount of time, the need for educational sustainability will continue to outlive this timeframe and education systems will need to evolve to address the changing of the world caused by dramatic changes in climate.

The terms education for sustainable development, sustainability, and sustainability literacy have been used thus far without much acknowledgement to their complex meanings and relationship. Before going much further, it is necessary to add context to the words:
sustainability, environmental education, and education for sustainable development, to better understand how educational sustainability will be addressed. The use of the word sustainability has gained traction since the 1980s, although its current definition is more fluid, causing confusion due to the varied ways the term is used colloquially and academically (Birdsall, 2014; Lange, 2018). Although there are nuances in the term, the current academic understanding of sustainability is often attributed to the Brundtland Report (WCED, 1987). The Brundtland Report addresses the fact that sustainability is broader than a focus on ecology or the environment (WCED, 1987). Sustainability does include environmental understanding, but also includes an understanding of economics and issues of equity – highlighting the systemic nature in which one aspect affects the other aspects (Lange, 2018; Nolet, 2009; WCED, 1987). After the Brundtland report was released, the word sustainability evolved into sustainable development at the 1992 Earth Summit in Rio de Janeiro (Lange, 2018).

The use of sustainability and even more so sustainable development has been met with concern and trepidation by some since its introduction, and through its continued use. Sauvé (1998) finds the use of the word sustainability irresponsible, and trendy. Orr and others have questioned the use of sustainable development, arguing that there is an implied positivity and that its definition runs counter to its own tenets, conveying unlimited growth, which, in and of itself is not sustainable (Lange, 2018; Mappin & Johnson, 2005; Orr, 1992; Wals & Jickling, 2002). Adding to the dissent, many environmental educators are cautious about moving towards the use of sustainability education in defining their work since they do not view the two as one and the same (Wals & Jickling, 2002).

Mappin and Johnson (2005) offer an analysis of the nuances between education about the environment, education in the environment, and education for the environment. This
discussion lays the groundwork to further address some of the complexities in the history of environmental education in public schools throughout the United States. Environmental education has often been taught as a discrete topic within science classes, lacking the integrated nature some argue is necessary for success (Feinstein & Kirchgasler, 2015; Mappin & Johnson, 2005). There has been growth recently in environmental education to include behavioral, personal, and social change topics, there are still questions about whether the tenets of environmental education fully align with the overall goals of education (Cole, 2007; Mappin & Johnson, 2005; Nolet, 2009).

The discussion in the nuances of words has a history that should not be ignored, given the impending global climate change crises, one might question just how critical this debate is when there is a need for action. What is important to note is that when the nuances are removed, all of these areas address ways in which education systems can and should be transformed (Cole, 2007; Orr, 2004; Sterling, 2011). Wals & Jickling (2002) argue that as sustainability understanding evolves and changes, sustainability should be viewed as a part of the pathway to changing education systems, recognizing that new ideas and ways of knowing are always emerging.

The Brundtland Report (WCED, 1987) initially called for a document which would articulate its vision of sustainability, where environmental, social, and ecological viewpoints all have an influence (Earth Charter Initiative, n.d.; Nolet, 2016). Discussions about what this document would look like took place in the lead up to the Earth Summit in Rio de Janeiro in 1992. However, due to the political climate at the time, agreements could not be reached (Earth Charter Initiative, n.d.; Nolet, 2016). The writing process continued, led by Maurice Strong, a Canadian businessperson and secretary general of the Earth Summit, and Mikhail Gorbachev,
former head of the Soviet Union (Earth Charter Initiative, n.d.; Nolet, 2016). Effort was made to reference various documents and sources from international law instruments to NGO documentations as well as to reach out to people from all walks of life (Earth Charter Initiative, n.d.; Nolet 2016). Particular effort was made to include the voices of individuals who have historically been marginalized (Nolet, 2016). After eight years of writing and revisions, the Earth Charter was officially released in 2000. The Earth Charter is a collaborative document which articulates a worldwide vision for, and the steps necessary to accomplish a sustainable future (Earth Charter Commission, 2000; Earth Charter Initiative, n.d.; Nolet, 2016).

The Earth Charter is a layered document that builds on itself starting with a brief preamble that provides context and addresses the challenges moving forward. Following the preamble are 16 principles with 61 support principles that outline the expectations, ending with a call to action (Earth Charter Commission, 2000). The principles outlined in the Earth Charter offer a bold vision of what a sustainable future could be, however, accomplishing these principles will require a shift in the thinking and values of many (Nolet, 2016).

For as long as there has been education there have been people calling for reforms to the educational system. Specific to sustainable systems, E.F. Schumacher called for “education of a different kind” when referencing both how far society had come in terms of education, yet how far society still needed to go to curtail the exploitation of resources (Sterling, 2011). Yet, this change in education is more nuanced than it seems on the surface. As Orr (2004, p. 8) points out, “It is not education, but education of a certain kind, that will save us.” In this case, Orr is implying that just changing education without a specific purpose, will not suffice in educating students to be more sustainable. This sentiment is shared by Sterling (2011) who argues that much of the current education systems propagate unsustainable living. Although
education needs to change, any change will not necessarily yield a more sustainable population of people. The belief held by many scholars (Lange, 2018; Nolet, 2009; Orr 2004; Sterling, 2011) is that if there is to be a change in education systems, the change needs to be towards increasing the sustainability literacy of all learners.

More specifically, the key to creating a sustainability literate population is held in the idea that all learners will become sustainability literate (UN, 2015). This means that the focus is not on educating some people but providing equitable educational experiences for all people, worldwide. Recent curriculum standards in the United States have even added a similar sentiment stating, “all standards for all students,” advocating that the standards presented are not just for high achieving students but intended for all students within a classroom (NGSS Lead States, 2013). On the surface this seems to coincide with the ideals of public education in the United States which has its foundation in educating all students but the actuality of this is far more nuanced. There are longstanding systemic concerns centered in colonization and inequity within the United States that need to be addressed before education truly is for all (Alim & Paris, 2017; Freire, 2018; Grande, 2015; Holmes & González, 2017; hooks, 1994; Ladson-Billings, 1998). To accomplish this Kowasch & Lippe (2019) advocate for a pluralistic approach to education where sustainability is the catalyst for critical thinking about deep, engrained approaches to education (Everett, 2008).

In working to achieve a sustainability literate population of people, Nolet (2009) succinctly summarizes the work of Orr and Sterling by acknowledging that current methods of educating individuals will not work. A teacher cannot just tell students about the damage they are doing and expect their students to suddenly become sustainability literate. Literacy is not just learning the words, as is often thought. Sustainability literacy embodies not only the
content knowledge but the attitude, disposition, skills, and values necessary for one to actively live sustainably (Stibbe & Luna, 2009). Teachers need to foster experiences that create lasting, sustainable change, often by encouraging learners to experience a shift in paradigms (Cranton, 2016; Sterling, 2011). Paradigms are the unspoken yet known societal beliefs about how the world functions that can also be thought of as the world views (Meadows, 2008; O’Sullivan, 1999). Changing paradigms may be unsettling for a learner during a change, it can have a profound impact for an individual who calls into question deeply held beliefs about how the world operates (Cranton, 2016; Meadows, 2008).

Finding a leverage point, or a place in a system where one can begin to start a movement and enact change is key (Meadows, 2008). There are different leverage points which can achieve different levels of success in perturbing a system (Meadows, 2008). Paradigm shifts are considered to be the second most challenging leverage point to achieve according to Meadows (2008), with transcending paradigms being the most challenging. Shifting or transcending the paradigms of individuals can be difficult to do, but once achieved, these effects can have a profound impact on a system, far greater than other leverage points (Meadows, 2008).

With respect to sustainability, Sterling (2011) discusses paradigm shifts in the guise of transformative learning experiences where the learner has a shift in their original values, beliefs, and assumptions that could result in a change in behavior. The depth of effect that any learning experience has on a student is identified as first-order, second-order, and/or third-order learning opportunities (Sterling, 2011). In these instances, first-order learning opportunities involve a change in thinking, second-order opportunities involve a change in behavior and third-order opportunities involve an epistemological change in which individuals fundamentally shift how they think and act with regards to the world (Sterling, 2011).
Most of the learning that happens in existing education systems occurs at the first-order level where the focus is on knowledge transfer from teacher to student (Cortese, 2003; Everett, 2008; Sterling, 2011). There is a time and place for knowledge transfer in school settings, however, if the goal is deeper-level thinking, which leads to transformation, then this likely will not occur under first-order learning opportunities. Second-order opportunities push the learner and the teacher into reflection about beliefs and assumptions. The act of reflection demands deeper thinking from the learner, but does not necessarily result in transformational change, because the learner’s behavior may not change as a result of the reflection (Sterling, 2011). Finally, third-order opportunities require epistemological change for the learner, where they fundamentally change how they act based on their experiences (Sterling, 2011). Third-order learning opportunities can be difficult for the learner because they call into question deep-held beliefs and understandings and uproots these for new understandings. Learning in this manner is difficult to orchestrate in a classroom setting because not every student will experience learning in the same way and what is transformative for one, may not be for another (Sterling, 2011).

However, teachers need to focus on creating deep learning experiences which can be transformative for their students by developing lessons that are participatory, active, and experiential in nature if they are to create a more sustainability literate population (Mintz & Tal, 2018; Sterling, 2011). In the sections that follow, four categories of sustainability literacy will be defined to help delineate what a person needs to be able and willing to do, and value to be considered sustainability literate.
Sustainability Literacy Competencies

Orr (1992) and others (Cole, 2007; Kagawa, Selby & Trier, 2006; Nolet, 2009) have called on individuals to become sustainability literate, which extends learning about sustainability past the point of just knowing to a more holistic engagement that includes thinking about, problem solving, and action towards sustainability (Nolet, 2009; Roth, 1992; Sterling, 2011). At the risk of sounding reductionistic, there is a need to identify the specific competencies in which an individual would need to be proficient to be considered sustainability literate. This acknowledgement can provide educators, teachers, and others with concrete targets and allow for the creation of learning objectives to better complement the existing curriculum. A word of caution - identifying competencies and specific learning objectives in sustainability has the potential to further feed the idea that sustainability is an add-on to the current curriculum (Nolet, 2009) This could not be further from the case. Sustainability and sustainability literacy should be holistically integrated into the curriculum, resisting the fundamental characteristics of reductionism (Nolet, 2016). This integration may force a revisiting of what and how curriculum is taught in all grade levels, kindergarten through post-secondary, but the focus should be on a deep, holistic approach to learning (Cranton, 2016; Widhalm, 2011).

The literature is rife with terminology that addresses what individuals should know and be held accountable for with regards to sustainability literacy. This terminology includes but is not limited to the following words: standards, learning outcomes, competencies, learning targets, knowledge, skills, objectives, and themes (Baartman, Bastiaens, Kirschner & van der Vleuten, 2007; Bransford et al., 2005; Nolet, 2009; Sipos, Battisti, & Grimm, 2008; Warren, Archambault & Foley, 2014; Wiek, Withycombe, & Redman, 2011). In addition to their presence in sustainability, these terms are also frequently used in education. Rightfully so, there
are nuances between each of these terms which can cause confusion about their actual meaning (Wiek et al., 2011). Providing clarification on which words will be used moving forward may help to alleviate some of this confusion.

The skills, knowledge and/or abilities needed to complete a task or navigate a problem are known as competencies (Baartman et al., 2007; Wiek et al., 2011). Competencies can be broad and general including skills, like problem solving and creative thinking, or they can be more specific to a field of study (Wiek et al., 2011). Wiek et al. (2011) uses the terminology *key competency* in instances where the competency is more specific to a field of study. Key competencies are not more important than general competencies, but they are considered to be competencies that are content area specific, or in this case unique to sustainability or preservice teachers (Wiek et al., 2011). From a hierarchical viewpoint, competencies are used to create learning outcomes (Wiek et al., 2011). Learning outcomes are the targets that teachers and others use when designing curriculum. They are the tangible aspects of the competencies which can show when understanding of the competency has been achieved (Sipos et al., 2008; Wiek et al., 2011).

Clarifying the difference between competencies, key competencies and learning outcomes should not negate the importance of the other terms previously listed. All of these terms convey crucial nuances that impact educators, teachers, lesson designers, and others who work in designing curriculum for students. For the ease of further discussion, the word *competency* will be used moving forward in this document.

There are different lists that contain various competencies, which, if mastered should lead to sustainability literacy (Bertschy, Künzli, & Lehmann, 2013; Cole, 2007; Cotton & Winter, 2007; Nolet, 2009; Nolet 2016; Roth, 1992; Sipos et al., 2008; Tilbury, 2011; Warren et.
The competencies on these lists are broad and wide-reaching, including specific skills, but also addressing the specific content that is needed to be learned and how that content should be taught. These competencies often find their foundation in the definition of sustainability from the Brundtland Report (WCED, 1987) where sustainable societies meet their needs without compromising the needs of the future. In addition, these lists identify that sustainability is broader than just an ecological way of knowing and address a need to include an understanding of the economic and socio-political ways in which the world is connected and the dissonance caused between these areas as well (Nolet, 2009; Tilbury 2011; WCED, 1987).

Nolet (2009), identified nine different sustainability competencies for preservice teachers including: stewardship, respect for limits, systems thinking and interdependence, economic restructuring, social justice, and fair distribution intergeneration viewpoint, nature as model and teacher, global citizenship, and the importance of local place. In an analysis of thirteen different case studies about sustainability education, Tilbury (2011) recognized that learning should be about gaining content knowledge, but also acknowledged that students needed to ask critical questions, clarify one’s own values, envision positive and sustainable futures, think systemically, respond through applied learning and explore the dialect between tradition and innovation. Wiek et al. (2011) in a review of sustainability literature identified the following competencies: systems thinking, anticipatory, normative, strategic, and interpersonal. Bertschy et al. (2013) stated that learners should have the following competencies: to understand and change their own living conditions, to participate in collective decisions, and to be empathetic to those who are unable to control their own life conditions. The list generated by Warren et
al. (2014) identified a need for learners to have competencies in future thinking, value thinking, systems thinking, and strategic thinking.

In analyzing these, and other lists four main categories of competencies seem to emerge. The first of these is a sustainability knowledge (Christie, Miller, Cooke, & White, 2013; Cortese, 2003; Foley et al., 2017; Mintz & Tal, 2014; Sipos et al., 2008; Wiek et al., 2011). The second is systems thinking in which a person is able understand the interconnected nature of the various aspects of their life (Barth, Godemann, Rieckmann, & Stoltenberg, 2007; Capra & Luisi, 2016; Cortese, 2003; Everett, 2008; Frisk & Larson, 2011; Kalsoom & Khanam, 2017; Merritt et al., 2018; Nolet, 2009; Sipos et al., 2008; Wiek et al., 2011; Wiek et al., 2016; Yavetz et al., 2009). The third is a need to understand the role of being a global citizen, including working towards social justice, locally and globally (Cortese 2003; Everett, 2008; Gibson, 2006; Kalsoom & Khanam, 2017; Nolet, 2009; Sipos et al., 2008; Thompson et al., 2013; Windschitl, Thompson, Braaten & Stroupe, 2012; Wiek et al., 2011; Wiek et al., 2016; Yavetz et al., 2009). And finally, the fourth category is a need to be focused on futures thinking, while maintaining and respecting the relationship between tradition and innovation (Everett, 2008; Foley et al., 2017; Frisk & Larson, 2011; Gibson, 2006; Kalsoom & Khanam, 2017; Meritt et al., 2018; Nolet, 2009; Wiek et al., 2011; Wiek et al., 2016). These competencies are a delicate balance and can appear to be overwhelming on the surface. Yet, the current educational standards and frameworks lend themselves to include these competencies without the creation of new standards (Nolet, 2016). The key is to identify places within existing curricular and pedagogical competencies to make connections and integrate a more intentional way to address sustainability (Nolet, 2016).
**Sustainability Knowledge**

Initially there was hesitation for including sustainability knowledge on the list of competencies, in part because it touches on the other competencies. This is evident in the list of learning objectives used in the Sustainability Science for Teachers course created by Arizona State University (Foley et al., 2017). The list highlights understandings that address the interconnected nature of sustainability ranging from having the disposition to be aware of problems, to identifying material loses and places to conserve, to understanding the interconnected nature of problems and their solutions. To truly teach about sustainability one has to be knowledgeable on the topic to begin to understand how it can be intentionally taught within and throughout the curriculum.

Knowledge of sustainability is a broad topic and includes a deeper understanding of the interplay between both content knowledge of sustainability, similar to what is identified by the SDGs, and pedagogical content knowledge of sustainability. Instructors need to understand what sustainability is, and how to teach sustainability to their students so that their teaching methods are sustainable (Christie, 2013; Cortese, 2003; Sipos et al., 2008; Widhalm, 2011). Knowledge of sustainability includes environmental or ecological knowledge, but also recognizes the complex relationship between environmental, economic, and social processes (Mintz & Tal, 2014, WCED, 1987). Beyond knowing and understanding the definition of sustainability, Cortese (2003, p. 17) identified specific topics which address the broad knowledge base needed for competence in sustainability knowledge. The list provided is not exhaustive with regards to sustainability knowledge, but includes: understanding that humans are part of nature, resources are exhaustible, Earth’s ecosystems are complex, technology has multiple impacts both positive and negative, the needs of others on the planet are not consistently met, and health
and well-being of communities, along with cultural backgrounds has an impact on individual success. These topics are mirrored by Foley et al. (2017) who used the Brundtland Report as a guide in determining the content knowledge that should be gained in a course that was designed about sustainability for preservice teachers.

**Systems Thinking**

Taking a systems approach to thinking means looking at how things, tangible or intangible, interact and behave together. More specifically, Meadows (2008) defined a system as “an interconnected set of elements that is coherently organized in a way that achieves something” (p. 11). Countering reductionistic thinking, systems thinking acknowledges that the system itself is more than the sum of its parts and takes a holistic approach to processing and understanding components and interactions of systems (Capra & Luisi, 2016; Meadows, 2008). Meadows (2008) further stated, “Systems surprise us because our minds like to think about single causes neatly producing single events … But we live in a world in which many causes routinely come together to produce many effects.” Due to the interconnectedness of a system, changing it can be difficult and near impossible (p. 100).

Wiek et al. (2011) identified concepts and methodologies that take an abstract understanding of systems thinking and move it pragmatically in a more concrete, action-based direction. Using quantitative and qualitative modeling, system analysis, and participatory approaches Wiek et al. (2011) articulated a need to broadly look at systems and their interactions. This action moves past knowledge of systems, which includes understanding concepts like feedback loops, cause-effect chains, and tipping points, to also address how systems interact across and within scales (i.e. local to global), and domains (i.e., society, environment, technology, economy). Instructors and students need to move past focusing on the individual parts of
any system to looking at how systems interact together, and the impact systems can have on each other.

**Social Justice**

Another category of competency to consider in moving towards a more sustainability literate society is social justice. The Brundtland Report highlights the connections between social justice, economic development, and environmental impacts (WCED, 1986). Yet, many environmental agencies continue to focus on the environmental impacts, neglecting the impact that all systems have together, likely because not all voices and viewpoints are being evaluated together (Nolet, 2009). Holmes & González (2017) go as far as to say that the problems in Western education may just be Western education itself due to its failings to holistically include the voices of all participants. However, the Earth Charter (2000) clearly articulates a socially just world as part of a vision for a sustainable future.

Relating social justice specifically to education, the United Nations and UNESCO have articulated a need through various initiatives, including the SDGs to provide equitable and inclusive learning opportunities for all students. In the United States, specifically, the desire for *education for all* has been identified, but arguably not achieved due to deeply embedded systems that support and propagate an unfair and unjust educational system (Alim & Paris, 2017; Grande, 2015; Holmes & González, 2017; UNESCO, 2016). One way to do this is through using asset pedagogies in the classroom which acknowledge and build from the assets that students bring to the classroom, instead of the deficits (Alim & Paris, 2017). Culturally responsive teaching, culturally relevant pedagogy, and culturally sustaining pedagogies are all methods which work to recognize and support students who are marginalized by the current education system. Working in tandem, asset pedagogies have the potential to transform
classroom spaces into socially just learning environments that truly support learning of all students. Teaching practices that support social justice will be discussed in greater depth later in this chapter.

Futures Thinking

Sometimes called anticipatory thinking, intergenerational thinking, or even long-term thinking, futures thinking begins to look past the here and now and envisions the future (Frisk & Larson, 2011; Nolet, 2009; Wiek et. al., 2011). Frisk & Larson (2011) remind their readers that if the focus is to meet the needs of the present without comprising needs of the future, there is an inherent need to address how actions today influence the future. In working to accomplish this goal, individuals must understand the impact that current decisions have on systems in the future, while anticipating how to prevent unintended, harmful consequences to occur (Frisk & Larson, 2011). In numerous places throughout the Earth Charter (Earth Charter Commission, 2000) there is a clear articulation that individuals must think about future generations as they work to live sustainably. Futures thinking emphasizes intergenerational equity which may require current generations to change how they live so that future generations can live sustainably.

Sustainability Literacy & Teacher Education

Thus far this discussion has focused on the need to have citizens who are sustainability literate to ensure the health and well-being of the planet. In the following discussion a case will be made for the importance of teacher education and preparation in helping educate a populace who will be sustainability literate. The literature provides direction for efforts focused in teacher education to make educating sustainability literate citizenry possible.
The UNESCO *Education for Sustainable Development Learning Goals* (2017) asserted that, “Educators are powerful change agents who can deliver the educational response needed to achieve the SDGs” (Up. 51). Change does not happen instantaneously. To increase the sustainability literacy of learners in the classroom, teachers need to have an understanding of sustainability literacy, which many currently do not (Green, et al., 2016). This need for knowledge and understanding is two-fold, as teachers, at all levels, need to know and understand sustainability not just for themselves, but so they can develop rich, meaningful experiences for their students to engage in the material and develop the necessary competence to be considered sustainability literate (Bransford et al., 2005; Falkenberg & Babiuk, 2014; Sterling, 2011; UNESCO, 2017). In-service and preservice teachers, as well as teacher educators, will need to be trained in sustainability literacy competencies (Bürgener & Barth, 2018; Nolet, 2009; UNESCO, 2017). Just learning about sustainability competencies will not be enough for true change to happen. Currently the education system needs to shift to a greater focus on developing deep, holistic, integrated learning experiences which explicitly work to increase the sustainability literacy of the learners (Lange, 2018; Nolet, 2009; Orr, 2004; Sterling, 2011). To achieve this dramatic and holistic change in teachers at all levels, as well as their students, how preservice and in-service teachers are trained will need to be changed (UNESCO, 2017).

Each of the four categories of sustainability literacy reaches into teacher education, but the academic literature on what this looks like varies greatly from category to category. In some categories, like sustainability knowledge, there is a strong connection between sustainability literacy and teacher education, with correlations drawn between the fields. In other instances, like the category of social justice, there is literature about being socially just in teacher education and there is literature about the value of social justice in creating sustainable
societies. There are places where connections can and are sometimes made, but the correlation is still emerging.

**Sustainability Knowledge in Teacher Education**

The need for sustainability knowledge in creating a sustainability literate society begins to address includes an environmental way of knowing, but also acknowledges the complex relationships between environmental, economic, and social processes (Cortese, 2003; Mintz & Tal, 2014; WCED, 1987). Knowledge of sustainability can then be expanded to address pedagogical content knowledge. Currently many instructors use a positivist approach to teaching, which fundamentally challenges the message they are sharing about sustainability (Christie et al., 2013; Mintz & Tal, 2018). A positivist view assumes that there are absolute truths, which are objective and indicate a linear progression, where a postpositivist view recognizes that knowledge is socially constructed and subjective (Christie et al., 2013; Littledyke & Manolas, 2010). To fully recognize and support sustainability in the classroom instructors need to move towards a postpositivist approach in their instruction, which more fully recognizes and supports the deep, transformative learning process that learners often go through as they work to shift and adjust their paradigms (Christie et al., 2013; Mintz & Tal, 2018; Sipos et al., 2008; Widhalm, 2011).

Christie et al. (2013) provided concrete steps that educators can take to shift their instruction into a postpositivist methodology, which more clearly aligns with the goals of sustainability education. Christie et al. (2013) and Cotton and Winter (2010) listed the following techniques: role playing, group discussions from a variety of viewpoints, stimulus activities, debates, critical instances, case studies, critical reading, problem-based learning, and field work. Although these activities often require more preparation before the class starts, they have
the potential to provide students with the opportunity to engage more deeply with the content, opening the possibility for deeper learning (Cotton & Winter, 2010).

Some educators (e.g., Christie et. al. 2013, Cotton & Winter, 2010) may use these methods but there is also caution that educators’ actions may be countering the sustainability message that is trying to be conveyed. Educators need to be aware of how their actions from teaching, to selecting curriculum and educational tools, to interactions with students convey messages to the outside world, but more importantly their students (Campbell, 2014). These decisions are often referred to as a “hidden curriculum” that, comprises unspoken ideals and agendas that get passed onto students based on decisions that are made by teachers and educators (Greenwood, 2010; Kahn, 2010; Liston & Zeichner, 1988; McIntosh, 1989). Teachers need to remember that students are always watching, observing, and learning from the smallest interactions with students who are late to the larger decisions about the curricular materials that are being selected (M. Clough, personal communication, 2006). Widhalm (2011) encouraged educators to make sure the methods they use mirror the messages and information they are conveying. Santone (2019) offered to those who are cautious about indoctrination that, “Everyone loses when standing up for justice is demonized as a radical agenda” (p. 5). This sentiment towards social justice can be expanded to include sustainability as well. Everyone loses when standing up for sustainability is demonized as a radical agenda. Together, social justice and sustainability are on the surface disparate ideas, but they have potential to address some concerns in education (Santone, 2019).

**Pedagogical content knowledge.** Explicitly mentioned in this category are content knowledge and pedagogical content knowledge (PCK). These two types of knowledge may seem trivial, however, there is a difference between the two. Content knowledge is the
knowledge that a teacher needs to have understand their content. PCK is knowledge of how to teach one’s content to students (Cochran, King, & DeRuiter, 1991). This includes instructional methods and strategies unique to one’s content area. Cochran et al. (1991) addresses that PCK is what distinguishes a teacher from a practitioner or, more specifically, a scientist from a science teacher. Post-secondary institutions work to prepare preservice teachers to know their content and how to teach their content. Preservice teachers often enroll in courses on pedagogy (also known as methods classes) to learn about instructional methods and strategies. Some of this knowledge is also gained during student teaching and practicum experiences where preservice teachers spend time observing, reflecting, and teaching in a classroom with a practicing teacher. Although it is important to know about sustainability, part of that knowledge involves knowing how to teach individuals about sustainability.

**Transformative learning.** To truly have a lasting impact on individuals their learning experience needs to be one that addresses the complex, holistic nature of sustainability and develops not only the head, but the heart and soul through the learning process (Sipos et al., 2008; Sterling, 2011). A core foundation of sustainability education is to foster a learning process that supports social and ecological sustainability through transformative learning (Cranton, 2016). There has been much discussion about transformative learning and what is entailed in these experiences (Lange, 2013; Hoggan, 2016). Yet, many scholars start with Mezirow in defining transformative learning (Cranton, 2016; Hoggan, 2016; Taylor, 1998; Moore, 2005). Mezirow’s focus is on the learner’s critical reflection and change of viewpoints based on a disorienting dilemma (Taylor, 1998). In short there are three themes in Mezirow’s theory of transformative learning which are: centrality of experience, critical reflection, and rational discourse (Taylor, 1998). These themes lead the learner to reconstruct their understandings and
worldviews, resulting in transformative learning (Cranton, 2016; Taylor, 1998). The role of the educator is to foster these experiences by serving as a facilitator. Cranton (2016) attends to this idea by stating, “the primary educator role is one of facilitator of a learner-directed or codirected (teacher and learner) process” (p. 81).

Cranton (2016) specifically addresses how educators can support a transformative learning experience by providing concrete examples for practitioners. Cranton (2016) instead articulated that educators can support authenticity that includes emotions. Cranton suggested that educators could support students as they work through their transformative learning experiences, to “help create conditions whereby students will become conscious of their assumptions, beliefs, and perspectives; realize that there are alternative points of view; and begin to see their perspectives in a different way” (p. 89). More specifically, educators can support learners by showing empathy and respect, listening, offering structure, asking open-ended questions, and encouraging students to find their own voice (p. 139).

In mainstreaming sustainability curriculum for pre-service teachers, educators of pre-service teachers need to teach for sustainability, providing a different learning experience for their learners. Instead of rote and didactic teaching, the educator must serve in the role of facilitator. This role is supported by the other structures already discussed in this paper, yet, further analysis shows that educators need to support, respect, encourage, and challenge the learner’s assumptions and beliefs (Cranton, 2016). Transformative learning is not linear, the educator can foster learning experiences that encourage students to reflect on their experiences and wrestle with new understandings and paradigms (Cranton, 2002). This is integration is paramount when embedding sustainability knowledge into existing coursework.
Social Justice in Teacher Education

The need for social justice in creating a sustainability literate society begins to address, on a fundamental level what is being taught, the hidden curriculum in these lessons, who has access to this knowledge, and what voices are being neglected throughout this process. There is a body of literature surrounding culturally responsive teaching, culturally relevant pedagogies, and critical race theory which has informed the work of culturally sustaining pedagogy. Paris (2012) questions whether being responsive and relevant is enough to address the needs of all students in the classroom. Culturally sustaining pedagogy takes this earlier work and recognizes it while also expanding on it with an additional focus of sustaining and maintaining the cultures of marginalized groups (Alim & Paris, 2017; Paris, 2012). Thompson et. al. (2013) have begun to address what this looks like in the classroom for preservice teachers. Termed ambitious teaching practices, there is a focus on developing deep learning experiences that are hands-on and directed towards solving complex problems instead of the standard emphasis on procedural-talk and information giving (Thompson et. al., 2013). Although initially geared to science classrooms, ambitious teaching focuses on selecting big ideas and modeling, working on student ideas, and pressing students for explanations, which have applications in all learning environments, not just the science classroom. (Thompson et al., 2013). The next few teaching methods, while not explicitly sustainability pedagogies, work to provide teachers with the pedagogical knowledge to create “inclusive and equitable” experiences for all students (UNESCO, 2016).

Culturally responsive teaching. Starting as a way to teach diverse students as a result of the desegregation movement of the 1960s and 1970s there have been different scholars who have advocated for different techniques in teaching diverse students, but Gay’s culturally
responsive teaching practice is one of two different prevailing concepts that have sustained (Aronson & Laughter, 2016). Viewed as a focus on teaching practice, culturally responsive teaching aims to make culture an integral part of all curricular content areas (Gay, 1975, 2002).

Gay (1975) advocated for a culturally pluralistic curriculum. A culturally pluralistic curriculum is intentional and addresses the concerns that rise from cultural lessons that are just one-off experiences of isolated activities meant to inform students about different ethnic or racial groups. Gay further stated, “Most Americans know very little about their own ethnicity, and even less about ethnic groups other than their own. This lack of knowledge often leads to inter-ethnic group hostilities and misunderstandings” (p. 177). A culturally pluralistic curriculum provides students with the opportunity to learn more about different ethnic groups, including more about their culture and history and also develop greater empathy for these groups while striving to eliminate ethnic illiteracy. Gay also said that individuals that curriculum must have a sense of purpose, have a clear philosophy, and be organized around clear objectives which will eventually lead to clear instructional plans. To achieve a culturally pluralistic curriculum, changes to the existing structure would need to be deliberate, intentional and a regular part of the curriculum. Gay (2013) laid foundations for culturally responsive teaching are found in her work on culturally pluralistic curriculum.

Before addressing the teaching actions necessary to foster cultural responsiveness in the classroom, Gay (2013) first emphasized addressing teachers’ beliefs. Many teachers are White, middle class, females from European descent. In addition, taking on a culturally responsive approach to teaching is often met with resistance. Gay (2013) advocated that culturally responsiveness is a learning process and that “diversity in teaching techniques and resources is necessary to achieve educational equity and excellence” (p. 57). In addition to
building an understanding of culturally responsive teaching, there is a need for teachers to understand the foundational underpinnings of race within the various systemic structures in the United States. Although many teachers do not want to acknowledge differences in race, there are profound systemic differences, Gay states, “I want my readers to understand that, from my vantage point, whichever way race initially came to be, it exists and it matters profoundly in teaching ethnically diverse students. Yet, race, like culture and other human differences, do not carry any inherent stamp of privilege or problem; these are socially and politically constructed” (2013, p. 61). Teachers who are culturally responsive and successful in teaching students from diverse backgrounds, regardless of their own racial or cultural background are allies for their students (Cochran-Smith, 1997).

Building from this work, Gay (2002) determined that students are more engaged in learning when lessons in class are tied to their lived experiences. However, most teachers are not prepared to teach culturally diverse students (Gay, 2002). In working to address this concern there is a need to develop teachers who are culturally responsive (Gay, 2002). According to Gay (2002), “Culturally responsive teaching is defined as using the cultural characteristics, experiences, and viewpoints of ethnically diverse students as conduits for teaching them more effectively” (p. 106). Specifically, culturally responsive teaching focuses on six different areas where culturally responsive teachers are: socially and academically empowering; multidimensional; validating of student’s culture, socially, emotionally, and politically comprehensive; transformative of schools and society; and emancipatory and liberating from oppressive educational practices and ideologies (Aronson & Laughter, 2016, p. 165).

Teachers who are culturally responsive develop cross-curricular lessons that take an authentic, holistic approach to learning, where the content is not the only focus of the
curriculum (Gay, 2002, 2010). In developing this curriculum, teachers build pedagogical bridges which serve as a constructivist way of connecting students’ prior knowledge to the new knowledge (Cochran-Smith, 1997; Gay, 2002, 2010, 2013). To be successful in developing a culturally responsive curriculum, teachers need to acknowledge barriers to success for their students and then work to remove those barriers in their lessons (Gay, 2002). Teachers also need to flatten the classroom hierarchy and provide opportunities where students can be teachers and vice versa (Gay, 2010). Gay states “I want them to be independent, critical, reflective, and quality thinkers and decision makers who are deliberate and intentional in constructing their personal pedagogical positions, and in monitoring and assessing the quality of their culturally diverse beliefs and behaviors” (2010, p. 231). Teachers should be cautioned though that teaching diverse learners should not be seen as a checklist (Cochran-Smith, 1997). Building from the specific teaching practices in culturally responsive teaching, culturally relevant pedagogy specifically focuses on attitudes and dispositions of the profession (Aronson & Laughter, 2016).

**Culturally relevant pedagogy.** From experience, when asked, practicing teachers are often quick to state and acknowledge what makes for best teaching practices. These include a host of different techniques, many of which were learned in their teacher preparation programs that are supposed to help all students achieve in their classes. These best teaching practices are articulated in professional expectations for teachers through some of the professional learning standards mentioned earlier, including the Danielson Framework for teaching or EdTPA (Danielson, 2007). Ladson-Billings (1995a) offers a critique of best teaching practices, arguing that if these stated techniques really are best teaching practices then they should be reaching all of the students in the classroom. Yet, since there is an achievement gap, there is a disconnect in
what has been taught as best teaching practices and how those best teaching practices are being used (Ladson-Billings, 1995a).

Culturally relevant pedagogy is an asset pedagogy which works to flip the narrative for minority students. Instead of analyzing where minority students, in this case, African American students and their families, are deficient when they enter the education system, it looks to acknowledge the experiences of these students as assets (Alim & Paris, 2017; Ladson-Billings, 1995a; Paris, 2012; Paris & Alim, 2014). Teachers who observed students in their homes and communities were able to bring this knowledge into the classroom (Ladson-Billings, 1995b). Bringing this information into the classroom helped build a responsiveness that did not force students to conform to mainstream culture and acknowledge the relationship between home and school (Ladson-Billings, 1995b). Instead of teachers inserting culture into education, education is inserted into the culture of students and the community (Ladson-Billings, 1995a, p. 159). Culturally relevant pedagogy moves the narrative away from a feel-good story to one where students feel empowered to achieve academic success (Ladson-Billings, 1995a). Ladson-Billings (1995a) identifies three different criteria for culturally relevant pedagogy, which are as follows: students must achieve academic success, students must develop and maintain cultural competence; and students must develop a critical consciousness. In working to achieve these criteria culturally relevant pedagogy helps to empower a group of students, instead of individuals (Ladson-Billings, 1995a).

Similar to culturally responsive teaching, classrooms that are culturally relevant exhibit a flattened hierarchy, where teachers and students work together to learn and grow (Ladson-Billings, 1995a). The classroom becomes a collaborative environment where students are part of a community of learners, helping each other learn and grow (Ladson-Billings, 1995b).
Students also maintain active involvement in the community (Ladson-Billings, 1995a). This active involvement in the community assists in developing “a broader sociopolitical consciousness that allows students to critique the cultural norms, values, mores, and institutions that produce and maintain social inequities” (Ladson-Billings, 1995a, p.162).

During a recent lecture, Ladson-Billings (personal communication, March 21, 2019) acknowledged her work in culturally relevant pedagogy but paused to state that many like culturally relevant pedagogy because it is a feel-good story. Yet, this feel-good story fails to get into the depths of systemic, societal injustice in the same manner as critical race theory (Ladson-Billings, personal communication, March 21, 2019). Critical race theory acknowledges that racism is a normal part of life in the United States and works to expose the multiple existences of racism (Ladson-Billings, 1998). In working to expose systemic, engrained racism, critical race theory also works to deconstruct these unjust systems, while constructing systems that equitable and socially just (Ladson-Billings, 1998). Yet there is an underlying concern, Ladson-Billings (1998) states, “But, I fear we (educational researchers) may never assume the liminal position because of its dangers, its discomfort, and because we insist on thinking of ourselves as permanent residents in a nice field like education” (p. 22). Ladson-Billings (1998, personal communication, March 21, 2019) continues to argue that the conversations that need to happen around critical race theory are only touched upon through culturally relevant pedagogy, but need to be a greater focus if true, systemic change to the education system will happen. This change must happen for sustainability to take hold.

**Culturally sustaining pedagogy.** Respecting and expanding on the work of Ladson-Billings, Paris (2012) developed a pedagogy referred to as culturally sustaining. “Culturally sustaining pedagogies seeks to perpetuate and foster – to sustain – linguistic, literate, and
cultural pluralism as part of schooling for positive social transformation” (Alim & Paris, 2017, p. 1). In the 2012 article, *Culturally Sustaining Pedagogy: A Needed Change in Stance, Terminology, and Practice*, Paris openly questions if either the terms relevant or responsive actually do enough to support and maintain the language and cultures of marginalized groups. Using the term sustaining shifts the narrative to be more than just responsive or relevant but encourages youth of marginalized groups to sustain the knowledge inherent in cultural experiences while also providing access to dominant cultural expectations (Paris, 2012). Culturally sustaining pedagogies requires that students not only sustain their culture but also question practices within their cultures that are regressive, such as homophobia or misogyny (Alim & Paris, 2017). “Our goal is to find ways to support and sustain what we know are remarkable ways with language, literacy, cultural practice, while at the same time opening up spaces for students themselves to critique the ways that they might be – intentionally or not – reproducing discourses that marginalize members of our communities” (Alim & Pars, 2017, p. 11).

**Futures Thinking in Teacher Education**

To support this competency in the classroom, students will need to think critically about how their current decisions and choices are leading to current happenings, while also being imaginative about solutions that look towards the future (Merritt et. al., 2018). In addition, there is a need to look to past events and evaluate the causes and consequences of prior actions (Frisk & Larson, 2011). When describing futures thinking Wiek et. al. (2011) identify various methodologies which could be used including forecasting, backcasting, and anticipatory approaches. Forecasting uses models to predict future outcomes with varying levels of success based on parameters known and how far in the future one is looking, but ultimately recognizes that the future cannot be predicted (MacKay and McKiernan, 2004). Backcasting involves
envisoning the future and then working backwards to present time to identify more specific scenarios and implications from the future goals (Frisk & Larson, 2011).

When thinking specifically about the classroom environment visioning activities are one of the more common ways to think about futures thinking. Visioning activities can be where students are asked about the current state of things, reflecting on the current state, envisioning where things should be in the future and finally identifying an action plan to accomplish the goals set forth earlier (Frisk & Larson, 2011). During visioning activities students need to discuss norms and values, while also considering how they will individually work to achieve their vision, but also how the group will work together to achieve the vision (Frisk & Larson, 2011). Although occasionally contextualized as stories or pictures, visioning can be accomplished through a variety of different outputs, which makes it content and curriculum neutral (Frisk & Larson, 2011; Wiek et. al., 2011).

Regardless of the requirements for sustainability literacy teachers have unique requirements they must meet within the state they teach to be a licensed teacher. Becoming a teacher in each state in the United States is different depending on each state’s individual requirements. These requirements are set by each state’s legislatures, who ultimately identify what they deem is important or necessary to receive a teaching license. These requirements became more apparent to me as I traveled and earned my own teaching license in three separate states. The process of applying for licensure in three states, in addition to hiring teachers to teach in specific content areas has provided me with a unique viewpoint into teaching licensure. Although there are similarities among states – for example, most individuals need to complete some type of student teaching experience regardless of where they are earning their licensure – there are also significant differences. Instead of sharing the specifications for each state, which can be
further complicated by the consideration of alternative pathways to licensure, the focus will be on a broader understanding of the competencies that preservice teachers must have to be successful in the classroom. It should also be mentioned that each license granting institution, typically a post-secondary institution, has their own degree-conferring requirements in addition to the state’s requirements for licensure. A diploma and a teaching license are not the same document. Often the requirements for graduation compliment the requirements for the state’s licensure requirements so that upon graduation one has their bachelor’s degree and can then apply to earn a teaching license.

The demands on teachers are increasing (Darling-Hammond, 2006) and post-secondary institutions face an overloaded curriculum as they prepare preservice teachers to become teachers (Falkenberg & Babiuk, 2014). Teacher education programs are often tasked with instructing preservice teachers on classroom management, instructional design, pedagogical methods, child development, assessment protocol and content knowledge (Fuller, 1969). Yet, “Education is increasingly important to the success of both individuals and nations, and growing evidence demonstrates that – among all educational resources – teachers’ abilities are especially crucial contributors to students’ learning” (Bransford et al., 2005, p. 2). Seemingly straightforward, Darling-Hammond (2006) indicates that teachers need to know their students, the content, and how to teach. However, in reality, these three topics are complex in their own nature and inextricably linked to each other. A teacher needs to be successful at all three of these topics to be an effective teacher however these three topics are not the competencies or the learning objectives with which preservice teachers measure their achievement (Darling-Hammond, 2006).
When looking at teachers as a group who will enact sustainable change, the focal point can be on developing sustainability literacy knowledge among in-service teachers, preservice teachers, or some combination of both groups. Using intentional professional development, coaching, and evaluations, the focus could be on changing the pedagogical and even the ontological views of practicing teachers. Yet there are a number of barriers which pose difficulties in working to achieve change with in-service teachers (Ghaith & Shaaban, 1999). Ghaith & Shaaban (1999) determined that individuals with more than 15 years of teaching often had far fewer concerns about their teaching than their peers with less experience, suggesting that working with teachers before this point in their career could have the greatest impact for changing existing practices.

**Sustainability Literacy & Preservice Teachers**

Researchers (e.g., (Fuller, 1969; Kagan, 1992) have questioned whether preservice teachers are developmentally ready and have the practical experience to actually have their pedagogical and ontological beliefs shifted through their preservice programs, which is essential for developing the understanding of sustainability and pedagogical practice that are necessary. Fuller (1969) identified concerns expressed about teaching by preservice teachers, which included classroom management, adequate content knowledge and evaluative measures, that were often not aligned with the material that was covered in their coursework. Their teacher-preparation courses included instructional design, pedagogical methods, child development, and assessment protocol. Through his analysis, Fuller (1969) determined that there were three stages an individual linearly progressed through in their preparation for, and then in their actual teaching career, which are: pre-teaching, early teaching, and late teaching. During these stages Fuller (1969) determined that the focus of concern for individuals shifted. Pigge and Marso
(1987), while attributing the work to Fuller (1969) classified these distinct stages as *self, task, and impact*. Stating that, “early concerns about teaching evolve around feelings of self-survival, later concerns are generated by the teaching task itself, and finally, the mature teacher’s focus of concern is upon student impact or growth” (Pigge & Marso, 1987, p. 2). Ensuing literature often used Pigge and Marso’s summarization for Fuller’s work referencing his discrete stages as *self-task-impact*.

Fuller’s contribution is often cited (e.g. Ghaith & Shaaban, 1999; Grossman, 1992; He & Cooper, 2011; Kagan, 1992; Veenman, 1984) as a pioneering study of how teachers learn to teach and suggested that intricacies and complexities of sustainability literacy would be inappropriate for preservice teachers. However subsequent research built on this initial work is often contradictory, providing a more nuanced view of how individuals make the transition from preservice to in-service teaching, which has implications for when individuals should learn about sustainability (Clandinin, Downey & Huber, 2009; Ghaith & Shaaban, 1999; Grossman, 1992; He & Cooper, 2011; Melnick & Meister, 2008; Pigge & Marso, 1987; Veenman, 1984; Watzke, 2007).

Watzke (2007) argued that the idea of teachers working through the discrete stages of *self-task-impact* does not accurately reflect the nature of teaching and that concerns centered on self or task may present themselves at various times throughout a beginning teacher’s career. Watzke (2007) determined that preservice teachers were able to have complex thoughts about their teaching and that behaviors, when established early in an individual’s teaching career, had the potential for lasting impacts on the duration of their career. Due to the reoccurring nature with which concerns could manifest, there is a need to engage preservice teachers in professional development around student learning early in their careers, and to revisit and
scaffold on these lessons throughout a teacher’s early career and thereafter (Watzke, 2007). Since teacher concern for student learning consistently remains high, increasing the focus on student learning for preservice and early career professional development has the potential to be impactful. Watzke (2007) stated, “As a consistent and long-term concern of the beginning teacher, there is a great potential for relevant and formative support of student learning to gain a lasting foothold into the future professional development of these teachers” (p. 122)

Preservice and early-career teachers are able to provide access to content in varying ways to their students, yet they recognize the complex nature of their role as more than someone who just delivers content (He & Cooper, 2011). This acknowledgement highlights the need of teacher preparation programs to introduce preservice teachers to diverse school settings, as well as include interactions with community members, and parents (He & Cooper, 2011). Many teacher preparation programs integrate experiences focused on skill building instead of just discussions, which is paramount in helping preservice teachers understand and work through issues in the classroom today, such as diversity and accountability (Clandinin, 2009; He & Cooper, 2011).

Preservice teachers learn about teaching through a variety of experiences before they begin their formal education (Thompson, Windschitl & Braaten, 2013; Zeichner & Tabachnick, 1981). Early career teachers and, preservice teachers live in two worlds informed by what they are taught and what they experience. Early career and preservice teachers take information gained during their formal education and try to make sense of this new knowledge through their prior experiences. Thompson et al. (2013) found that, “The challenge for novice teachers is that they must develop such narratives across settings with competing contextual discourses – that juxtapose status quo (conservative) forms of teaching and ambitious, progressive forms
of teaching” (p. 578). The experiences that they have had before often overwrite what they have learned in their teacher preparation programs (Thompson et al., 2013; Zeichner & Tabachnick, 1981).

Compounding how preservice teachers process new information, they are presented with conflicting information where they are sometimes encouraged to change the system, and other times encouraged to conform to the practices they encounter so as not to seem problematic (Zeichner & Tabachnick, 1981). Thompson et al. (2013) have found that “…through modifications to their vision of practice and through enactment of developing visions, novice teachers are able to justify existing frameworks, adopt new frameworks, or create hybrids to guide their practice” (p. 578). Using action research as a way to encourage reflective teaching, Gore & Zeichner (1991) found that preservice teachers were able to change their teaching practices to become more critically reflective as a result of the action research they conducted as preservice teachers.

Among competencies for preservice teachers. Preservice teachers need to meet institutional requirements for degree conferment. These requirements often address knowledge of current competencies for in-service teachers as a preparation tool. Preservice teachers are also held accountable to state competencies for licensure. The following is a discussion of these various competencies.

The Council for the Accreditation of Educator Preparation (CAEP) has identified five different standards or competencies which post-secondary institutions must meet for accreditation (CAEP, n.d.). The standards cover topics such as content and pedagogical knowledge, clinical experience, recruitment, program impact, and provider quality (CAEP, n.d.). Within these standards, the one most focused on preservice teachers is the development of content and
pedagogical knowledge. Specifically, within the standards about content and pedagogical knowledge, substandard 1.1 stated, “Candidates demonstrate an understanding of the 10 INTASC [Interstate Teacher Assessment and Support Consortium] standards at the appropriate progression level(s) in the following categories: the learner and learning; content; instructional practice; and professional responsibility” (CAEP, n.d.).

Established in 1987, INTASC is comprised of state education agencies and national education organizations who work to prepare, license, and maintain licensure for teachers (CCSSO, n.d.). A core belief of INTASC is that licensing standards are the main driving factor in all standards and educational expectations within a state (CCSSO, n.d.). This means that once the standards have been determined, all other preparation (i.e. of preservice teachers, learning experiences, community outreach) should tie back to these standards. The INTASC Model Core teaching standards were developed by the Council of Chief State Schools Officer’s and INTASC. The teaching standards outline what teachers should know and be able to do so that every student can find success in college or the workforce (CCSSO, 2013). The current model core teaching standards were designed to show an acknowledgement of the increasing accountability required for teachers, the need for teachers to reach all learners, and to find commonalities between numerous standards, including the Common Core State Standards (CCSS) and the NBPTS (CCSSO, 2013). The ten standards are grouped into four different categories. These standards and categories are as follows:

- The learner and learning
  - Learner development
  - Learning differences
  - Learning environments
• Content knowledge
  o Content knowledge
  o Application of content

• Instructional practice
  o Assessment
  o Planning for instruction
  o Instructional strategies

• Professional responsibility
  o Professional learning
  o Ethical practice
  o Leadership and collaboration (CCSSO, 2013).

The inclusion of the INTASC Model Teaching Standards within the CAEP standards address a breadth of competencies that preservice teachers need to know before becoming teachers.

**Sustainability Education for Preservice Teachers**

Preservice teachers want to create classroom spaces where students can safely become creative, critical thinkers and develop deeper social-emotional skills (Gay, 2010). Although preservice teachers are gaining knowledge about the content they will teach and how to teach that content, most preservice teachers do not enter the field focused on reconstruction of the education system (Gore & Zeichner, 1991; Liston & Zeichner, 1987). And, because these are not goals for most, the education they receive does not focus on social justice or reconstruction (Gore & Zeichner, 1991). Liston & Zeichner (1987) state, “A more critically oriented approach to teacher education in conjunction with other educational, political, and economic reforms, could help to create a more democratic and just society” (p. 17).
Due to a number of complex reasons, the literature is sparse on the impact of education for sustainability with preservice teachers (Andersson, 2017; Ernst, 2009; Falkenberg & Babiuk, 2014; Fien & Maclean, 2000; Hopkins & McKweon, 2005). Many preservice teachers are not exposed to sustainability in their coursework (Ernst, 2009; Fien & Maclean, 2000). The reason for this is two-fold: educators at the university-level often are not experts in sustainability and feel that they cannot teach about sustainability, and coursework on sustainability is not required for a degree in teaching, in part due to the large volume of content already required (Falkenberg & Babiuk, 2014; Lozano, Lozano, Mulder, Huisingh, & Waas, 2013). Although educators’ hesitations run counter to the tenets of sustainability education being holistic and integrated, there are others who have tried to address this concern (Chase & Rowland, 2004; Eisen & Bartlett, 2006). Even when preservice teachers are exposed to sustainability in their coursework, it is not mainstreamed. Falkenberg and Babiuk (2014) referenced sources from the United States and from Australia, where sustainability coursework is almost non-existent in preservice coursework, and other locations where some efforts are being made to integrate sustainability. Andersson (2017) acknowledged that most of the literature addresses a teacher’s own sustainable development knowledge and not the effect of teacher education programs.

Nolet (2009; 2016) and others (Bürgener & Barth, 2018; Mintz & Tal, 2014, 2018; Santone, 2003) determined that some of the structures are in place to support the addition of sustainability competencies without them becoming an add-on to an already packed curriculum for teachers. In the United States, national content standards in the K-12 education system, from the CCSS to the NGSS, have placed an emphasis on students developing skills in creative thinking, communication, problem solving, critical thinking, and making connections (CCSSO & NGA, n.d.; NGSS Lead States, 2013). The learning of these skills is driven by content, but
these standards also address some of the key competencies that individuals will need to have when faced with the consequences of global climate change. Another goal of these standards and the Every Student Succeeds Act, is education for all students (ESSA, 2015). The Next Generation Science Standards articulate that when implemented a goal of the standards should be, “all standards for all students” (NGSS Lead States, 2013). This language is important because, while not explicitly stating this goal as sustainability, creating an “inclusive and equitable learning environment” is a one of the SDGs and a piece of moving to a sustainable society (UNESCO, 2016; NGSS Lead States, 2013). Although the beginning pieces of moving to a sustainability literate population are there, systemically there are still aspects that are missing. These missing pieces include intentional acknowledgement of the need for sustainability education or a more equitable, decolonized education system, for this goal becoming a reality (Grande, 2015; Orr, 2004, Lange, 2018, Nolet, 2016; Sterling, 2011).

Sustainability is not holistically integrated into any of the aforementioned components from teacher preparation and knowledge to classroom components including standards (CCSSO & NGA, n.d.; ESSA, 2015; NCLB, 2001; NGSS Lead States, 2013). Feinstein & Kirchgasler (2015) criticized the NGSS for not fully exploring the interconnected nature of sustainability by articulating, “Rather than depicting sustainability as a complex problem requiring multiple sources of knowledge, and then emphasizing the specific contribution of science, the NGSS repeatedly imply that sustainability is a scientific problem that can best be understood in scientific terms” (p. 132). Inequity in the American public education system is stark and complicated (Liston & Zeichner, 1987). The systems in place continue to benefit affluent schools and communities while leaving struggling communities and schools behind (Grande, 2015). Finally, the call for education of a different kind is not new, being originally
asked for over 30 years ago (Orr, 2004; Sterling, 2011). If these calls to change have not been answered with what is currently being done, then it is time to reevaluate what is currently being done (Ladson-Billings, 1995a). Holmes and González (2017) openly question if some of the concerns in Western education could be solved by a more inclusive, holistic way of knowing, which includes Indigenous ways of knowing. Thompson et al. (2013) echo a similar concern stating, “What is needed is a more robust theory of teacher learning that accounts for how participation in different communities – that project different messages about instruction and learning – shapes the language and practice of novice teachers” (p. 609).

In moving toward the goal of increased sustainability literacy much of the literature resides in theory. There are directives to create holistic, integrated classrooms, with flattened hierarchical structures, where teachers and students learn together through transformative, hands-on, place-based constructivist learning techniques. Yet, while very little is written on sustainability education integration, even less has been written on the actual impacts of specific techniques to achieve these combined goals (Wiek et al., 2016). Mintz & Tal (2018) even go as far as to acknowledge that much of what is stated in policy documents about ESD does not actually happen in the classroom.

Moving forward, there is a need to develop learning experiences that holistically connect content with pedagogies that support sustainability literacy and deep thinking. These learning experiences need to foster the four categories of sustainability literacy: general knowledge about sustainability, systems thinking, social justice, and futures thinking. Specific pedagogies, courses, and activities have been suggested that facilitate this movement to support sustainability literacy. Yet, this limited exposure to sustainability does not necessarily support the fostering of sustainability literacy. Knowing that the complexities within the education
system there is a need to determine how to leverage the existing systems to accommodate sustainability education (Mintz & Tal, 2018). My study will focus on building an understanding of how preservice teachers are currently being educated on sustainability literacy and what understanding of sustainability literacy preservice teachers are developing in their teacher preparation program.

**Summary**

Educators and teachers at all levels often do not have the necessary knowledge or understanding of sustainability literacy to enact the required changes. Knowing that teachers can enact change, providing professional development and coaching in sustainability literacy is paramount. The literature suggests that preservice teachers have the potential for the greatest impact in enacting this change. Teacher preparation programs have a broad set of competencies that already work to achieve compliance with state and university requirements for licensure and degree conferment. Although a unit or a course on sustainability can have a positive effect on one’s understanding, there is also acknowledgement that one course or unit may not achieve the desired transformative change required for the learner to become sustainability literate. The literature is sparse on the impact of multiple courses on one’s understanding of sustainability. While there are numerous expectations to manage in teacher preparation programs, there is the potential to find places where sustainability literacy overlaps with these existing expectations.
Chapter 3. Design & Method

The purpose of this mixed-methods study was to understand how three perspectives and four categories of sustainability literacy: sustainability knowledge, systems thinking, social justice, and futures thinking, were present in existing coursework for teacher preparation at a public university in the United States. Four courses taken by students throughout a teacher education program were studied. Participants in the study were faculty and student volunteers from the four selected courses. During the study the following data was collected and analyzed: faculty survey, faculty interview, course materials and a student survey. Analysis of the data was done using a sustainability literacy framework that was developed based on criteria set forth in the sustainability literature to identify the prevalence and depth of three perspectives and four sustainability literacy categories (Appendix A). The study addressed these two research questions:

1. How are preservice teachers currently being educated on the knowledge, skills, and dispositions associated with sustainability literacy?
2. What understanding of sustainability literacy are preservice teachers developing based on their education?

Research Design

Modifying research conducted by Mintz & Tal (2018), this study used convergent mixed methods in a multiple-case study with a cross-case analysis of multiple courses in an undergraduate teacher preparation program. The convergent mixed-methods approach allowed for near-simultaneous collection of quantitative and qualitative data which was analyzed to address two research questions (Creswell & Creswell, 2018; Creswell & Clark, 2018). Creswell & Clark (2018) articulate that convergent mixed methods allow for each type of data that
is collected to compliment the other while compensating for the shortfalls of the other. Yin (2009, p. 63) states that using a mixed-methods approach allows the researcher to “collect a richer and stronger array of evidence than can be accomplished by any single method alone.” In this case taking a convergent mixed-methods approach provided an understanding of sustainability literacy in teacher preparation programs from multiple viewpoints. Mixed methods approach also provided the opportunity for a pragmatic analysis of data (Creswell & Creswell, 2018). In acknowledging that each category of sustainability literacy competency encompassed different theoretical foundations, a mixed-methods approach provided the opportunity for the collected datasets to answer the research questions (Creswell & Creswell, 2018).

Yin (2009, p. 18) articulates that case studies allow the researcher to “investigate a contemporary phenomenon in depth and within its real-life context especially when the boundaries between phenomenon and context are not clearly evident.” In this instance three different cases, the Early Course case, the Mid-Course case, and the Capstone case served as individual cases in an attempt to understand sustainability literacy through the research questions, leading to a multiple-case study approach. This allowed for a systematic analysis of similar outcomes in similar situations, but also allowed for the acknowledgement of different outcomes in different situations (Yin, 2009). However, studying individual cases does not necessarily provide an understanding of the holistic integration of sustainability literacy throughout an entire teacher education program (Mintz & Tal, 2018). A cross-case analysis of the multiple cases was used to further analyze the data (Yin, 2018). The cross-case analysis offered further insight into and generalizations about sustainability literacy competencies within a teacher education program (Yin, 2018).
Methods

Research into sustainability literacy within teacher education programs is a relatively new undertaking. Although grounded in theory, this study was exploratory in nature, intending to gather a broad set of data and make meaning of the data (Creswell & Creswell, 2018). Multiple types of data including faculty survey, faculty interview, student survey, and evaluation of course materials were used to provide multiple sources of evidence as a means to validate the results and converging lines of inquiry (Yin, 2018). Yin (2018) and Creswell & Clark (2018) caution that there are inherent concerns when analyzing quantitative and qualitative data due to the requirements of multiple data collection techniques. However, if collected correctly, a broad set of data can also provide a wealth of information in working to understand the presented research questions (Creswell & Clark, 2018; Yin, 2018). Specifically, in answering how preservice teachers are educated on the knowledge, value, and dispositions associated with sustainability literacy the following data was the most relevant: faculty survey, faculty interview, and course materials. The student survey, faculty survey and faculty interview were most relevant in answering the second research question that looked at the understanding preservice teachers were developing about sustainability literacy based on their coursework.

Participants and Setting

This study analyzed data from four courses at an undergraduate teacher education program at the small public university classified as M3 (Carnegie Classifications, 2017). These were courses that almost all preservice teachers must take, for certification to teach in elementary or secondary schools. Seven courses were identified as required, of which four lent themselves to one or more of the four categories of sustainability literacy based on their course titles and descriptions. The Early Course case was comprised of one course which had a focus on
diversity in education. The Mid-Course case contained two courses; one course with a focus on environmental education and the other course with a focus on educating special education students. The Capstone Course case contained a seminar course that ran concurrently with the off-site internship experience for preservice teachers. Participants of the study were faculty and student volunteers from these selected courses.

**Timeline**

Due to the convergent nature of this mixed methods study the following timeline was followed for data collection. Data collection corresponded roughly with the Fall 2019 semester. Participating faculty members provided consent and were invited to complete a survey on a five-point Likert-type scale and open-ended items that asked them about how the course they taught addressed the four different categories of sustainability literacy. In addition, participating faculty members provided access to their course materials in November 2019. Participating faculty members granted access to their courses via the university’s learning-management system. Course materials included, but were not limited to, the syllabus, textbooks, readings, ancillary materials, lectures, assignments, and assessments. Following the survey, participating faculty members participated in a single semi-structured interview where common questions were asked of all participants as a way to gather more information about how preservice teachers were educated on the knowledge, skills, and dispositions associated with sustainability literacy. Faculty interviews were then completed from December 2019 through February 2020. Participating students in identified courses were asked to submit student surveys during the last two weeks of the fall term in December 2019. Each of the above cases were analyzed separately, and then combined into a cross-case data set (Yin, 2018).
Data Collection

Surveys

Two different groups of participating students and faculty members received surveys during data collection. Faculty and student surveys were similar, aside from demographic questions and a few small changes in phrasing of questions based on the group receiving the survey. Even though the questions were similar, the surveys for each group of participants were used to answer different research questions. The faculty survey was used to answer research question one about how preservice teachers are educated on the knowledge, skills, and dispositions associated with sustainability literacy. The student survey was used to answer research question two about what understanding of sustainability literacy preservice teachers are developing based on their education.

Surveys were intentionally administered as a means to add quantitative data into the narrative as a way to build an understanding of the research questions (Creswell & Creswell, 2018). This rationale is two-fold. First, the research on sustainability literacy in teacher education programs has been primarily limited to a course or a unit (Mintz & Tal, 2018). Surveying participating faculty and students throughout a teacher education program provided an opportunity to greatly expand on the existing knowledge base by looking holistically at multiple courses and the subsequent knowledge, skills, and dispositions that are taught as well as learned in these courses. Second, using surveys provided an opportunity to collect quantitative and qualitative data simultaneously. This allowed for both a quick snapshot of how participating faculty and students felt about their courses with follow-up qualitative short answer responses which provided additional depth to the quantitative portion of the survey. This study was strengthened by the addition of multiple data sources. In addition, due to the current nature
of high-stakes public education in the United States, having a quantitative component, in the
survey, has the potential to increase the interest in the data.

Survey items were designed to elicit responses that addressed the research questions, model, and categories. There was a chance of respondent bias, but it was more likely that wording of items misled respondents. To address this concern, some items were part of a pilot study conducted during prior to the start of this study.

**Facility surveys.** Faculty who taught one of the four previously identified courses were asked to complete a survey as a way to understand how preservice teachers were being educated on the knowledge, skills, and dispositions associated with sustainability literacy (Appendix B). The survey instrument consisted of both five-point Likert-type items and follow-up short answer items. Five-point Likert-type items asked faculty about their comfortability and training in sustainability, the prevalence of the sustainability literacy categories (sustainability knowledge, systems thinking, social justice, and futures thinking) in their courses, in addition to the teaching methods used in their courses. Likert-type items sought responses on a five-point scale ranging from *strongly disagree* to *strongly agree*, with *neutral* being the middle option. The following is an example of an item on the survey: “This course addresses the knowledge, skills, and dispositions associated with social justice.” Following each item, participating faculty members were asked to “Explain your answer” through a short answer response. Asking participating faculty members to provide a short answer following their responses was done for content validity and to provide context for participating faculty members’ responses. Questions in the survey were tested during a pilot study that occurred during the Summer of 2019. Minor changes were made from the pilot survey to the actual survey items, as a way to add additional clarification to the items. This included a brief explanation of each
category prior to being asked to respond to it on the survey, and the addition of examples to accompany the teaching practices.

Faculty surveys were administered to participating faculty members via Qualtrics. Qualtrics is an online survey tool used by UWSP. Using Qualtrics facilitated both the delivery of the survey and the analysis of the survey results from the surveys. After providing consent to participate in the study, participating faculty members were sent an email with a link for the survey. The email sent to participating faculty members addressed next steps in the study, including how to share course materials, intent to schedule an interview and a brief explanation about the survey. The survey was administered to participating faculty members toward the end of the Fall 2019 semester, with the majority of participants completing the survey in November 2019. The decision to wait until the end of the course was intentional as there was a need to view how the course was being taught and not have the survey influence future course design.

**Student surveys.** Students enrolled in one of the four previously stated courses were asked to voluntarily respond to a survey at the end of their course as a way to measure their understandings about sustainability literacy (Appendix B). Aside from demographic questions, five-point Likert-type items and open-ended items mirrored those asked of participating faculty members on their survey. Responses to five-point Likert-type scales focused on the sustainability literacy categories of *sustainability knowledge, systems thinking, social justice, and futures thinking*, in addition to asking students about the types of teaching practices they observed within their courses. Responses to the Likert-type items were on a five-point scale from *strongly disagree to strongly agree*, with *neutral* being the middle option. The following is an example of one item from the survey: “This course addresses the knowledge, skills or
dispositions associated with systems thinking.” Following each item, participating students were asked to “Please provide an example.” Asking for a short answer follow-up item provided content validity and additional context for participating students’ responses. Small changes to demographic questions and the wording of items were made to the Capstone course survey to acknowledge that students in the Capstone course would have different experiences that students enrolled in the early or mid-course cases.

All student surveys were administered via Qualtrics that was ideal in this situation due to the potential for a large number of respondents, ease of delivery and analysis of the data. Prior to students receiving the link to the survey in Qualtrics, a brief explanation about the study was given verbally to students, and then again at the start of the survey. Consent was granted when students submitted their survey responses. The link for the survey was shared via the university’s learning management system, and again through email. Students completed the survey during the last two weeks of the Fall semester, with the survey closing to students in December 2019.

**Faculty Interviews**

Faculty were asked to participate individually in a single semi-structured, face-to-face interview (Appendix B) to provide addition insight into responses provided on their surveys. The goal of the interviews was to further address how preservice teachers were being educated on the knowledge, skills, and dispositions associated with sustainability literacy. Interviews were used instead of journaling, observations, or other methods as they were a quick and personal way to gather addition insight into how the courses were design and taught to students. In addition, information collected during the interview was used to provide validity to the faculty surveys and the evaluation of course materials (Creswell & Creswell, 2018).
Participants in interviews were the same participating faculty members who taught the previously identified courses. After participating faculty members granted consent to participate in the study, plans were made to conduct the faculty interview, face-to-face on campus. Faculty interviews were completed from December 2019 through February 2020 and accommodated participating faculty members’ schedules. A loose interview protocol was developed, which primarily focused on the six items that were asked of all participants. Interview items were far-reaching and asked participating faculty members about their backgrounds in sustainability, intentional course decisions related to sustainability, and their beliefs on sustainability in teacher preparation programs.

Interviews were conducted individually with each participating faculty member in their offices on campus. Interviews were recorded using a digital recording device and notes were taken in case the recording device failed during the interview. Transcription of the interviews was completed using NVivo Transcription, a web-based transcription service. After the transcripts were completed by NVivo Transcription the researcher reviewed the transcripts for errors, referencing the audio from the interviews. Any discrepancies identified were corrected. The corrected file was then used in data analysis.

Course Materials

Faculty were asked to share course materials that include but are not limited to the course syllabus, textbooks, readings, ancillary materials, lectures, assignments, and assessments. Course materials were evaluated as a means to understand how preservice teachers were being educated on the knowledge, skills, and dispositions associated with sustainability literacy. Evaluation of course materials was selected as a less intrusive way to understand the content and structure of the course than a classroom observation. In addition, this method provided
a clearer understanding of the materials used and the structure of the course than by having participating faculty members share self-selected course materials.

After providing consent to participate in the study, participating faculty members were asked to share course materials. The majority of participating faculty members shared their materials through the university’s learning management system by adding the student research to enter their course as an observer. This provided access to all of the course materials but did not give the student researcher access to student work or grades. In a few instances participating faculty members also provided hard copies of assignments or shared work through other electronic means like email. Although evaluation of course materials was conducted throughout each course, there were also opportunities toward the end of the course to ask participating faculty members about their course materials during faculty interviews.

When course materials were collected, syllabi were primary data analyzed, in addition to assignments or activities referenced by faculty or students in surveys or interviews. Course syllabi were coded and evaluated for prevalence of the four categories of sustainability literacy. Magnitude coding was used as a way to quantitatively measure each of the categories of sustainability literacy (Saldaña, 2009). A pilot study in conjunction with an evaluation of the literature was conducted during the summer preceding this study to determine the criteria used in the magnitude coding. If possible, peer-debriefing was used to achieve inter-rater reliability (Mintz & Tal, 2018). When course materials were coded, they were used to validate other responses (Creswell & Creswell, 2018).

Data Analysis

After data collection, quantitative data and qualitative data were analyzed before being merged and compared. Merged data were used to interpret the results for each case (Creswell
& Clark, 2018, p. 119). After each individual case was analyzed a cross-case comparison and interpretation was done to generate a holistic understanding of how the four categories of sustainability literacy are found within one teacher education program in the United States (Creswell & Creswell, 2018).

For analyzing case study data, Yin (2018) suggested that researchers select an analytical strategy and analytical techniques. The analytical techniques of pattern matching, and explanation building were used to evaluate each individual case by identifying patterns and connecting those patterns to theoretical explanations (Yin, 2018). Pattern matching has the researcher take a predicted outcome and compare it with collected data for similarities or differences (Yin, 2018). The predicted outcome in this instance was the alignment of each case with the four categories of sustainability literacy addressed earlier. An extension of pattern matching is explanation building where case study data is analyzed by generating an explanation from the data that explains the case (Yin, 2018). The results from data collection will be analyzed against the four categories of sustainability and an iterative explanation will be built surrounding how closely aligned each course is with the sustainability literacy categories (Creswell & Clark, 2018).

After each individual case was analyzed, a cross-case synthesis was done to holistically understand sustainability literacy in a teacher preparation program (Yin, 2018). The focus of a cross-case synthesis is on maintaining the integrity of each individual case by focusing on the cases and not the variables (Yin, 2018). According to Yin (2018), “In a case-based approach, the goal is to retain the integrity of the entire case and then compare or synthesize any within case pattern across the cases.” Conducting a cross-case synthesis favors a holistic understanding of the cases (p. 196). In this study, after each of the individual cases have been analyzed,
the cross-case synthesis looked to holistically understand how each case impacted the research questions as a whole.

**Sustainability Literacy Framework & Depth Analysis**

Three perspectives served as the model for this study: instrumental, intrinsic, and critical. The creation of the model has its heart in the instrumental perspective as a pragmatic identify and measure sustainability literacy categories within existing coursework. However, the remaining two perspectives are apparent by their appearance in distinct categories within the framework. The framework was used to analyze all of the collected data from surveys to interview transcripts to course materials. It provided a common metric for understanding what sustainability literacy categories were present in addition to the depth with which the sustainability literacy categories were referenced. The development and use of a framework also assisted in the cross-case analysis because all of the materials from each of the individual cases were analyzed using the same framework, which provided another layer of commonality in completing the cross-case analysis. All qualitative data (i.e., survey short answer responses, interviews transcripts, and course materials) received two layers of coding, one to identify sustainability literacy category and the other to identify depth of coverage for that category, both represented on the sustainability literacy framework.

The sustainability literacy framework was developed using the sustainability literacy categories of sustainability knowledge, systems thinking, social justice, and futures thinking. Criteria were established for each sustainability literacy category, relying heavily on the literature review, that would distinguish each individual category from the next. In addition, a fifth category emerged and was added to the framework of teaching practice. Because the courses studied were all part of a teacher preparation program it made sense that there would be
teaching practices that were discussed that did not have links to sustainability literacy and the researcher felt it was necessary to include this category in the framework as well. In addition to unique criteria which was established for each category, key words were also identified as a way to further assist in the identification of the category that was being referenced.

When presented with one of the qualitative pieces of data (i.e., interviews, survey short answer responses, or course materials) identification of sustainability literacy categories was completed first. The researcher first identified a complete thought or idea in the piece of data being analyzed. Then using the criteria on the framework, the researcher identified which category was being referenced. The criteria on the framework is not a checklist and an item did not need to meet all of the criteria to be coded for that category. An item may have meet one or more of the criteria to be placed in the category. If an item met the criteria for two or more categories the item was coded to the category with which it meets more of the criteria. If the item meets both categories equally context was considered, determining which category there was more alignment. Often times a complete thought or ideas was a sentence, however, on occasion sentences were broken up based on the multiple references to different categories within a sentence.

After data were coded for sustainability literacy, the same data was then coded for the depth with which that category was addressed. Adding the depth coding provided more information about how the sustainability category was being referenced and, if action was being taken within the coded category. The initial inspiration for depth coding was drawn from Sterling (2011) when thinking about education of, for and as sustainability. Sterling’s work was then combined with magnitude coding (Saldaña, 2009) to understand the context with which faculty and students were referring to each sustainability literacy category. Depth was coded
as a Level 1, Level 2, or Level 3, with the higher depth number being associated with a greater likelihood of change in action occurring with that statement. Specific criteria were established for each coding level based on the idea that discussions about each sustainability literacy category would range from a recognition of the category to change in behavior in that category. A Level 1 code was given to a statement that merely referenced or addressed the category. This was as straightforward as someone identifying a keyword or phrase associated with a category. A Level 2 code was given anytime the category was referenced making a connection to what happens in the classroom or to student learning. A Level 3 code was applied anytime faculty or students talked about students changing their behavior or being involved in a transformative learning experience related to the category.

After data was collected and analyzed interrater reliability was completed using the sustainability literacy framework to verify the reliability of the framework. Those participating in interrater reliability coded a section of survey data based on written directions. A comparison was done and if necessary, a brief meeting was held to assist in increasing interrater reliability using the sustainability literacy framework.

**Surveys**

**Student surveys.** Student participants \((n = 90)\) in four different courses volunteered to take a survey about how the sustainability literacy categories and teaching practices were exhibited in their courses. The survey consisted of minimally identifying information, as well as five-point Likert-type and short answer items. The survey was completely anonymous with students completing some basic demographic information that asked them about which course they were enrolled in, their progress in their college courses, identified major, etc. The data
was aggregated to look at the understanding of sustainability literacy that students in the course overall develop.

Responses to the five-point Likert-type items were analyzed using frequency distribution. This distribution data began to answer what understanding of sustainability literacy pre-service teachers were developing based on their experiences in class. In addition, statistical analysis of responses on five-point Likert-type scales were done to look for mean responses, standard deviation, and Cronbach’s \textit{alpha} for reliability which was 0.85. A comma-separated values file of the raw data was uploaded into R (version 3.6.1), a computer software program for statistical analysis. Short answer responses were used to check for validity of responses on five-point Likert-type scales. In addition, short answer responses were analyzed using the sustainability categories in Appendix A. The short answer responses were added to NVivo 12 (version 12.6.0) for ease in coding and analysis. Using NVivo allowed for the application of two different layers of coding which could then be more easily quantified, as well as analyzed separately and together. The short answer responses were first coded for the sustainability literacy category discussed and then coded for the depth which the category was referenced. Coding using the sustainability literacy framework allowed for identification of general themes that that were aligned with the already established sustainability literacy categories (Creswell & Creswell, 2018). Responses on the survey were triangulated with the other data collected as a validity check (Creswell & Creswell, 2018).

\textbf{Faculty surveys.} Faculty members \((n = 7)\) teaching the four courses volunteered to complete a survey toward end of their courses that addressed how preservice teachers were being educated on the knowledge, skills, and dispositions associated with sustainability literacy. The survey consisted of five-point Likert-type scales and short answer items. Minimally
identifying information was collected as a means to guide follow-up interviews with faculty based on their responses to the short answer items and course materials.

Responses to five-point Likert-type items were analyzed using frequency distribution. The frequency distribution data began to answer how preservice teachers are educated on the knowledge, skills, and dispositions associated with sustainability literacy. Statistical analysis of the Likert-scale responses was done to look for mean responses, standard deviation, and Cronbach’s alpha for reliability which was 0.35. A CSV file of the data was uploaded into R for the statistical analysis. Short answer responses were used to check for validity of the Likert-scale responses. In addition, short answer responses were analyzed using the sustainability literacy framework to identify which sustainability literacy categories were addressed in each course, in addition to the depth with which the categories were addressed. The short answer responses were uploaded to NVivo 12 (version 12.6.0) for ease in coding and analysis. Using NVivo allowed for the application of two different layers of coding which could then be more easily quantified, as well as analyzed separately and together. The short answer responses were first coded for the sustainability literacy category discussed and then coded for the depth which the category was referenced. Coding using the sustainability literacy framework allowed for identification of general themes that that were aligned with the already established sustainability literacy categories (Creswell & Creswell, 2018). Responses on the survey informed faculty interviews and triangulation was used to validate this with other data collected during this study (Creswell & Creswell, 2018).

**Faculty Interviews**

Semi-structured interviews of participating faculty members took place after the faculty surveys were completed. After completion of the interviews with faculty, interviews were
uploaded to NVivo Transcription, a web-based transcription service through NVivo for transcription. The transcriptions were checked by the researcher to confirm for accurate transcription of the interview. The transcripts were reviewed for overall content, identifying broad themes and ideas (Creswell & Creswell, 2018). Transcripts were then uploaded to NVivo 12 (version 12.6.0) where they were coded using the sustainability literacy framework. First the transcripts were analyzed for sustainability literacy category using the sustainability literacy framework discussed earlier. Then each coded category was evaluated for depth, also using the sustainability literacy framework. Responses to interview items were triangulated with other data collected as a check on validity for all of the data (Creswell & Creswell, 2018).

**Evaluation of Course Materials**

Course materials for the aforementioned courses were collected through the University’s learning management system. Analysis of the material took place utilizing the sustainability literacy framework discussed earlier. Materials were coded first for sustainability literacy category and then for depth with which the category was covered. Course materials were triangulation with other data to ensure validity in the coding process (Creswell & Creswell, 2018). A description of the results for each course will be presented sharing descriptions and themes (Creswell & Creswell, 2018).

**Ethics & Trustworthiness**

I sought to understand how preservice teachers were educated on sustainability literacy and what they learned through their coursework. I evaluated syllabi and collected data from participants at one midwestern university.

Participants had of low risks of harm or coercion. There were no conflicts of interest. A research protocol was approved by the University of Wisconsin - Stevens Point Institutional
Review Board (Appendix C). Participation was voluntary. Participants provided informed consent after receiving a brief explanation of the goals and expectations for the research project. The researcher met face-to-face with all faculty participants to discuss the study, provide opportunities for their questions, and to complete the informed consent document. Student participants were introduced to the study through a brief face-to-face presentation during their course. Students provided consent by completing the survey. The participants did not receive any incentives for participating like money, extra points in class, or rewards of any kind. Participants did not receive special privileges for participating in the study nor were they be reprimanded for choosing not to participate. Participants were allowed to withdraw from the study at any time and any collected data related to them was not be used in the data analysis. No deception was used in the study.

Privacy and confidentiality were maintained for the participants. Due to the small sample size and limited number of courses being evaluated, faculty names were not be used. In addition, course names were not used, and each course was referenced by the case that it was assigned or by the topic of the course. In addition, other generalizations about the courses were used. Faculty were asked to review their case analysis prior to publication to provide the opportunity for them to provide feedback or request that material be coded or removed. Printed data materials are kept in a lock cabinet in a home office. Electronic course materials will be presented through Canvas, a learning management system, which requires a secure UWSP login for access. Survey results will be collected through Qualtrics which requires a secure UWSP login for access. Any downloaded digital course materials, survey results, transcriptions or other electronic data were secured through password protection.

*Controls for Bias*
Yin (2018) encouraged researchers conducting case studies to have a definite protocol in place prior to the start of data collection. Yin (2018) also reminded researchers that no case-study goes entirely by plan and that one must be adaptable, yet also unbiased in these adaptations. Due to the convergent nature of this study, much of the data was collected simultaneously or near simultaneously lessening the need for adaptations to be made while data was being collected. Multiple data types were collected and triangulated with each other to provide validity to each of the collected data types. More specifically the case analysis for each individual case was shared with the faculty of that case to provide feedback or request that material be coded or removed transcripts. Any coding done was analyzed regularly for drift (Creswell & Creswell, 2018). In addition, interrater reliability was conducted using the sustainability literacy framework on survey data.

**Summary**

This chapter addressed the intended research design and methodological approach. A convergent mixed-methods multi-case-study approach examined how preservice teachers were educated about sustainability literacy and their reported understanding of sustainability literacy from their courses. Data were collected through a faculty survey, faculty interview, evaluation of course materials and a student survey (Appendix D). Each type of data was evaluated within a case, before each case was individually evaluated leading to a cross-case analysis being done to create a holistic understanding of sustainability literacy in teacher education programs Eth-ical considerations and controls for bias were implemented.
Chapter 4. Findings

This study was conducted to examine how four categories of sustainability literacy competencies were taught in four courses in an existing teacher preparation program, and the role these competencies had on preservice teachers' understandings of sustainability literacy. Specific attention was given to the expansion of sustainability in a broader context than just an environmental way of knowing. The study addressed the following research questions:

1. How are preservice teachers currently being educated on the knowledge, skills, and dispositions associated with sustainability literacy?
2. What understanding of sustainability literacy are preservice teachers developing based on their education?

This study collected data from four courses in a teacher preparation program at a public university classified M3 (Carnegie Classifications, 2017). The selected courses are required for almost all students seeking teaching certification regardless of whether they will teach elementary or secondary students. In addition, these courses were chosen because, based on course titles and descriptions of content, they had a higher likelihood of covering one or more of the four categories of sustainability literacy. The selected courses were placed into three different cases: Early Course, Mid-Course, and Capstone Course based on when in their program of study these courses are taken by preservice teachers. The Early Course category contained one course, with multiple sections taught by three different faculty members. The Mid-Course category contained two different courses, each with multiple sections, taught by three different faculty. The Capstone Course category contained one course with multiple sections facilitated by one faculty member.
Within each course the following data was collected and analyzed: student survey, faculty survey, faculty interview, and course materials. The faculty survey, faculty interview, and review of course materials provided the most relevant data for answering Question 1, which addressed how preservice teachers are being educated on the knowledge, skills, and dispositions associated with sustainability literacy; while the student survey, faculty survey and faculty interview provided the most relevant data for answering Question 2, which addressed the understanding of sustainability that preservice teachers developed based on their education.

The data for this study was collected concurrently from November 2019 through February 2020. The following four data sets were collected:

- Course Materials: Faculty members granted access to their materials through the University’s approved learning management system, shared hard copies of documents during interviews, and shared additional materials electronically through email and programs like Dropbox.

- Faculty Survey: The faculty survey was administered to all faculty teaching courses within the study, which was administered through an online survey platform. The survey consisted of ten items on a five-point Likert-type scale, and corresponding short answer items that asked faculty to explain their responses on the Likert-type scale. None of the items on the survey were required. All faculty participants responded to all items on the five-point Likert-type scale; however, they did not all provide explanations in the corresponding short answer responses.

- Faculty Interviews: Interviews were conducted with all faculty teaching the courses under study and ranged in length from 10 to 30 minutes. The interviews were conducted after each instructor had completed their faculty survey and shared their
course materials with the researcher. The intent of the interview was to provide each faculty member with an opportunity to expand on information provided in the online survey and to contribute further context for course materials they shared.

- Student Survey: Students also completed a survey, which was similar in content to the faculty survey, through an online survey platform. In addition to demographic questions, the survey consisted of eight items on a five-point Likert-type scale, and corresponding short answer items that asked students to explain their responses on the five-point Likert-type scale. Students were not required to answer any of the items. Almost all students who participated in the study answered all of the items on a five-point Likert-type scale, but a smaller number of students provided explanations in the short answer responses. Response rates were as follows:
  - 23.3% of student participants in the Early Course case;
  - 30.5% of student participants in the Mid-Course case; and
  - 9.3% of student participants in the Capstone Course case.

Early Course, Mid-Course, and Capstone Course cases were individually evaluated and then a cross-case analysis was conducted among the three cases to address the research questions. Triangulation was done within each case to look for convergence in the data, which added to validity of the findings. Each type of data provided different viewpoint on the research questions and increased the volume and diversity of the information collected, which was especially important given the small sample size of seven faculty members in four courses. The findings shared in the following sections are explored in depth using tables, graphs, and other representations along with discussion of what the findings might suggest. Possible errors inherent in the data are also discussed.
Early Course Case

The Early Course case comprised six sections of one course that specifically addressed diversity in education. It was a required course in the teacher preparation program and had a required 12-hour practicum experience for students. Students \( n = 51 \) often take this course before they formally enter the teacher preparation program. In it, 51% of survey participants self-identified as first-year college students, and 29.4% identified themselves at the second-year level. Three faculty members taught this course, with each one leading different one to three sections.

*Research Question 1: How are preservice teachers being educated?*

To understand how preservice teachers are being educated in the knowledge, skills, and dispositions associated with sustainability literacy, an initial analysis was done to identify which of the four categories of sustainability literacy were present in the qualitative data that was collected. The four categories of sustainability literacy being assessed in this study are sustainability knowledge, systems thinking, social justice, and futures thinking. In addition, a fifth category, *teaching practice*, was added after its prevalence emerged during data analysis. Collected qualitative data, including short answer responses on the faculty survey, short answer responses on the student survey, select responses to faculty interview, and analysis of course materials were analyzed using the sustainability literacy framework. The prevalence of responses by category in each data set is shown in Table 1.

*Table 1. Responses Coded for Sustainability Literacy Categories*

<table>
<thead>
<tr>
<th>Category</th>
<th>Sustainability Knowledge</th>
<th>Systems Thinking</th>
<th>Social Justice</th>
<th>Futures Thinking</th>
<th>Teaching Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty Syllabus</td>
<td>0</td>
<td>2 (3%)</td>
<td>55 (76%)</td>
<td>0</td>
<td>15 (21%)</td>
</tr>
<tr>
<td>Faculty Items 2 &amp; 3</td>
<td>12 (26%)</td>
<td>7 (15%)</td>
<td>20 (43%)</td>
<td>3 (7%)</td>
<td>4 (9%)</td>
</tr>
<tr>
<td>Faculty Short Answer</td>
<td>1 (4%)</td>
<td>5 (18%)</td>
<td>11 (39%)</td>
<td>4 (14%)</td>
<td>7 (25%)</td>
</tr>
<tr>
<td>Student Short Answer</td>
<td>5 (3%)</td>
<td>6 (4%)</td>
<td>59 (40%)</td>
<td>14 (10%)</td>
<td>62 (42%)</td>
</tr>
</tbody>
</table>

83
Social justice responses were highly prevalent throughout each of these data sets. Given that this Early Course specifically addressed diversity in education, the prevalence of social justice themes was not all that surprising. Teaching practices were the next most prevalent category, especially on faculty and student short answer survey responses. The prevalence of teaching practices was also not that surprising as the early course is a course in the teacher preparation program, and it would be expected to find students learning about teaching practices that are not associated with the sustainability literacy categories. The next three categories of sustainability knowledge, futures thinking and systems thinking have some variation in their prevalence in above charts. Some of the variance for these three categories can be explained by the type of data that was analyzed. For example, futures thinking responses were more prominent in student surveys (Table 1). However, this is because students were often referencing experiences from class that they will do when they are future teachers. To understand the overall prevalence of these three categories, responses in each sustainability category across data sets were aggregated to add some clarity to the variation (Table 2).

Table 2. Combined Sustainability literacy Category Prevalence for Early Course Case

<table>
<thead>
<tr>
<th>Sustainability Knowledge</th>
<th>Systems Thinking</th>
<th>Social Justice</th>
<th>Futures Thinking</th>
<th>Teaching Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregated</td>
<td>7</td>
<td>20 (7%)</td>
<td>145 (50%)</td>
<td>21 (7%)</td>
</tr>
</tbody>
</table>

The faculty survey provided a chance to learn how faculty felt they were educating students on the knowledge, skills and dispositions associated with sustainability literacy. Ten five-point Likert-type scale items in the faculty survey had faculty reflect on their training and comfortability in sustainability, how their course addressed each sustainability literacy category, and the teaching practices they utilized in their class. Survey results are presented in
segments, starting with Figure 1. This segment focuses on how faculty responded to the items on a five-point Likert-type scale related to the prevalence of sustainability literacy categories in their courses.

*Figure 1. Early Course Faculty Responses on Sustainability Literacy Categories*

<table>
<thead>
<tr>
<th>Category</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>This course addresses knowledge, skills, and dispositions associated with general knowledge of sustainability.</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This course addresses knowledge, skills, and dispositions associated with systems thinking.</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>This course addresses knowledge, skills, and dispositions associated with social justice.</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>This course addresses knowledge, skills, and dispositions associated with futures thinking.</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Mirroring data shared earlier about the prominence of sustainability literacy categories in the Early Course case, all faculty strongly agreed that they focus on social justice in their teaching. Also consistent with results reported earlier, there was slightly less agreement about the other three categories, with one faculty member disagreeing that they even addressed futures thinking in their course.

To clarify the survey results it was helpful to look at the short answer responses that followed the items on a five-point Likert-type scale. Faculty were asked to explain their responses with the prompt, “Explain your answer.” Although faculty explanations were often brief, they provided additional insight into their intended goals for the course, which clearly highlighted a focus on social justice. For example, when specifically asked to explain how their course addressed knowledge of sustainability one faculty member identified a “social-cultural” component to the course. Another faculty member shared that “because the course focuses on diversity in education, there is a social justice undercurrent to all of it.” Adding a layer of quantification, these responses were coded using the sustainability literacy framework.
sustainability literacy category of social justice continued to be the most prevalent (39%) in short answer responses coded as social justice, followed by teaching practices (25%), systems thinking (18%), futures thinking (14%), and sustainability knowledge (4%).

It should be noted that statements were coded regardless of which sustainability literacy category the statement was referencing. For example, one faculty shared, “I most intensely focus on the social-cultural components and equal access to opportunity.” when asked to explain their responses to the degree in which they addressed “general sustainability knowledge” in their course. This was coded as social justice due to the acknowledgement of “social-cultural” and “equal access to opportunity” which are part of the social justice category on the sustainability literacy framework.

Although short-answer survey responses were brief, faculty interviews yielded more in-depth information about the ways in which social justice and other sustainability literacy categories, were addressed in the Early Course case. Interviews were semi-structured and focused on six different items (Appendix B). Two of the items specifically asked faculty about the course, while the other items were focused on other topics related to sustainability literacy. Interview Item 2 asked faculty if they made any specific decisions in their course design about sustainability. Interview Item 3 asked faculty about an assignment they felt highlighted sustainability. Using the sustainability literacy competency framework, the interview transcript was coded for prevalence of sustainability literacy categories.

A majority of responses to Interview Items 2 and 3 continued to highlight a focus on social justice (43%). The remaining categories had the following percentages: sustainability knowledge (26%), systems thinking (15%), futures thinking (7%) and teaching practices (9%). It should be noted that while there was a slight increase in the prevalence of sustainability
knowledge and systems thinking categories, this was due in part to the specific wording of the interview items, which intentionally asked faculty about their focus and design with regards to sustainability in a general sense. Specific sustainability literacy categories were not referenced, but the word sustainability was used in both questions leading to an increase in coding related to sustainability knowledge even though this category was not as prevalent in other sources of data.

As participating faculty members responded to Interview Item 3 about specific activities that highlighted sustainability, their responses focused on social justice over other sustainability literacy categories. Each participating faculty member shared a different activity highlighted sustainability. One participating faculty member discussed a visioning activity their students participated in early in their course. That participating faculty member shared that students were asked to “step into the shoes of another person” and think “about how they interact with their environment, with people, but then also thinking about sustainability as not being a detriment to your happiness.” This participating faculty member shared that “this really epitomizes [the course] in one hand of thinking about how people view sustainability and happiness in different countries around the world by stepping into their lives in their shoes.” Another participating faculty member shared an activity where students researched “communities that are different than our backgrounds” by conducting an interview with someone from that community. The participating faculty member shared that students often learn a lot about the biases held towards these communities. Finally, the third participating faculty member shared fishbowl activities that their students participated in throughout the course. The participating faculty member shared that reading case studies about “different aspects of identity and diversity in [the] United States” helped students position their thinking as future educators in these
situations by forcing students into thinking about the “other perspectives” including “how this affects their role in the community, their perception in the community or what their students do after this or how will this affect other teachers.” The activities were all different, but they all provided insights into how faculty were teaching students about sustainability and how faculty thought about sustainability within the context of their classes. These examples showed that while the faculty survey results indicated that all the sustainability categories are addressed, social justice was the most prevalent.

Interview Item 3 focused on course assignments, and Interview Item 2 asked faculty about intentional course design with sustainability in mind. In responding to Interview Item 2, participating faculty members recognized some ambiguity for their students, and even for themselves in the design of the course specifically around the topic of sustainability. All Early Course faculty articulated that the course they taught was not a sustainability course and shared that due to this, students may not be able to explicitly identify sustainability as a core learning outcome of the course. One participating faculty member specifically expressed their thoughts about integrating sustainability pedagogical knowledge into the course by saying, “I take a competency-based approach, so students won't necessarily go through my course and be like, oh, that was so linked to like environmental education.” Another participating faculty member said, “I don't even know if I would call it sustainability. It's sort of helping to build some of those thinking capacities.” The third participating faculty member stated, “Sustainability is kind of my motto or my philosophy, but that doesn't mean I'm teaching sustainability as a separate topic or chapter.”

Coded interview data were further supported by the syllabi that showed that social justice was a frequently referenced topic (76%), followed by teaching practices (21%) and
systems thinking (3%). However, in this same syllabi data, there was no reference specifically to the sustainability knowledge or futures thinking.

The syllabi articulated that the primary foci of courses were to assist students in identifying and addressing issues of diversity in education by acknowledging that there are injustices and inequities in the world. Although syllabi varied among participating faculty members, each syllabus included course learning objectives and INTASC standards for each course, all of which were coded for sustainability literacy categories, and all of which fell under the category of social justice.

In addition to asking how participating faculty members designed their courses and learning activities to focus on sustainability literacy categories, they were also asked about methods and teaching practices utilized in their classes. They acknowledged the social justice sustainability literacy category in their teaching practices. Participating faculty members reported strong agreement that they utilized culturally responsive, culturally relevant, and culturally sustaining practices with their students (Figure 2).

Figure 2. Early Course Faculty Responses on Teaching Practices

Short answer responses continued to support participating faculty members’ responses to the above items highlighting a focus on social justice. One faculty shared that “A lot of the work that happens in this course is helping students develop self-awareness about their own identities
and how those interacted with their educational experiences.” Another faculty shared, “I try to bring in other expertise to help with this [culturally responsive, culturally relevant, and culturally sustaining pedagogies] because my perspectives should not be the only perspective that the students are guided from.” Faculty self-reported belief that they utilized teaching practices that the researcher found were supported in the sustainability literacy literature, but there was not enough specificity in the faculty data describing teaching practices to link some of their practices definitively to the four sustainability literacy categories.

In answering the first research question, while faculty openly acknowledged that the course at the center of the Early Course case was not a sustainability course, they provided examples that highlighted the social justice category far more than the other sustainability literacy categories. Faculty were also able to self-identify the use of teaching practices that support general sustainability literacy, although there was not enough specificity in the examples given to link the practices to the four sustainability literacy categories studied. In the Early Course case, it is clear that preservice teachers were exposed to the knowledge, skills, and dispositions most closely associated with the social justice sustainability literacy category.

Research Question 2: What understanding is being developed?

The second research question focused on what understanding of sustainability literacy was being developed by preservice teachers based on their educational experiences. Due to the inherent complexity in the word understanding, answering this question was approached through two separate steps. The first step was to identify whether student participants recognized sustainability literacy categories in their coursework. Even though the course in the Early Course case was not a sustainability course it was selected because it contained topics that could be linked to the sustainability literacy categories. Using the student survey and follow-
up short answer responses, student participants self-identified which sustainability literacy categories they felt were covered in their course. The survey and follow-up short answer responses were then further analyzed in the second step, for depth of understanding. The depth analysis provided additional insight into how student participants were referencing the sustainability literacy categories and if they were taking action with knowledge gained from their coursework in the sustainability literacy categories. Using this two-step process, the focus was to understand how students in the Early Course case were learning about sustainability literacy based on their experiences in class.

Starting with the student survey as a way to process their recognition of sustainability literacy categories, Early Course case student participants were generally in agreement with the questions that were asked on the survey. Looking closer at responses to items on a five-point Likert-type scale, a majority of participating students reported that all four categories of sustainability literacy were covered in their courses (Figure 3).

*Figure 3. Early Course Student Responses on Sustainability Literacy Categories*

<table>
<thead>
<tr>
<th>Category</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>This course addresses knowledge, skills, and dispositions associated with general knowledge of sustainability.</td>
<td>5</td>
<td>16</td>
<td>21</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>This course addresses knowledge, skills, and dispositions associated with systems thinking.</td>
<td>1</td>
<td>17</td>
<td>22</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>This course addresses knowledge, skills, and dispositions associated with social justice.</td>
<td>1</td>
<td>16</td>
<td>15</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>This course addresses knowledge, skills, and dispositions associated with futures thinking.</td>
<td>2</td>
<td>10</td>
<td>23</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>
Student participants reportedly agreed that futures thinking was the most addressed sustainability literacy category; 39 student participants agreed or strongly agreed that their courses addressed this category. Initially, this seemed surprising. However, when their positions were examined, a rationale was that were enrolled in a teacher preparation course and plan to become teachers, so they were often asked to think about the near future, when they would become teachers. Student participants identified that they were often asked to think about their future experiences as classroom teachers and in their short answer responses often responded, “as future teachers” or shared scenarios that were centered “in our classroom environments.” This near-future thinking is not consistent with the long-term future thinking that is being called for in the sustainability literacy literature. Even though students used words and phrases that were identified on the sustainability literacy framework as being related to futures thinking, there was little evidence in their responses to suggest long-term futures thinking, with responses focused on the next few years, not the next few generations.

In their responses to items on a five-point Likert-type scale, after futures thinking, participating students most strongly agreed that their course covered the knowledge, skills, and dispositions associated with social justice, followed by systems thinking, and then sustainability knowledge. Acknowledgement of a focus on social justice by participating students matched responses by participating faculty, who also reported strong agreement that their courses addressed social justice.

To clarify the survey results it was helpful to look at the short answer responses that followed responses to five-point Likert-type scale items. Student participants were asked to explain their scalar responses by responding to a prompt, “Please provide an example.” Students’ short answer responses were coded, just as faculty responses were, using the
sustainability literacy framework. The prevalence of the sustainability literacy categories for the survey short answer responses were as follows:

- Teaching practice (42%);
- Social justice (40%);
- Futures thinking (10%);
- Systems thinking (4%); and
- Sustainability knowledge (3%).

Student-survey responses showed a slightly higher percentage of responses for teaching practice (42%) than for social justice (40%). When asked to provide examples of how certain teaching methods were used in their course, students frequently shared information about their practicum experiences. This practicum experience was a required part of the course in the Early Course case. Responses from students about their practicum experiences varied with a number of students responding to the prompt with just the word, “practicum.” The rest of the students provided a little more information about the actual practicum experience with responses like, “I did my Practicum[sic] hours when I was in a classroom for 5 [sic] weeks, observing, and helping a fifth-grade classroom,” and “Learned and participated in my practicum.” All of these examples were coded as teaching practice because they addressed a critical aspect of a teacher education course, but explanations did not provide additional information that could link the practicum experience to one of the four categories of sustainability literacy. As such, all but one reference to the practicum experience were coded as teaching practice, which explains why this category was highly reflected in the data.

The next highest coded category was the sustainability literacy category of social justice with 40% of the short answer responses being coded this way. Student data was similar to
the faculty survey data shared earlier, where social justice was also the most prevalent of the sustainability literacy categories at 39%. For students, their understanding of social justice was articulated by frequently referencing the need to “think about inclusion” and create “safe environments” for all students. Students also identified some of the same activities that faculty members discussed extensively during the survey and interviews. However, in sharing these and other activities, student explanations were often vague, only referencing the activity. For example, one student shared, “The course did a great job of expressing that students come from a vast amount of different social statuses and from the different geological locations. This is showed with the fish bowls[sic] or PLC's[sic] discussing the chapters.” Another student shared, “We talked a lot about social issues that we could face as teachers and were given very good teaching and opinions on how to face it.” These statements were coded as social justice because the students referenced “different social status” and “social issues we could face as teachers” both hinting at a connection to “achievement of all students,” which matched criteria on the sustainability literacy framework. However, based on these and other comments by students, it was not possible to discern the social justice content of the actual activities or the understanding students took away.

In addition, students often struggled to accurately identify and explain each sustainability literacy category and practice on the survey, even though descriptions of each of the categories were given, and brief examples of each of the teaching practices were shared to provide all students with the same background information. About 35% of responses that students provided as short answer explanations to their responses to five-point Likert-type items were coded in other categories. For example, when asked about systems thinking one student responded, “We discussed how creating an environment of equality has the potential to change
students’ lives for the better. In addition, a single person learning more about a culture has the opportunity to open the eyes of others by enlightening them.” Although one could potentially infer that this student was viewing the classroom as a set of overlapping systems, there was not enough evidence in the quote to be conclusive, so it was coded as social justice rather than systems thinking.

After addressing which categories were recognized by students in the Early Course case, an analysis of the depth with which each category was addressed was also completed as a way to further explain the understanding of sustainability literacy students were developing. Adding the layer of depth coding provided more information about how the sustainability category was being referenced and, if action was being taken related to the coded category. Every time the data was coded for a sustainability category, it was also coded for the depth with which the category was addressed. Depth was coded as a Level 1, Level 2, or Level 3, with the higher depth number being associated with a greater likelihood of change in action occurring. A Level 1 code was given to a statement that merely referenced or addressed the category. This was as straightforward as someone identifying a keyword or phrase associated with a category. For example, one faculty said, “I would describe sustainability as progressing towards living equitably within the bounds of nature,” which was coded as a Level 1 statement because it included the phrase “living equitably within the bounds of nature,” which includes terms associated with the sustainability knowledge category. The Level 2 code was given anytime the category was referenced making a connection to what happens in the classroom or to student learning. When asked about their students, one faculty member replied, “They see the big problems that are facing the world right now. Like, they're very real for our students.” Due to the mention of their students, this was coded as a Level 2. The Level 3 code was applied anytime faculty or
students talked about students changing their behavior or being involved in a transformative learning experience related to the category. An example of this was when one faculty member, referencing a large-scale course project, shared that, “I have students this semester at the end of the semester they told me that they had started taking Navy showers [a short shower, focused on water conservation] because of us talking about it in lecture.” Statements like this were coded at a Level 3 because they addressed a change in student behavior in the category based on what had been discussed in class. A more detailed discussion of depth coding is shared in Chapter 3.

The short answer responses on the student survey were analyzed for the depth in which the sustainability literacy category was addressed. This supplied additional information about how students were processing the material covered in class. In general, the majority of student responses about the sustainability literacy categories were coded as Level 2 indicating that the categories were discussed by students in the context of their course as shown in Figure 4.

Figure 4. Early Course Student Short Answer Responses on Sustainability Literacy

![Bar chart showing percentages of Level 1, Level 2, and Level 3 coding done in each category.]

The graph represents percentages of Level 1, Level 2, and Level 3 coding done in each category. The number of times each category was represented in the data is noted by $n$. 

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All of the statements receiving codes of sustainability knowledge, systems thinking, and teaching practice were coded as a Level 2. Even though all of the statements made with regards to sustainability knowledge and systems thinking were coded as a Level 2, it should be noted that the occurrence of these statements was much smaller than for social justice where there were over 50 responses coded as such. For example, one student shared, that they had “Multiple in-class activities based on sustainability.” While another student shared, “Activities that are done in class show[s] Systems [sic] Thinking.” These comments were vague, only referencing activities in a sustainability literacy category, with no acknowledgement of the content of the activities or the corresponding learning that occurred.

While the majority of responses were coded at a Level 2, there were also some students who indicated changes of behavior associated with the social justice category. This is evident in the Level 3 coding shown in Figure 4 in the category of social justice. A student provided a response about material they were learning which was coded as a Level 3, indicating a change in behavior, or thinking due to what was learned in class. The student said, “As the educator, I would have to accommodate to the particular student's needs in order to ensure that he/she is learning. This can affect the classroom too because I might end up implementing the styles, I used on that student for the rest of the class to not single him/her out…” A second student identified that they had “to critically think about how my bias[es] affect my perception of others.” A third student stated, “In this class, we learned about differences in a classroom,” and then provided a complex answer about changes they would make in their future classroom to accommodate students with ADHD. Although not necessarily transformative in nature, each of these responses highlighted student reflection and growth within the category of social justice based on what was learned in their courses.
Students were also asked on the survey to identify teaching practices that the faculty of their courses utilized that supported sustainability literacy. Asking students to identify teaching practices encouraged them to think past recognition and reflect on the practices that the faculty exhibited. Their reflection on teaching practices continued to add to the understanding of sustainability literacy that students were building from their courses. Students in the Early Course case were in strong agreement that the faculty of their courses utilized all of the listed teaching practices as shown in Figure 5.

*Figure 5. Early Course Student Responses on Teaching Practices*

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>In this course I participated in experiential learning experiences, transformative learning experiences and/or non-western or indigenous ways learning.</td>
<td>4</td>
<td>1</td>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td>In this course I participated in experiences that were culturally responsive, culturally relevant, and/or culturally sustaining.</td>
<td>2</td>
<td>4</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>In this course I was asked to critically think, problem solve, and/or creatively think.</td>
<td>1</td>
<td>4</td>
<td>24</td>
<td>19</td>
</tr>
<tr>
<td>In this course I was asked to be reflective on my learning.</td>
<td>3</td>
<td>9</td>
<td>21</td>
<td>18</td>
</tr>
</tbody>
</table>

While culturally responsive, culturally relevant, and/or culturally sustaining pedagogies had the highest level of strongly agree responses, the other practices were almost equally present. Similar to student data shared earlier students short answer responses varied when asked to explain their responses to five-point Likert-type items. Some students regularly used words like “discuss” or “talk about” to describe activities, which does not identify the actual teaching practice that preceded the discussion or which sustainability category was being addressed. Other students reported activities and experiences that they felt were culturally responsive, culturally relevant, and/or culturally sustaining from class. In their explanations of these activities, students referenced projects that were part of the course syllabus and shared by faculty, like the “personal cultural presentation,” while others referenced “guest speakers who spoke
to us about different things such as the Native American community, Islamic community, and the LGBTQ+ community.” One student even commented, “It is hard to provide a specific example for this, the whole class made you think and learn about cultural responsibility.” However, some of these responses continued to be vague, like many of the short answer responses shared previously, by referencing an activity that took place, but offering little information about the context of the activity. This lack of specificity and variance in responses from students supports the small percentage of Level 3 coding in most of the sustainability literacy categories (Figure 4).

Faculty data was also coded for depth offering different viewpoints on student data as faculty were sharing their experiences around the sustainability literacy categories, which often included their perception of the learning that students were doing in their courses. Depth coding for the faculty survey short answer items, syllabi, and Interview Items 2 and 3 were combined to show which sustainability literacy category was being addressed by participating faculty members throughout the Early Course case (Figure 6).

Figure 6. Early Course Faculty Combined Data on Sustainability Literacy

The graph represents what percentage of Level 1, Level 2, and Level 3 coding done in each category. The number of times each category was represented in the data is noted by \( n \).
As anticipated, participating faculty members reportedly discussed almost all of the sustainability literacy categories in their classes or while addressing student learning, with social justice continuing to be the highest discussed category, as was evident by the high percentage of Level 2 codes throughout the sustainability literacy categories, including social justice. Data from participating students also showed high percentages of Level 2 coding. Because there was no Level 3 coding in any of the sustainability-literacy categories, it can be inferred that faculty did not address change of student behavior and/or beliefs associated with any of the categories. A participating faculty member said that “I'm not always sure they [students] are ready to both change their thinking about individual people (or kinds of people) *and* deeply internalize a systems-thinking approach to equity and identity,” which could explain why faculty did not have any aspects of their courses coded at a Level 3. Although faculty did not discuss a change in student behavior in any of the sustainability-literacy categories, students were still influenced by the course, with some students identifying changes in their thinking or behavior in the categories discussed in class.

In addressing the second research question, data from participating students in the Early Course case self-identified that all four of the sustainability literacy categories were covered in that course. However, a closer look at student understanding indicated that students were able to directly connect class activities to the category of social justice, explicit connections to the other three sustainability-literacy categories were not as evident, which makes sense given their course focused on diversity in education. Two student participants in the Early Course case reported that their thoughts or behaviors associated with social justice were changed, but these responses were not noted by faculty.
**Conclusion of Early Course Case**

The Early Course is a course on diversity in education. When looking at how preservice teachers are being educated in the knowledge, skills and dispositions associated with sustainability literacy there was a high prevalence of social justice throughout the data, with less prevalence of the other sustainability-literacy categories. This was evident in examples provided by faculty of the courses who commented on specific course design, topics addressed, and activities completed by students. In addressing what understanding of sustainability literacy preservice teachers are developing based on their coursework, students were able to provide specific examples of connections between course experiences and the sustainability literacy category of social justice, while they were not able to do the same for the other three categories. A few students were also able to identify that their thinking and/or behavior changed as a result of materials learned in the course in the area of social justice.

**Mid-Course Case**

The Mid-Course case contained two different courses taught by three different faculty members. Both of these courses were placed in the Mid-Course case because a prerequisite for each course was admittance into the teacher education program, which requires students to have completed a minimum of 24 credits, in addition to other requirements. This meant that 61.5% of the student participants in the Mid-Course case self-identified as juniors, and the remaining students self-identified as seniors. The majority of students take these two courses after taking the course in the Early Course case, but before beginning their culminating off-campus internship. The two courses varied in structure and content covered, but both courses were selected due to the high likelihood of at least one of the sustainability literacy categories being present, based on the titles and course descriptions.
One of the two courses in the Mid-Course case had a focus on environmental education, based on the course title and description. This course was structured with a large lecture that all students attended that was taught by one faculty member. There were also four smaller discussion sections. The discussion sections were taught by the faculty member who taught the lecture and another faculty member. In addition, there was a required 6-hour practicum for students enrolled in this course. Fifty-nine percent of the students (n = 23) who were part of the Mid-Course case were enrolled in this course. The other course in the Mid-Course case had a focus on teaching students with disabilities based on the course title and description. There were two sections of this course taught by one faculty member. The course had a required 10-hour practicum experience for students. Forty-one percent of the students (n = 16) who were part of the Mid-Course case were enrolled in this course.

**Research Question 1: How are preservice teachers being educated?**

To understand how preservice teachers in the Mid-Course case are being educated in the knowledge, skills, and dispositions associated with sustainability literacy, an initial analysis was done to identify which of the four categories of sustainability literacy were present in the qualitative data that was collected. Similar to the Early Course case, the sustainability literacy categories analyzed were *sustainability knowledge, systems thinking, social justice, futures thinking,* and *teaching practice.* Collected qualitative data, including short answer responses on the faculty survey, short answer responses on the student survey, select responses to the faculty interview, and analysis of course materials were analyzed using the sustainability literacy framework shared in Chapter 3 for the sustainability literacy categories. Table 3 shows prevalence of each sustainability literacy category in each data set.
Table 3. Prevalence of Responses Coded for Sustainability Literacy Categories

<table>
<thead>
<tr>
<th>Type</th>
<th>Sustainability Knowledge</th>
<th>Systems Thinking</th>
<th>Social Justice</th>
<th>Futures Thinking</th>
<th>Teaching Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty – Syllabus</td>
<td>56 (35%)</td>
<td>28 (18%)</td>
<td>55 (34%)</td>
<td>2 (1%)</td>
<td>19 (12%)</td>
</tr>
<tr>
<td>Faculty – Interview Items 2 &amp; 3</td>
<td>44 (47%)</td>
<td>14 (15%)</td>
<td>6 (6%)</td>
<td>0</td>
<td>29 (31%)</td>
</tr>
<tr>
<td>Faculty – Short Answer</td>
<td>10 (23%)</td>
<td>6 (14%)</td>
<td>13 (30%)</td>
<td>3 (7%)</td>
<td>11 (26%)</td>
</tr>
<tr>
<td>Student – Short Answer</td>
<td>23 (17%)</td>
<td>7 (5%)</td>
<td>40 (30%)</td>
<td>12 (9%)</td>
<td>51 (38%)</td>
</tr>
</tbody>
</table>

Sustainability knowledge, social justice, and teaching practices were highly prevalent through the data sets, with some variation. Given that the two courses in the Mid-Course case specifically focused on environmental education and special education, the prevalence of sustainability knowledge and social justice in the data does not seem surprising. The prevalence of teaching practices also does not seem surprising as the Mid-Course case includes courses in the teacher education program, and it would be expected to find students learning about teaching practices that are not associated with the sustainability literacy categories. The next two categories of systems thinking and futures thinking demonstrated lower prevalence but also have some variation in the above table. To add clarity to this variation, data from the above table were aggregated (Table 4).

Table 4. Combined Sustainability Literacy Category Prevalence for Mid-Course Case

<table>
<thead>
<tr>
<th>Type</th>
<th>Sustainability Knowledge</th>
<th>Systems Thinking</th>
<th>Social Justice</th>
<th>Futures Thinking</th>
<th>Teaching Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregated</td>
<td>133 (31%)</td>
<td>55 (13%)</td>
<td>114 (27%)</td>
<td>17 (4%)</td>
<td>110 (25%)</td>
</tr>
</tbody>
</table>

Sustainability knowledge, social justice, and teaching practice showed similar overall prevalence across the data being the most prevalent categories. Systems thinking and futures thinking clearly demonstrate lower prevalence than the other categories, with systems thinking
being a little more prevalent than futures thinking. The results seem to indicate that while all four categories of sustainability literacy are being addressed in the Mid-Course case, sustainability knowledge, and social justice are the more prevalent sustainability literacy categories, likely due to the content focus of the courses as mentioned earlier. However, a surface perusal of the data is not enough to understand the depth and richness of the Mid-Course case. There is a need to dive deeper into this and other collected data to begin to understand how preservice teachers are being educated in sustainability literacy categories, especially in the areas of sustainability knowledge and social justice.

A logical starting place for this deeper dive was with the faculty survey, which provided a chance to learn how faculty felt they were educating students on the knowledge, skills, and dispositions associated with sustainability literacy. Faculty responded to ten items on a five-point Likert-type scale on a survey that addressed their training and comfortability in sustainability, how their course addressed each sustainability literacy category, and teaching practices that they used in class. Similar to the Early Course case, the survey will be presented in small segments starting with Figure 7. This particular smaller segment focused on how faculty responded to items on a five-point Likert-type scale related to the prevalence of the sustainability literacy categories in their courses.
Consistent with the data about the prominence of sustainability literacy categories in the Mid-Course case, faculty agreed that all four sustainability literacy categories were addressed, with stronger agreement in sustainability knowledge being present and less agreement about futures thinking. Slightly less consistent with the data, systems thinking appears to have stronger agreement from the faculty, and there was slightly less agreement about social justice being addressed in courses. Due to the small number of participants there is some ambiguity between the choices of strongly agree and agree, which makes it necessary to look at the short answer responses that correspond to the Likert-scale statements for clarification.

Faculty were asked to explain their responses to five-point Likert-type items on the survey with the prompt, “Explain your answer.” These explanations provided valuable insight into the content that was taught in these courses. Adding a layer of quantification, the short answer survey responses were also coded using the sustainability literacy framework. The percentage of coded responses were as follows:

- Social justice (30%);
- Teaching practice (26%);
• Sustainability knowledge (23%);
• Systems thinking (14%); and
• Futures thinking (7%).

The sustainability literacy categories of social justice and sustainability knowledge continued to have prominence in the survey short answer responses with 30% of all short answer responses being coded as social justice and 23% of all short answer responses being coded as sustainability knowledge. These results are consistent with the aggregate data where sustainability knowledge and social justice were also highly prevalent. It should be noted that short answer responses to the survey items were coded regardless of the statement being referenced. For example, one faculty member shared, “It's essential we model how to do this with respect and that we teach children to teach each other to value differences (and disability), to be accepting, and that taking care of each other (the parts) creates a better world (whole) and [vice] versa…” This statement was coded as social justice even though it includes ideas from systems thinking, because of the strong focus on “valuing differences,” it more closely aligns with the coding parameters for social justice than systems thinking.

More specifically, when faculty were asked on the survey how their courses addressed sustainability knowledge, responses mirrored the anticipated responses for the courses that the faculty taught, highlighting a focus on sustainability knowledge in the environmental education focused course and social justice in the special education focused course. A faculty member of the environmental education course shared that students participated in sustainability activities, “but that is not the focus of the instruction,” sharing that “two-thirds of the course focus[es] on teaching methods” while the other third covers “environmental studies.” The other faculty member of this course responded, “students are engaged in readings, lectures, discussions, and
assignments related to the content and pedagogy of [sustainability knowledge].” It appears that both faculty members of this course had different interpretations about the level with which their course addressed sustainability, and some of this discrepancy could be due to the complex history between environmental educators and sustainability educators and the choice of the word sustainability in the survey. Both faculty members acknowledge this historical tension between the two fields during their interviews. The first faculty member articulated in the interview that, “I generally really see environmental education and education for sustainability as very similar” sharing that they take a “broader view of environmental education” including “all the social and political and economic components.” However this faculty member finished that thought with, “I'm talking about a course in environment education and you're interviewing me about sustainability” implying that there are differences between the two fields, which could explain the possible hesitancy to outwardly agree on the survey with sustainability being covered in the course.

The faculty member teaching the course that addresses special education topics shared a focus on multiple aspects of the education system in their course. When responding to how their course addressed sustainability knowledge, they shared that their course focused on “how to teach students with disabilities in the general education classroom” and that this focus “would encompass economic systems…political systems…and social systems.” The faculty also shared a responsibility to address “teacher burnout” in their course because the “future general education classroom teachers come in nervous about how they will handle teaching students with special needs…In other words, they [students] worry about their sustainability in being able to manage their job and all of the student needs.” These comments by this faculty
member primarily focused on social justice concepts, but also addressed a complexity inherent in special education within the various systems that interact to provide services to students.

While faculty shared thoughtful responses to the survey, the faculty interviews further expanded on these responses, providing information about the ways in which sustainability knowledge, social justice, and the other sustainability literacy categories were addressed in their courses. Two out of the six questions in the faculty interview focused on content and course design. Question 2 specifically asked faculty if their courses were intentionally designed for sustainability, while Question 3 asked faculty to pick an assignment they felt highlighted sustainability. Using the sustainability literacy competency framework, the interview transcript was coded for sustainability literacy categories.

The majority of responses to questions two and three highlighted a focus on sustainability knowledge with 47% of responses being coded as sustainability knowledge, 31% of the responses were coded for teaching practices, 15% for systems thinking, 6% for social justice and 0% for futures thinking. It should be noted that while there was an increase in the prevalence of sustainability knowledge, this was due in part to the specific wording of the interview items intentionally asking faculty about their focus and design with regards to sustainability in a general sense. Specific sustainability literacy categories were not referenced, but the word, sustainability was used in both questions. The highest number of responses were coded as sustainability knowledge. In addition, faculty provided rich examples of how systems thinking and social justice, as well as sustainability knowledge, were present in their courses.

As faculty answered question 3 about specific activities or assignments in their course that they felt highlighted sustainability, answers continued to focus on sustainability knowledge, and social justice. Each faculty shared at least one activity they felt highlighted
sustainability. Both faculty of the environmental education course shared that students participated in an assignment that integrated environment science and teaching practices into one project. In describing the project one faculty member shared that the project has “four distinct pieces to it.” The first part of the project has students “pick a topic that we discuss in lecture,” with students going “through the chapters of the textbook” to pick a topic. Then students then “go to the library.” While in the library, the other faculty member shared that students, “spend a class period with a librarian learning how to look for and learning how to find reputable information on environmental issues.” This faculty member shared that going to the library “improved the sustainability component [of the project] because that directly helps them [students] write the paper on their environmental issue and find the ecological, social and economic impacts.” Students are asked to “pick an issue related to the topic and then they’re invited to find….curricular resources.” After students research their topic and subsequent issue at the library “they have to write [an] action plan; something they’ll do themselves [related to the topic]. Then they have to write a lesson plan and they have to reflect on their actions.” Students post reflections on the “discussion board to be read by their peers.” One faculty shared that “I think that is nice because they get positive feedback from their peers,” continuing, “…they get to read what other people are doing, which also positively reinforces the idea that you can take action.” The descriptions of the project shared by both faculty members support the sustainability literacy categories of sustainability knowledge and teaching practice. This categorization is due to students taking action towards an environmental topic and writing a lesson plan based on research that they had to complete as part of the project.

Both environmental education faculty also explained other class activities that supported sustainability. One faculty member shared how their students participated in nature
journaling. The assignment requirements posted online explained that they were expected to complete “at least 8 journal entries, one per week.” The assignment further clarifies that, “Weekly journals should relate to a place in nature that you observe, experiences, environmental issues, or current events happening related to the natural world. You are encouraged to spend time outside during this semester as you complete your journal!” The faculty member shared that, “It’s an interesting assignment…I think it has benefits that we did not fully realize before…because students will actually write this is something, I could do with my students to reduce their stress.” This same faculty member also noted that students shared, “how that helps them reduce their stress,” which has an impact “as far as sustainability of them as a person.” Faculty member comments seem to indicate that the nature journal assignment not only encourages students of the course to get outside and reflect on nature, which supports sustainability, the assignment may also have a broader positive impact by encouraging students to think about their own wellbeing and the wellbeing of their future students.

In addition, the other environmental education faculty member shared that “we also talk about differentiation, including all students, which I would kind of put under the social justice piece of sustainability.” The faculty shared that this focus on differentiation is “how to differentiate their lessons,” explaining that they go to a local forest preserve and participate in environmental education activities. The faculty shared that, “I have them pair up or get in small groups and talk about what aspects of this space would make it good for including all students and what would be challenging. And so, they try to list not just the physical aspects, but also some learning aspects, and social aspects.” Addressing ways to differentiate lessons and taking students outdoors to explicitly discuss how to create a safe space for all students highlights intentional actions in the category of social justice by this faculty member.
The faculty of the special education course shared an activity that their students participate in which they select a “professional development offering of their choice or professional engagement to get in there, in the field, and learning outside of the classroom.” The faculty shared that “some of them choose a coffee and culture workshop on campus talking about gender sexuality, or some of them do a district board meeting or some of them do an online webinar.” While students select different activities, the faculty shared that “a lot of what they come back with align[s] with an idea of sustainability.” The faculty member articulated that these experiences were linked to sustainability because students were learning about the special education field and building connections within the special education community. However, this faculty member, who self-identified as having little training or comfortability teaching about sustainability, did not provide further explanation about ways this activity could introduce students to complex systems inherent in special education or how experiences like these could expand student knowledge in areas of social justice. In addition, as part of connecting this professional development activity to sustainability, the special education faculty member echoed comments by the environmental education faculty member, saying students were learning about “teacher well-being” through their professional development choices.

While the course assignments and activities were different, they all provided valuable insight into how faculty were teaching students about sustainability and how faculty thought about sustainability within their courses. Mid-Course Faculty responses clearly reflected the content focus of their courses. The faculty who taught the environmental education course, highlighted a stronger focus on sustainability knowledge, while the faculty member who taught the special education course underscored a focus on social justice.
Building from these specific course activities, faculty were asked on question 2 of the interview about intentional decisions they made with regards to sustainability in their course design. Responses from faculty were far reaching and exhibited a divergence between the environmental education faculty members and the special education faculty member, which was uncharacteristic of the majority of the data collected. The two faculty members of the environmental education course spoke at length about course design and experiences related to sustainability that were intentionally part of their course. One faculty member shared they used “backwards design” to help them identify “what is most important,” identifying a focus on “environmental literacy” as “really important in environmental education.” This faculty member also shared that they “intentionally indoctrinate students” using “small talk.” They shared, “I wouldn’t make it part of lecture, it would just be part of our chit chat at the start” referencing different sustainable life choices that they and others made like biking to work or inquiring about bamboo toothbrushes.

The other environmental education faculty member shared specific course decisions that supported sustainability, like the selection of the textbook. This faculty member shared that their new textbook is “not straight environmental science. It has much more [of a] environmental studies and sustainability perspective.” They also discussed how they recently “talked about the sustainable development goals” in class and how they worked with students on how to “differentiate their lessons” for when they become teachers. These examples highlight that the environmental education faculty were readily able to communicate connections between their course and the sustainability literacy categories of sustainability knowledge and social justice.
The environmental education faculty responses are different than the third Mid-Course case faculty member’s response to the same question. When asked about intentional decisions that they made in their course design to support sustainability this faculty member replied, “None.” However, as this faculty member explained their answer in the interview they shared that the survey items helped them reflect on “how we talk about it [sustainability],” acknowledging that they could be using specific “vocabulary when I talk about it [sustainability]” as a way to “connect the content and then take it a step further.” This faculty member continued to explain how they might do things differently in the future, “So, maybe in the future [that’s] where it’s going. But as of right now, I intentionally, no, I haven’t connected it, even in my head. It’s like, a separate body, but it’s really not.” Even though this faculty member shared that the course was not intentionally designed to support sustainability, they continued to articulate ways in which their course facilitated learning about sustainability, which is evident in the examples shared.

The responses in the interview from faculty are further supported by the syllabi that faculty shared with students. When looking at the prevalence of sustainability literacy categories, the percentage of coded responses were as follows:

- Sustainability knowledge (35%);
- Social justice (34%);
- Systems thinking (18%);
- Teaching practice (12%); and
- Futures thinking (1%).
Even though syllabi varied for each course in the Mid-Course case, sustainability knowledge and social justice categories continued to be prevalent in the items that were covered in the syllabi. The syllabi were coded as an entire document. However, when specifically looking at the knowledge, skills, and dispositions listed on the syllabi, both courses listed close to 40 different criteria for students to achieve (Table 5).

Table 5. Knowledge, Skills, & Dispositions on Syllabi

<table>
<thead>
<tr>
<th>Course</th>
<th>Sustainability Knowledge</th>
<th>Systems Thinking</th>
<th>Social Justice</th>
<th>Futures Thinking</th>
<th>Teaching Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Education</td>
<td>24</td>
<td>12</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Special Education</td>
<td>0</td>
<td>2</td>
<td>28</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>

The breakdown of knowledge, skills, and dispositions on the syllabus continues to highlight a focus of sustainability knowledge in the course that addresses environmental education and a focus of social justice in the course that addresses special education.

In addition to understanding how faculty designed their courses and learning activities to focus on the sustainability literacy categories, faculty were also asked general questions about the methods and teaching practices they used to teach students in their classes. Faculty continued to generally be in strong agreement that they used teaching practices that utilize experiential learning experiences in addition to having students be reflective in their learning as shown in Figure 8.
Faculty short answer responses to these four questions were examined for connections to the four sustainability literacy categories. Faculty shared a few experiences in each category linked to sustainability knowledge with one faculty member identifying that, “students think critically when researching and writing about an environmental issue, observing instruction at [a local school forest] and writing about it, and considering questions such as how time spent in nature might or might not inspire sustainable actions.” This example highlights how the faculty member uses critical thinking as a teaching practice to support the learning of sustainability literacy.

With regards to culturally responsive practices one faculty member shared, “Most curriculum materials used in this class are based on western understandings of science, conservation, democracy, and school.” Another faculty member shared, “I do this, but I could do a better job. I work to be inclusive in my language, help students develop background knowledge since they have such varied experiences, elicit their personal experiences, share information and facilitate discussions about culturally and linguistically diverse exceptional students and issues of over and underrepresentation.” These statements highlight faculty awareness of the meaning and importance of culturally responsive teaching practices, but they may also help to
explain why the faculty were hesitant to strongly agree with the proposition that they utilize culturally responsive, culturally relevant, or culturally sustaining practices.

In answering the first research question, even though the Mid-Course Case contained two courses with different learning outcomes and objectives, faculty of both courses shared experiences, activities, practices, and anecdotes which could, when combined, be linked to all four sustainability literacy categories. A closer inspection of the data revealed that sustainability knowledge and social justice were the most prevalent sustainability literacy categories addressed in this case. While faculty were able to self-identify the use of teaching practices that supported sustainability literacy in a general sense, there was not always enough specificity in the data collected to link the practices to a specific sustainability literacy category. In the Mid-Course Case it is clear that preservice teachers were exposed to the knowledge, skills, and dispositions associated most closely with the sustainability knowledge and social justice categories.

**Research Question 2: What understanding is being developed?**

The second research question addressed what understanding of sustainability literacy is being developed by preservice teachers based on their educational experiences. Similar to the Early Course case a two-step approach was taken to answering this question. The first step was to identify if students could recognize the sustainability literacy categories in their coursework. Using the student survey and follow-up short answer responses, students self-identified which sustainability literacy categories they felt were covered in their course. The survey and follow-up short answer responses were then further analyzed in the second step, for depth of understanding. The depth analysis provided additional insight into how students were referencing the sustainability literacy categories and if they were taking action with knowledge
gained from their coursework in the sustainability literacy categories. Using this two-step process, the focus was to understand how students in the Mid-Course case were learning about sustainability literacy based on their experiences in class.

Starting with the student survey as a way to process student recognition of the sustainability literacy categories, students in the Mid-Course case were generally in agreement with the questions asked on the survey. Looking closer at responses to five-point Likert-type scale items, a majority of participating students who took the survey reportedly agreed that all four categories of sustainability literacy were covered in their courses (Figure 9).

Figure 9. Mid-Course Student Responses on Sustainability Literacy

At first glance, 34 students reportedly agreed or strongly agreed that futures thinking was addressed in their course. Students in the Mid-Course case shared mixed interpretations of futures thinking, even though a brief explanation preceded each statement on the survey. Some students looked at futures thinking from their position as future teachers. These students shared examples about, “how we can bring this material into our future classrooms,” and discussions around “ideas that we can use for future students.” Other students discussed the future within the context of environmental impact. These students shared discussions on environmental issues and “what we can do now to preserve our planet as much as possible for our future.”
The near future thinking exhibited by students thinking about their “future classrooms” is not consistent with the long-term futures thinking addressed in the sustainability literature. However, the conversations about futures thinking in the context of environmental impact are closer to the vision of futures thinking addressed in the sustainability literature. What is difficult about the explanations shared by students is their use of the word “future.” There was often a lack of context around how the word future was used causing some ambiguity in the interpretation between the near future or single generation future, and long-term or intergenerational futures as addressed in the sustainability literature. Even though students used words and phrases that were identified on the sustainability literacy framework as being related to futures thinking, the lack of explicit articulation towards long-term futures thinking, made it difficult to determine if responses focused on the next few years or the next few generations. When continuing to look at data from responses to five-point Likert-type items, after futures thinking, participating students almost equally agreed that their courses covered the knowledge, skills, and dispositions associated with social justice, systems thinking, and sustainability knowledge.

To clarify the survey results it was helpful to look at the short answer responses that followed the five-point Likert-type items. Participating students were asked to explain their answers to the items by responding to the prompt, “Please provide an example.” Their short answer responses were coded, just as faculty responses were, using the sustainability literacy framework. The prevalence of the sustainability literacy categories for the survey short answer response from the students were as follows:

- Teaching practices (38%);
- Social justice (30%);
- Sustainability knowledge (17%);
• Futures thinking (9%); and
• Systems thinking (5%).

The student survey responses showed the highest percentage in teaching practices with 38% of responses coded in this category. When asked to provide examples of how certain teaching practices were used in their courses student frequently referenced their practicum experiences by sharing basic information about the experience. Students shared things like, “I completed my practicum at an elementary school, and I gained a lot of experience from that” or “I completed a ten-hour practicum” or “Practicum experience at [local] school forest.” In addition to sharing about the practicum experiences students provided information about activities that they completed, frequently referencing “case studies” and “journals.” All of these experiences were coded as teaching practices because they referenced specific activities as part of the course, but explanations did not directly reference any of the sustainability literacy categories, which explains why the category of teaching practices was highly reflected in the data.

The next highest coded category was the sustainability literacy category of social justice with 30% of the responses coded this way. Student data was similar to faculty survey data shared earlier where social justice was also the most prevalent of the sustainability literacy categories. When discussing social justice students shared a wide variety of responses. Students frequently talked about providing “accommodations” for students, the need to “differentiate” activities, and the desire to create “inclusive” learning environments. While some student responses lacked specificity, only mentioning the activity or desired outcome of the activity, some responses began to offer more of an understanding of what was learned. One student shared, “This class discusses how to accommodate students of all different backgrounds to create a classroom system that succeeds.” Another student shared, “We discussed how
assessments can be racially bias[ed] and how to avoid that.” These responses were all coded as social justice because students referenced vocabulary and criteria on the sustainability literacy framework about the “achievement of all students” and “diversifying teaching materials and methods.” There is difficulty discerning the specific “accommodations” addressed, and what “different backgrounds” mean, but there is more context provided in these responses to help explain what students were learning about social justice. The student responses shared demonstrated a basic understanding of the need to create equitable and inclusive learning environments as often addressed in the sustainability literacy literature.

After addressing which categories were recognized by students in the Mid-Course case, an analysis of the depth with which each category was addressed was also completed as a way to further explain the understanding of sustainability literacy students were developing. Adding a layer of depth coding provided more information about how the sustainability categories were being referenced and, if action was being taken related to the coded category. Similar to the Early Course case, every time the data was coded for a sustainability category, it was also coded for the depth with which the category was addressed. Depth was coded as a Level 1, Level 2, or Level 3, with the higher depth number being associated with a greater likelihood of change in action occurring.

The short answer responses on the student survey were analyzed for the depth at which the sustainability literacy category was addressed. This supplied additional information about how students were processing the material covered in class. In general, the majority of student responses about the sustainability literacy categories were coded as Level 2 indicating that the categories were discussed by students in the context of their course as shown in Figure 10.
Figure 10. Mid-Course Student Short Answer Responses on Sustainability Literacy

The graph represents what percentage of Level 1, Level 2, and Level 3 coding done in each category. The number of times each category was represented in the data is noted by \( n \).

Although some Level 2 responses were vague in their reference to class activities, many of the responses offered additional insight into what students were learning. For example, one student shared, “We looked at the physical effects of global warming such as earlier Springs and late Winters, positional shifts in biomes, rising sea levels, and more unpredictable and variable weather.” Another student shared, “We talk about different legislation that affects special education and the history of the special education field and the injustices that happen in the past.” There was some ambiguity around how students will use this information, preventing it from being coded at a Level 3. However, these responses shared specific information about what students learned in class and there was a clear connection to the sustainability literacy category referenced, in the first instance to sustainability knowledge and in the second to social justice.

Although a majority of responses were coded at Level 2, there was one student who indicated changes of behavior associated with the sustainability knowledge category. This is
evident in the Level 3 coding shown in Figure 10 in the category of sustainability knowledge. A student provided a response about two different class activities they said, “engaged our personal and cultural beliefs,” which was coded as a Level 3 indicating a “self-examination on beliefs” from the sustainability literacy framework. The student shared an activity where students “stood up and moved left or right based on if we agree with climate change statements.” In the other activity, the student shared that they, along with peers, “marked our hometowns on a map and then marked different locations where mining has taken place.” Each of these activities highlighted a self-identified reflection that made this student think about their own “personal and cultural beliefs” based on activities done in class.

Students were also asked on their survey to identify teaching practices that the faculty of their courses utilized that supported sustainability literacy. Asking students to identify teaching practices encouraged them to think past simple recognition and reflect on the practices that the faculty exhibited. Their reflection on teaching practices continued to add to the understanding of sustainability literacy that students were building from their courses. Students in the Mid-Course case were in strong agreement that the faculty of their courses utilized all of the listed teaching practices as shown in Figure 11.

*Figure 11. Mid-Course Student Responses on Teaching Practices*

<table>
<thead>
<tr>
<th>Teaching Practices</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>In this course I participated in experiential learning experiences,</td>
<td>2</td>
<td>1</td>
<td>18</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>transformative learning experiences and/or non-western or indigenous ways learning.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In this course I participated in experiences that were culturally responsive,</td>
<td>3</td>
<td>4</td>
<td>20</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>culturally relevant, and/or culturally sustaining.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In this course I was asked to critically think, problem solve, and/or creatively think.</td>
<td>3</td>
<td>3</td>
<td>21</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>In this course I was asked to be reflective on my learning.</td>
<td>1</td>
<td>1</td>
<td>22</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>
While experiential learning had the highest occurrence of strongly agree responses at 18 students, being reflective had the highest combined occurrence of agree and strongly agree at 37 students. Participating students’ short answer responses also varied when asked to explain their responses to items on five-point Likert-type scales. Some student respondents regularly used words like “discuss” or “talk about” to describe activities, which does not identify the actual teaching practice that preceded the discussion and/or which sustainability category was being addressed. Other student respondents referred to activities and experiences that they reportedly felt addressed experiential learning experiences and opportunities to be reflective. Students in the environmental education course spoke about going to a local school forest, and to a separate environmental site focused on teaching and learning. One student shared, “Each student was required to spend a day at a school forest where we helped teach children and observed how a school forest works.” Students in the special education course spoke about attending general education classes with students who had individualized education plans (IEPs). One student shared, “We were required to complete a 10-hour practicum experience inside of a general education classroom where we observed the adaptations and accommodations that the CT [cooperating teacher] makes for students with disabilities.” While student responses did not go into much detail, they provided additional insight into what was happening at the school forest or during the practicum experience. This lack of specificity and variance in responses from students supports the small percentage of Level 3 coding in many of the sustainability literacy categories (Figure 10).

Faculty data was also coded for depth offering different viewpoint on student data as faculty were sharing their experiences around the sustainability literacy categories, which often included their perception of the learning that students were doing in their courses. Depth coding
for the faculty survey short answer, syllabus, and interview items 2 and 3 were combined and produced an overall understanding of the depth with which each sustainability literacy category was being addressed by faculty throughout the Mid-Course case as shown in Figure 12.

Figure 12. Mid-Course Faculty Combined Data on Depth of Sustainability Literacy

The graph represents what percentage of Level 1, Level 2, and Level 3 coding done in each category. The number of times each category was represented in the data is noted by n.

As anticipated, social justice, and sustainability knowledge were the sustainability literacy categories referenced the most within the context of class or student learning, which resulted in the high percentage of Level 2 codes in these sustainability literacy categories. In their comments, faculty indicated that some student behaviors changed, or that transformative learning took place within the context of the sustainability knowledge and social justice categories, which resulted in their Level 3 coding. This matches data shared earlier, in research question 1, which indicated that faculty most frequently addressed the topics of sustainability knowledge, and social justice in their courses.

Faculty shared several examples of distinct experiences in their courses that directly impacted student behavior and learning, leading to Level 3 coding. The first experience
centered around discussions before and during class. This faculty member shared, that “chit chat” before class “helps with norms.” This faculty member specifically referenced discussions about the temperature at which students’ thermostats are set or what they purchase at the supermarket. Speaking directly about the lecture component of the class, the faculty member continued to share that students, “at the end of the semester they told me that they had started taking Navy showers because of us talking about it in lecture.” This faculty also shared that students completed a nature journal for their course and that in the process of journaling, students “commented on how that helps them reduce their stress.” Another faculty member shared that through their course students’ viewpoints changed on helping students with disabilities. The faculty shared, “By the time they leave, many realize that it does not necessarily take a lot of time to meet the needs of students with disabilities and that what they can do for the kids with disabilities is best practice for all students anyway.” Both of these anecdotes from faculty share how students are shifting their thinking in the areas of social justice and sustainability knowledge, within the context of activities done in class.

In answering the second research question, students in the Mid-Course case self-identified that all of the sustainability literacy categories were being addressed in their courses. However, a closer look at student understanding indicated that while students were able to directly connect class activities to the categories of social justice and sustainability knowledge, explicit connections to the other two sustainability literacy categories was not as evident. A student in the Mid-Course case was able to identify how their thoughts or behaviors associated with sustainability knowledge were changed, and faculty of the Mid-Course case expanded on this, identifying areas where student thoughts or behaviors were changed in sustainability knowledge and social justice.
**Conclusion of Mid-Course Case**

The Mid-Course case contains two separate courses with course topics that focus on environmental education and special education. When looking at how preservice teachers are being educated in the knowledge, skills, and dispositions associated with sustainability knowledge, there was high prevalence of sustainability knowledge and social justice in the Mid-Course case and less prevalence of the other sustainability literacy categories. This was evident in examples provided by faculty of the courses who commented on specific course design, topics addressed, and activities completed by students. In addressing what understanding of sustainability literacy preservice teachers are developing based on their coursework, students were able to provide specific clear examples of connections between course experiences and the sustainability literacy categories of social justice and sustainability knowledge, while the other categories were less clear. Students and faculty were also able to identify places where students’ thinking and/or behavior changed as a result of material learned in their courses in the areas of social justice and sustainability knowledge.

**Capstone Course Case**

The Capstone Course case contained a one-credit course that ran concurrently with the capstone experience, an off-site internship for preservice teachers, and was facilitated by one faculty member. This one-credit course was added to the internship experience for students from a variety of teaching majors, so the content part of the course was the same, regardless of the department through which students completed their internship. As part of their course requirements, preservice teachers were asked to attend up to five different seminars throughout the semester, which were facilitated by the single faculty member teaching the course.
This is the last course that students take in their teacher preparation program, which presents some unique challenges for gathering information from these preservice teachers. Since preservice teachers are off-site and working in an intense internship, there was only a 9.3% return rate on student surveys. In addition, the focus of the five seminars was to provide assistance to students in completing their Educative Teacher Performance Assessment (edTPA), a portfolio that must be completed as a step towards earning licensure when students finish their internship and graduate. This inherently makes the nature of the Capstone Course case different than the other cases studied. In the Early and Mid-Course cases, faculty met at least weekly with students, teaching a minimum of 15 classes with students in the same timeframe in which the Capstone Course students met for their five seminars. In addition, while faculty of the Early and Mid-Course cases addressed specific teaching standards as covered in their course syllabi, faculty in these courses appeared to have less emphasis focus on preparing students for the edTPA, which was a primary focus of the Capstone Course case.

The study intent was to examine the Capstone Course case in the same manner and depth as the previous two cases, however due to the limitations of a low survey response rate from students and only one faculty member facilitating the course, the findings and analysis will not be as complete as in the other cases. An abbreviated look at the results for the Capstone Course follows.

**Research Question 1: How are preservice teachings being educated?**

To understand how preservice teachers in the Capstone Course case were educated in the knowledge, skills, and dispositions associated with sustainability literacy, an initial analysis was done to identify which of the four categories of sustainability literacy were present in the qualitative data that was collected. Similar to the Early and Mid-Course cases the sustainability
literacy categories analyzed were sustainability knowledge, systems thinking, social justice, and futures thinking, with a fifth category of teaching practice, emerging during data analysis. Collected qualitative data, including short answer responses on the faculty survey, short answer responses on the student survey, selected responses to the faculty interview, and analysis of course materials were analyzed using the sustainability literacy framework. In Table 5 are aggregated the prevalence of each sustainability literacy category.

Table 6. Aggregated Data on Sustainability Literacy

<table>
<thead>
<tr>
<th>Type</th>
<th>Sustainability Knowledge</th>
<th>Systems Thinking</th>
<th>Social Justice</th>
<th>Futures Thinking</th>
<th>Teaching Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregated</td>
<td>10 (11%)</td>
<td>9 (10%)</td>
<td>26 (29%)</td>
<td>9 (10%)</td>
<td>36 (40%)</td>
</tr>
</tbody>
</table>

Teaching practices was the most prevalent category (40%). As explained in the two previous cases, teaching practices emerged as its own category in the data because all of the studied courses were part of a teacher preparation program, and helping students develop a repertoire of teaching practices is an important outcome of preparing them to teach. Thus, the prevalence of teaching practices is not surprising as the Capstone Course case facilitates learning in an internship centered on teaching, and it would be expected to find students learning about and discussing teaching practices that are not associated with the sustainability literacy categories. In addition, the faculty member acknowledged that there were time and content restrictions, stating on the survey, “This course is already so packed with the edTPA assessments, it would not allow time to add additional content to a 1 credit course.” When considering the other categories, social justice is the next most prevalent at 29%, with sustainability knowledge, social justice and futures thinking all having similar prevalence, each at about 10%. This seems to indicate that even though all four sustainability literacy categories are addressed in the Capstone Course case, social justice is the most prevalent sustainability literacy category.
Similar to the Early and Mid-Course cases, the faculty of the Capstone course completed a survey with items on a five-point Likert-type scale and follow-up short answer responses. Consistent with the data about the prevalence of the sustainability literacy categories in the Capstone Course case, the faculty member strongly agreed in the survey that they focused on social justice in their facilitation of the course. When explaining how the course addressed the knowledge, skills and dispositions associated with social justice the faculty replied, “My course is rooted in the idea that best practice is inclusive practice and membership in the classroom of all students. Culturally responsive teaching [and] culturally relevant pedagogy are taught and incorporated into the content for this course.” Not only did the faculty member share key phrasing related to social justice from the sustainability literacy framework, they also articulated that these concepts were foundational for the course, highlighting the importance of social justice in the Capstone Course case.

The faculty interview further expanded on these survey responses, providing information about the ways in which social justice and the other sustainability literacy categories were addressed in this course. As for the Early and Mid-Course cases, interviews were semi-structured (Appendix B). As the faculty member answered question 3 in the interview about specific activities they felt highlighted sustainability, answers continued to focus on social justice. The faculty member shared that they encouraged students to use “universal design for learning” as a way for them as future educators to work towards “understanding individual needs and always being prepared to accommodate or provide that welcoming environment.” As described by the faculty member, universal design for learning, as a practice, is supportive of the social justice sustainability literacy category because there is a focus on understanding individual student needs and creating a welcoming environment for all students.
The faculty member also explained how the edTPA helped encourage deeper thinking in their preservice teachers, specifically around social justice. The faculty shared, “I really like that students [preservice teachers] are asked to really evaluate, discuss and describe their students’ assets, cultural, family, community [on the edTPA].” The faculty member continued to say that if it was not for the edTPA, “I don't know if they [preservice teachers] would look at students in that way…But it causes them [preservice teachers] to kind of look at them in a broader sense and how their community and their families and home life shape them.” In sharing this information, the faculty member articulated what they felt was an area of strength with the edTPA, specifically sharing how preservice teachers are asked to think more holistically about the students in their internship experience, through an asset-based approach to instruction, and further focusing on the various parts of their students’ lives. The focus on asset-based approaches in the edTPA supports the sustainability literacy category of social justice.

In addition to understanding how the faculty member designed their course and learning activities to focus on sustainability literacy categories, they were also asked general questions about the methods they used to teach students on the faculty survey. In responding to items on a five-point Likert-type scale about their teaching practices the faculty member continued a strong acknowledgement of social justice throughout their teaching practices. Specifically, on short answer responses, the faculty member self-identified that they used an asset-based approach to instruction. The faculty member shared, “I assist students to identify the personal, familial, and community assets.” The faculty shared that this was important because “when a teacher can recognize these assets, they use the information to connect with individual students and the class as a whole.” In addition, the faculty member later shared in the survey responses that, “I stress that the ultimate purpose of my course is to facilitate student teachers
becoming responsive, reflective practitioners in education.” Taking an asset-based approach to instruction is addressed in the literature as culturally responsive, culturally relevant, and culturally sustaining, an approach this faculty member strongly agreed they utilized.

In answering the first research question, even though the Capstone Course case was uniquely different from the Early and Mid-Course cases it was possible to draw a connection between the information collected and all of the sustainability literacy categories. A closer inspection of the data revealed that social justice was the most prevalent sustainability literacy category addressed. The faculty member self-identified the use of teaching practices that support social justice, however, there was not enough specificity in the data collected to link practices to the other three sustainability literacy categories. In the Capstone Course case, preservice teachers were exposed to the knowledge, skills, and dispositions associated most closely with the social justice sustainability literacy category.

**Research Question 2: What understanding is being developed?**

The second research question focused on what understanding of sustainability literacy was being developed by preservice teachers based on their education experiences. Similar to the Early and Mid-Course case the student survey and short answer responses were helpful in addressing this question. However, there were limitations related to collecting data from students in the Capstone Course case because of the 9.3% response rate, with only nine individual students completing the survey. Due to the low response rate, a brief discussion of the survey will be shared, focusing on how students referenced the sustainability literacy categories, but no generalizations can be made about the understanding students in the Capstone Course developed.
Students who completed the survey in the Capstone Course case were generally in agreement with the questions asked on the surveys. Looking closer at responses on five-point Likert-type scales, a majority of participating students reportedly agreed that all four categories of sustainability literacy were covered in their course (Figure 13).

*Figure 13. Capstone Course Student Responses to Items on Sustainability Literacy*

<table>
<thead>
<tr>
<th>Category</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>This course addresses knowledge, skills, and dispositions associated with general knowledge of sustainability.</td>
<td>1</td>
<td>7</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>This course addresses knowledge, skills, and dispositions associated with systems thinking.</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>This course addresses knowledge, skills, and dispositions associated with social justice.</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>This course addresses knowledge, skills, and dispositions associated with futures thinking.</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

At first glance, students agreed that sustainability knowledge was the most addressed category with 8 students agreeing or strongly agreeing that their course addressed the knowledge, skills and dispositions associated with sustainability knowledge. This was followed by an almost equal agreement with social justice and futures thinking being addressed, followed by systems thinking.

To clarify the survey results it was helpful to look at the short answer responses that followed responses to items on five-point Likert-type scales. Students were asked to explain their responses by answering the prompt, “Explain your answer.” Students’ short answer responses were coded, just as faculty responses were, using the sustainability literacy framework discussed in Chapter 3. The prevalence of the sustainability literacy categories for the survey short answer response from the students were as follows: 39% for teaching practices, 25% for social justice, 13% for systems thinking and futures thinking, and 11% for sustainability knowledge. It should also be noted that student short answer responses indicated students had
two different interpretations of what the survey was asking. Some students interpreted the survey as applying to the specific course in the Capstone Case, while others interpreted it as applying to the entire teacher education program.

Participating students’ responses to five-point Likert-type items on the survey were not consistent with their short answer responses. For example, on the Likert-type items in the survey, students reportedly strongly agreed that sustainability knowledge was the most addressed, and short answer sustainability knowledge had the lowest percentage of responses. Due to this variation, a brief discussion of the survey short answer responses will be shared, focusing on how students referenced each sustainability literacy category.

The most prevalent category in the survey short answer responses was teaching practices with 39% of responses coded in this category. When asked to provide examples of how certain teaching practices were used in their courses, student referenced a variety of experiences, in a variety of different ways. Some students shared brief experiences, stating singular experiences such as, “developing lesson plans,” or general information like, “I was always required to reflect in nearly every one of my classes.” Other students provided more in-depth answers, identifying specific activities or courses which influenced their learning. One student shared, “Hands-on learning was a big focus throughout my methods class and has served me well in my student teaching thus far.” All of these experiences were coded as teaching practices because they referenced specific activities as part of the course, but explanations did not reference any of the sustainability literacy categories.

The next highest coded category in the survey short answer responses was the category of social justice with 25% of the responses being coded this way. When discussing social justice students continued to share a wide variety of responses and personal interpretations of
social justice, from experiences they had throughout the program to reflections on how well they felt social justice was addressed in the program. The course in the Early Course case was mentioned in a few short answer responses with students identifying it as a course that focused on social justice, however supporting information was not provided. Given the variance in explanations and the low response rate, it was challenging to draw any conclusion from these shared responses that could reflect all students in the Capstone Course case.

Systems thinking and futures thinking were the next most addressed categories. 13% of the short answer responses were coded as systems thinking. While answers continued to vary, students frequently referenced the environmental education course in the Mid-Course case as a place where they learned about systems thinking. Specifically, one student mentioned how the environmental education course “talks alot[sic] about cause and effect when it comes to humans and our environment.” Another student shared that the environmental education course addressed the relationships between society and “how we interact with the earth have.” While not necessarily specific on the content that was learned, these and other responses acknowledged places in the teacher education program where students learned about systems thinking. 13% of the short answer responses were also coded as futures thinking. Students continued to provide a wide variety of responses about futures thinking, with some students self-identifying that futures thinking was present in their courses, to others saying they had never heard of the terminology before the survey. Regardless, the majority of survey responses did not contain enough context to determine if students were thinking about the near future, when they will become teachers, or long-term futures thinking, as referred to in the sustainability literature. This made it difficult to identify commonalities that would represent all students in the Capstone Course case.
Sustainability knowledge had the lowest percentage of coded short answer responses on the survey with 11%, however it was identified by students as the most addressed category on responses to five-point Likert-type items. In short answer responses students referenced courses in the Early and Mid-Course case as covering topics of sustainability. While these courses were identified as addressing sustainability knowledge, little information was provided past the acknowledgement that sustainability was addressed in these courses. This made it difficult to identify additional information about how sustainability knowledge was addressed based on the information shared.

In answering the second research question, student participants in the Capstone Course case self-identified that all of the sustainability literacy categories were being addressed in their courses. Student participants’ responses to items on a five-point Likert-type scale were not consistent with their survey short answer responses, making it difficult to identify areas of convergence. However, student participants reported learning connected to sustainability knowledge, social justice, and systems thinking throughout their teacher education program, specifically referencing courses in the Early and Mid-Course cases.

**Conclusion of Capstone Course Case**

The Capstone Course case contained a one-credit course that ran concurrently with the internship experience. When looking at how preservice teachers are being educated in the knowledge, skills, and dispositions associated with sustainability knowledge, there was a high prevalence of social justice in the Capstone Course case and less prevalence of the other sustainability literacy categories. This was evident in examples provided by the faculty member of the course who commented on specific course design and topics addressed. In addressing what understanding of sustainability literacy preservice teachers are developing based on their
coursework, student participants sometimes provided conflicting responses making it difficult to draw conclusions about the information shared. It should also be noted that student participants reported learning connected to sustainability knowledge, social justice, and systems thinking from courses in the Early and Mid-Course cases.

**Cross-Case Analysis**

This study consisted of three different cases the Early Course case, Mid-Course case and Capstone Course case, which were analyzed separately to understand how four categories of sustainability literacy competencies were taught and the role these competencies had on preservice teachers’ understandings of sustainability literacy. The final step in completing the data analysis for this study was looking across cases to build a holistic understanding of how the sustainability literacy categories are taught throughout the teacher education program and the understanding of sustainability that preservice teachers are developing based on their experiences throughout the teacher education program.

**Research Question 1: How are preservice teachers being educated?**

**Prevalent Sustainability Literacy Categories Connected to Course Focus.** In looking across cases, the data indicates that the sustainability literacy category that is most prevalent in each course is the one closest to the content focus of the course. The course in the Early Course case focused on diversity and throughout the data collected for the case, there was evidence that social justice was the most prevalent sustainability literacy category over the other categories. Faculty identified a “social-cultural” component to the course with one faculty member specifically saying, “because the course focuses on diversity in education, there is a social justice undercurrent to all of it.” This social justice undercurrent was evident in class activities faculty shared like when students were asked to “step into the shoes of another
person,” conduct interviews, and participate in fish-bowl discussions where students addressed, “different aspects of identity and diversity in [the] United States.” While the data collected identifies that the other sustainability literacy categories were, at a minimum addressed throughout the Early Course case, there was a clear articulation through all of the data collected that social justice was the most addressed category in the course about diversity.

The two courses in the Mid-Course case were focused on environmental education and special education. There was evidence throughout this case that sustainability knowledge was the most addressed category in the environmental education course and social justice was the most addressed category in the special education course. Faculty members of the environmental education course shared specific course design decisions that aligned with sustainability knowledge and described a large-scale project that addressed sustainability knowledge and supporting teaching practices for their students. The faculty member of the special education course highlighted professional development activities that addressed social justice topics and shared the following, “How we treat each other and how we educate any student has a ripple effect on society. It's essential we model how to do this with respect and that we teach children to teach each other to value differences (and disability) …” when describing their course.

Finally, one main focus of the course in the Capstone case was assisting students in completing the edTPA. While the edTPA addresses a number of different aspects related to teaching, the faculty of the course shared how one key focus of this assessment is in how it asks preservice teachers to utilize asset-based pedagogies and build an inclusive classroom environment, which aligns most closely with the social justice sustainability literacy. The faculty member explained that On the edTPA preservice teachers are asked to identify, discuss, and reflect on “their students’ assets; cultural, family, community,” which the faculty felt
encourages preservice teachers to think about their students “in a broader sense,” taking into consideration factors like the students’ communities and families. The faculty member of the Capstone Course case continued this focus into how their course is structured, sharing, “My course is rooted in the idea that best practice is inclusive practice and membership in the classroom of all students,” while highlighting the use of culturally responsive and culturally relevant pedagogies as being foundational to the course.

While the cases contained different courses, the data collected indicates that each course addressed the sustainability literacy category most aligned with the content of the course. This acknowledgement is not necessarily surprising because one would expect to find students learning about the content focus of their courses. However, what is a little more surprising are the places where these courses, that were not designed as sustainability courses, supported sustainability literacy categories. This indicates that the places where the course content overlaps with the sustainability literacy categories have the potential to serve as leverage points, opening dialogue between sustainability educators and teacher educators about how to prepare more sustainability literate teachers.

**High Prevalence of Social Justice.** The sustainability literacy category of social justice was a highly prevalent category in all three cases. The Early Course case, the Mid-Course case and the Capstone Course case all contained courses focused on aspects of social justice. This prevalence addressed something that has been a trend in education since the enactment of No Child Left Behind in the early 2000s, which when oversimplified, articulated a requirement that no child be left behind in the education they received. As a result of No Child Left Behind legislation, many of the current national standards express a written desire for every student to be successful. This heightened focus on all children achieving is potentially impacting the
findings of this study because preservice teachers are being taught how to recognize student differences and help all students become successful through practices like differentiation and universal design for learning, which faculty explicitly addressed.

The Early Course case addressed social justice, by focusing on diversity. As previously stated, a faculty member of this course shared that much of the course was designed with a “social justice undercurrent,” providing students with background knowledge about the diversity of people around them, and that they could encounter in the classroom. The Mid-Course case contained two courses, of which one focused on special education and the other on environmental education. The data collected about the special education course was often closely associated with the sustainability literacy category of social justice providing preservice teachers with specific skills and knowledge on how to educate students with disabilities. Even the environmental education course, while not as focused on social justice as the special education course, included instruction on differentiating in-class and outdoor activities to address the needs of all learners. Finally, social justice was also highly prevalent in the Capstone Course case, which focused on completion of the edTPA. Students were asked on the edTPA to continue building from their initial experience in the Early Course case and Mid-Course case to holistically apply asset-pedagogies to support the learning of all students in their classrooms. As such, all three cases continued a high prevalence of social justice, even though the way that social justice was addressed varied between the courses.

Teaching Practices Not Connected to Sustainability Categories Were Highly Prevalent. During data analysis a fifth category, teaching practices, emerged in addition to the four sustainability literacy categories. The category of teaching practices was not connected to the sustainability literacy categories but its prevalence across all three cases was noteworthy
because educating preservice teachers on teaching practices is a primary goal of teacher education programs. Throughout all three cases the category of *teaching practices* was highly prevalent in almost every data set, sometimes even taken prominence over the sustainability literacy categories, which was true for the Capstone Course case. In aggregated data from the Early Course case, teaching practices was the most prevalent category after social justice, and in the Mid-Course cases, teaching practices was the next most prevalent category after sustainability knowledge and social justice. This high prevalence of teaching practices throughout all three cases serves as a reminder that the primary focus of a teacher preparation program is helping preservice teachers build a repertoire of effective teaching strategies. While there are places where sustainability literacy and teaching practices can overlap, these connections are not obvious making it difficult for teacher educators to focus what would appears as on one more thing to an already full curriculum.

*Research Question 2: What understanding is being developed?*

**Student Understanding of Sustainability Categories Demonstrated Through Connections to Course Content and Activities.** Student participants made strong connections between sustainability categories and with the course content. Students in the Early and Mid-Course cases were able to connect course activities and learning from class to the sustainability literacy category that was the focus of the course. This meant that students in the Early Course case were able to explain connections between their course on diversity and the sustainability category of social justice. And students in the Mid-Course case could explain connections between their course on environmental education and the category of sustainability knowledge, as well as connecting their special education course content to social justice. In addition, a few students in the Capstone Course case were able to explain connections between specific
courses and their corresponding sustainability literacy categories when discussing their learning in the program as a whole. While, one would expect to find students learning about the content of their courses, there is additional significance with the addition of the sustainability literacy categories. None of the courses studied were sustainability courses, yet students were still able to draw connections between activities in their courses and the category of sustainability literacy that most aligned with the focus of the course. Based on the data in this study, there is the potential to leverage the existing connections between course content and sustainability literacy categories to intentionally deepen student understanding in sustainability literacy.

**Understanding of Sustainability Categories Grows Throughout the Program.** Students showed increased cognizance in their understanding of the sustainability literacy categories from the Early Course case through to the Mid-Course case. In the Early Course case students often provided short, non-descriptive responses when asked to provide an example of the sustainability literacy category. Through their responses it was possible to identify which category they were referencing; however, it was not always possible to discern the content of the activity or the specific learning that students were taking away from the course. In the Mid-Course case, students provided richer examples of their learning. Some students still provided vague responses, yet other students provided additional context around what they were learning in class. For example, one student shared, “We discussed how assessments can be racially bias[ed] and how to avoid that,” which shared more specific information about the content of the course. The data collected seems to indicate that, as students progress through their teacher education program, they are able to provide more detailed responses about what they are
learning in their courses. This could serve as a powerful way to scaffold student learning about the sustainability literacy categories throughout the entire teacher education program.

**Limitations**

This study was potentially limited by several factors. First, the majority of the data is self-reported data. The faculty survey, student survey, and faculty interview all rely on participants to provide truthful responses to the questions that were asked. There were several factors that helped to mitigate this self-reporting limitation. Student surveys were completely anonymous, so students had little incentive to be untruthful when completing their surveys. Given the low-stakes nature of the questions that were asked faculty also had little incentive to be untruthful when participating in the study. In addition to the low-stakes nature, multiple types of data were collected as a way to ensure validity with the faculty data.

Another limitation of the study was that each case contained different numbers of faculty, different numbers of courses, and different numbers of student participants. The grouping of courses into cases was done, in large part, to ensure anonymity for the faculty participants. In balancing anonymity with variation in the cases, it was more important to provide participants with anonymity due to the small sample size, especially of faculty participants. While each case was different in structure, the courses that were grouped together were taken by students at the same stage of their teacher education program. The data that was collected and the way the data was analyzed was consistently done for all cases. This allowed the focus to be on answering the research questions and not the variation in the cases.

A third limitation of the study was the tenuous nature of student responses. Question 2 of the study sought to look at student understanding of sustainability literacy categories. However, evaluating student understanding is often a complex task. The survey was designed to
gather preliminary understandings from students, which, after analysis it did, but there are places where more information would have been helpful to fully grasp student understandings. This study provided the opportunity to look at faculty and student responses to similar questions to identify learning associated with sustainability literacy categories.

One final limitation of the study was the use of a framework that was created for the study. There may be some concern about using a new tool in a study. However, there was not an existing tool that matched with the goals of this study so the sustainability literacy framework was created, grounded in the sustainability literature, to define sustainability categories that could be identified in a variety of data. The framework was shared with members of the educational sustainability community for feedback and adjustments were made based on their feedback. In addition, the framework was shared with other researchers who were asked to apply the framework to a subset of the data. On the first pass each researcher approached coding of the data differently. However, through brief discussions and shared examples of how the data was coding, a second subset of data was coded with improved reliability in the use of the framework.

Although there were potential limitations to the study, steps were taken to mitigate these limitations. The data collected and analyses in this chapter represent the three cases and offers a holistic view of how sustainability literacy categories are addressed in a teacher preparation program.

**Summary**

The purpose of this study was to determine how four categories of sustainability literacy competencies were taught throughout an existing teacher preparation program and the role these competencies had on student understanding of sustainability literacy. A mixed-methods
case study with a cross-case analysis was completed on four courses organized into three cases, throughout a teacher preparation program to answer the research questions. Faculty surveys, faculty interviews, course materials, and student surveys were analyzed using a sustainability literacy framework for the prevalence and depth with which each sustainability category was referenced and discussed. Through this process the data indicated that throughout all three cases the sustainability literacy category that was more prevalent in a course was aligned with the content focus of the course. In addition, responses on teaching practices were prevalent throughout all four courses.
Chapter 5. Conclusions & Recommendations

Scholars have called for “education of a different kind” to create a more sustainability literate populace (Orr, 2004; Sterling, 2011). In addressing this call, teachers and educators are often viewed as key change agents because they are at the forefront of how this shift in education will be delivered (UNESCO, 2017). However, many teachers and educators are not trained in sustainability (Green et. al., 2006). This makes it challenging for teachers because they not only need to know about sustainability, but they also need to have a deeper understanding of sustainability so they can teach their students to become sustainability literate (Bürgener & Barth, 2018; Lange, 2018; Nolet, 2009; Orr, 2004; Sterling, 2011; UNESCO, 2017). While there is literature that suggests the positive impact one unit or one course can have on a preservice teacher’s understanding and efficacy in sustainability, there is also literature that suggests that one unit or one course is not substantial enough for lasting change in the student of the course (Andersson, 2017; Mintz & Tal, 2018).

Teacher preparation programs serve a unique role in preparing future teachers with the background knowledge and pedagogy necessary to educate students in the future. Considering the end goal of a more sustainability literate populace, there is a need to consider how preservice teachers are educated in the knowledge, skills, and dispositions associated with sustainability literacy. This study provided a holistic look at sustainability literacy through a teacher preparation program by addressing the following research questions:

1. How are preservice teachers currently being educated on the knowledge, skills, and dispositions associated with sustainability literacy?
2. What understanding of sustainability literacy are preservice teachers developing based on their education?
Three different perspectives, the instrumental, intrinsic, and critical served as the foundation for this study. The instrumental perspective looked to pragmatically connect sustainability literacy competencies with teacher education. The intrinsic perspective looked at how preservice teachers were learning about sustainability literacy in their coursework. The critical perspective looked at inclusion and equity for all learners.

**Key Findings**

This study examined the presence of four sustainability literacy categories: sustainability knowledge, systems thinking, social justice, and futures thinking, in four teacher preparation program courses. Identifying these discrete categories provides educators, teachers, and others with concrete targets that can allow for more direct, holistic integration of sustainability literacy into the existing curriculum (Nolet, 2016). Drawing from sustainability literature, working definitions were developed for the four sustainability literacy categories to help guide data collection and analyses.

The first category, *sustainability knowledge* addresses environmental or ecological ways of knowing, in addition to the complex relationships between environmental, social, and political processes (Christie, Miller, Cooke, & White, 2013; Cortese, 2003; Foley et al., 2017; Mintz & Tal, 2014; Sipos et al., 2008; WCED, 1987; Wiek, 2011). *Systems thinking* counters reductionistic thinking by acknowledging that the system itself is more than the sum of its parts, through a holistic approach to processing and understanding components and interactions of systems (Barth et. al., 2007; Capra & Luisi, 2016; Cortese, 2003; Everett, 2008; Frisk & Larson, 2011; Kalsoom & Khanam, 2017; Meadows, 2008; Merritt et al., 2018; Nolet, 2009; Sipos et al., 2008; Wiek, 2011, 2016; Yavetz et al., 2009). *Social justice* aims to answer the call for “inclusive and equitable” learning experiences by utilizing asset-based pedagogies,
such as culturally responsive, culturally relevant, and culturally sustaining practices, to truly support the learning of all students (Alim & Paris, 2017; Earth Charter, 2000; Cortese 2003; Everett, 2008; Gay, 2002; Gibson, 2006; Kalsoom & Khanam, 2017; Ladson-Billings, 1995a; Nolet, 2009; Sipos et al., 2008; Thompson et al., 2013; UNESCO, 2016; WCED, 1986; Windschitl et al., 2012; Wiek, 2011, 2016; Yavetz, 2009). The category of futures thinking recognizes the need to think about how current actions impact future generations, when specifically thinking about living sustainably now and in the future (Everett, 2008; Foley et al., 2017; Frisk & Larson, 2011; Gibson, 2006; Kalsoom & Khanam, 2017; Meritt et al., 2018; Nolet, 2009; Wiek, 2011, 2016; WCED, 1986). In addition to examining the presence of these categories in the curriculum, the study also explored the understanding of these categories that students, who were preservice teachers, reportedly developed based on their experiences in class. The following are key findings from the study.

**Prevalent Sustainability Literacy Categories Connected to Course Focus**

Data from the study indicated that each course exhibited a high prevalence of the sustainability literacy category that most correlated with the content of the course. The Early Course case focused on diversity. The highest prevalence of responses was for social justice. The courses in the Mid-Course case focused on environmental education and special education. Responses in the environmental education course exhibited the highest prevalence in the sustainability literacy category of sustainability knowledge, and responses in the special education course exhibited the highest prevalence in the sustainability literacy category of social justice. The Capstone Course case focused on completion of the edTPA. Responses in the Capstone Course were highest in the sustainability literacy category of social justice.
High Prevalence of Social Justice

In all three cases, there was a high prevalence of responses in the social justice category. In the Early Course case, responses coded in the social justice category were for learning about diversity. In the Mid-Course case responses coded in the social justice category were for addressing the needs of students with disabilities in the special education course; in the environmental education course responses coded in the social justice category were for differentiation of learning experiences to make the curriculum accessible to all students. In the Capstone Course case responses coded in the social justice category were for discussion of the whole student, using asset-based pedagogies that were critical for successfully completing the edTPA. This high prevalence of responses coded in the social justice category throughout the program suggests a focus on social justice in the teacher education program, potentially as a response to current drivers in education that emphasize education for all students.

Teaching Practices Not Connected to Sustainability Categories

In data for all three cases, responses coded in the fifth category of teaching practices was one of the most prevalent, if not the most prevalent. The high prevalence of responses coded in the fifth category of teaching practices across all three cases serves as a reminder that the courses were all in a teacher preparation program. Teacher preparation courses have their own set of standards (i.e. INTASC) and requirements that must be met in order for preservice teachers to be licensed to teach, often, concurrently with the content of the course.

Student Understanding of Sustainability Categories

Student participants in the Early and Mid-Course cases reported understanding of the sustainability literacy categories by describing connections between the course content and the categories. One way these connections were determined was through references to specific
class activities where sustainability literacy categories were addressed. Student participants in the Early Course case often referenced fishbowls and course discussions. Student participants in the Mid-Course case described making accommodations for learners, and specific activities, like nature journaling. Based on responses by students, the sustainability literacy categories that were most prevalent corresponded to the topic of the course. In addition, student participants in the Capstone Course case specifically identified courses in the Early and Mid-Course cases and referenced either just the course or activities in the course, which highlighted connections to the sustainability literacy categories. Student participants drew connections between the sustainability literacy categories and the activities and content of the course highlights natural places where the connection between teacher education and sustainability could be strengthened in an attempt to build more sustainability literate preservice teachers.

**Understanding of Sustainability Categories Grows Throughout the Program**

As student participants progressed through the teacher education program, their articulation of the sustainability literacy categories reportedly deepened, offering more insight into what was learned through activities completed in class. Student participants in the Early Course case connected course activities to sustainability literacy categories. However, their responses were brief, often naming the class activity without elaborating upon it, making it difficult to do much more than identify the sustainability literacy category from what they shared. Student participants in the Mid-Course case often expanded on their explanations of activities by connecting them to their own learning, future classrooms, and own future actions that resulted from the knowledge learned. Even with the small sample size ($n = 9$), student participants in the Capstone Course case demonstrated deeper understanding of the categories, even to the point of realizing gaps in their understandings. Students expressed a need to have a deeper
understanding in their knowledge, specifically around social justice, acknowledging places where it would be helpful to know more about how to actually change their teaching practices to be more culturally responsive. Growth from the Early Course case through the Capstone Course case offers the possibility of further application and deepening of knowledge during the internship. Knowing that students grow in their learning throughout the teacher education program provides the opportunity to scaffold student learning about sustainability literacy throughout the entire teacher preparation program.

Discussion

The following section will situate the study’s key findings within the context of the existing sustainability literature.

Prevalent Sustainability Literacy Categories Connected to Course Focus

One goal of this study was to identify how preservice teachers were educated in the knowledge, skills, and dispositions associated with sustainability literacy. One key finding was that responses in each course showed a high prevalence of the sustainability literacy category closely associated with the main focus of the course. Orr (2004) and others have called for education of a different kind as a way to change unsustainable behaviors towards a sustainable populace, in part arguing for a change in both content and practice (Lange, 2018; Nolet, 2009; Sterling, 2011). Alongside this call for education of a different kind, there has also been acknowledgement that teacher preparation programs have a full curricular responsibility as they work to address instructional design, pedagogical methods, child development, and assessment protocol, in addition to other topics (Darling-Hammond, 2006; Falkenberg & Babiuk, 2014; Fuller, 1969; Lozano, et. al., 2013). The demands of teacher education, not necessarily
linked to sustainability, have led some to conclude that preservice teachers are not exposed to sustainability in their coursework (Ernst, 2009, Fien & Maclean, 2000).

The findings of this study seem to suggest a possible contradiction to the above conclusion. Even though faculty openly and readily admitted that their courses were not sustainability courses, they linked their course topics and activities to at least one sustainability literacy category. This further supports the discussion by Nolet (2009, 2016) and others (Bürgener & Barth, 2018; Mintz & Tal, 2014, 2018; Santone, 2003) that there are existing places within teacher preparation programs that could support the addition of sustainability competencies without them being add-ons to the curriculum. While, it is true that faculty who had greater comfortability and training in sustainability were more readily able to draw explicit connections between sustainability and their courses, all faculty members were able to articulate a connection between their course content and at least one sustainability literacy category. This finding should not be taken to mean that sustainability literacy is currently fully integrated throughout a teacher preparation program but does suggest places where sustainability literacy could be more intentionally integrated.

**High Prevalence of Social Justice**

Social justice was a highly prevalent sustainability literacy category throughout all three cases discussed. Its presence as a highly prevalent sustainability literacy category, on the surface, runs counter to the notion that preservice teachers do not receive an education focused on social justice or reconstruction (Gore & Zeichner, 1991; Liston & Zeichner, 1987). Yet, there is a current drive in education to create “inclusive and equitable” learning experiences for all students (UNESCO, 2016). The articulation of success for all students is found in many current K-12 standards and identified through the utilization of asset-based pedagogies in the
edTPA and through the Danielson Framework (CCSSO, 2013; Danielson, 2007; NGSS Lead States, 2013). The data collected from this study reveals a culturally pluralistic curriculum, where students are learning about different ethnic or marginalized groups to develop greater empathy for these groups (Gay, 1975). Examples of this type of learning were shared by faculty members and students in both the Early and Mid-Course cases when they described their courses and experiences in the courses. One could argue that this type of learning is a crucial first step in addressing the beliefs of preservice teachers (Gay, 2013). However, the data collected was not conclusive enough to identify whether or not preservice teachers in these courses were able to develop an understanding of or even a practice towards culturally relevant pedagogy, which includes the empowerment of learners (Ladson-Billings, 1995a). Going a step beyond culturally relevant pedagogy, the data was also examined for culturally sustaining pedagogies, which looks to assist marginalized groups in sustaining their cultures and in the questioning of regressive practices (Alim & Paris, 2017). These findings do not provide conclusive evidence that culturally sustaining pedagogies were being practiced or taught. While foundational knowledge about social justice is evident throughout the teacher education program, more could be done to work towards enactment of culturally relevant and culturally sustaining pedagogies within the teacher education program.

**Teaching Practices Not Connected to Sustainability Categories**

The data collected for this study was initially analyzed for four sustainability literacy categories. However, during the data analysis process a fifth category of teaching practices, not connected to the sustainability literacy categories, emerged. Teaching practices was one of the most highly prevalent categories in the aggregated data in all three cases. This high prevalence further underscores the focus of the studied courses in the program, which is to prepare
preservice teachers to become teachers. Darling-Hammond (2006) indicated that to be successful, teachers need to know their students, the content, and how to teach. Building these understandings in preservice teachers falls to teacher preparation programs, where courses often address topics such as instructional design, pedagogical methods, child development, and assessment protocol (Fuller, 1969). Also, as part of state accreditation requirements, there are ten INTASC standards that must be met within a program in order for students to be certified. (CAEP, n.d.; CCSSO, 2013). These standards coupled with the requirements of the edTPA, ultimately drive the content of teacher education programs. There were places where the INTASC standards shared during the study overlapped with the sustainability literacy categories, but there were other times when the standards explicitly addressed teaching practices (CCSSO, 2013; Pearson Education, 2019). Teacher education programs must prepare teachers based on criteria that does not explicitly reference sustainability literacy. For a large-scale change to occur in teacher education programs, like the inclusion of sustainability literacy, there will need to be a change in educational policy, like policy related to teaching standards.

**Student Understanding of Sustainability Categories**

A second goal of this study was to examine understandings of sustainability literacy among preservice teachers. The literature is sparse on the impact of sustainability education for preservice teachers, with some concluding that preservice teachers are not exposed to sustainability in their coursework (Andersson, 2017; Ernst, 2009; Falkenberg & Babiuk, 2014; Fien & Maclean, 2000; Hopkins & McKweon, 2005). However, in this study students were able to connect course activities and learning to the sustainability literacy category that aligned most closely with the focus of the course. This finding indicates that students were exposed to sustainability concepts and could link class activities to the sustainability literacy categories,
when explicitly asked. While showing understanding by being able to connect course concepts and activities to sustainability literacy categories is a good start, the literature also stresses that teachers need to be able to develop meaningful lessons that their students can engage with to develop the necessary competence to be sustainability literate (Bransford et. al., 2005; Falkenberg & Babiuk, 2014; Sterling, 2011; UNESCO, 2017). The data collected did not provide conclusive evidence that preservice teachers in any of the cases had the additional depth of knowledge necessary to plan lessons that can engage their future students in learning about sustainability literacy.

**Understanding of Sustainability Categories Grows**

Student understanding appeared to deepen throughout the sequence of courses, as students in the Mid-Course case provided more in-depth answers about the how their coursework addressed the sustainability literacy categories than those in the Early Course case. This deepening of understanding could indicate that students were experiencing transformative learning experiences throughout their coursework. Cranton (2016) articulated that through transformative learning experiences students become more aware of their assumptions and beliefs, which creates the opportunity for students to be open to alternative points of view. As students become more open to other perspectives, there is a greater likelihood that they will be able to shift their paradigms which is key in creating a more sustainability literate populace (Cranton, 2016; Meadows, 2008; Sterling, 2011). Sterling (2011) articulates these paradigm shifts as transformative learning in sustainability where individuals have a shift in their values, beliefs, and assumptions to varying degrees using the terms first-order, second-order, and third-order learning opportunities; first-order learning opportunities often involve a change in thinking,
second-order learning opportunities involve reflection around beliefs, and third-order learning opportunities involve an epistemological shift in thinking.

The data indicated that students in the Early Course case were likely experiencing first-order learning, which is common in the existing education system, where knowledge was transferred from the instructor to the student (Cortese, 2003; Everett, 2008; Sterling 2011). This is because students in the Early Course case could articulate a connection between a course activity and the sustainability literacy categories but provided few details about what was being learned. Students in the Mid-Course case expanded on their learning by connecting class activities to their own learning and sharing how their future classrooms and students would be impacted. They were also able to identify how their own personal actions could change as a result of their new knowledge. While not necessarily second-order learning due to the data being inconclusive on students’ actual shifts in beliefs and assumptions, there was more reflection taking place for Mid-Course case students than for students in the Early Course case. A few students in the Capstone Course case demonstrated even deeper understandings through their articulations of gaps in their learning. The ability to think about their learning and recognize places for continued growth indicates a deeper level of reflection, possibly at the second-order level. However, the data collected was inconclusive on the actual shifts in beliefs students in the Capstone Course were experiencing. So, even though student understanding grew throughout the program, the data collected was not conclusive on whether or not students experienced transformative learning or learning of the third-order.

**Conclusions and Implications**

The goal of this study was to address two research questions about how preservice teachers were taught about sustainability literacy and the understanding they develop based on
the information learned. The study had its foundation in three separate perspectives, instrumental, intrinsic, and critical, due to the emergent and cross-curricular nature of educational sustainability (Nolet, 2016; Sterling, 2011). The heart of this study coincides with the instrumental perspective which pragmatically looked at the connection between sustainability literacy competencies and teacher education as a way to increase sustainability knowledge in pre-service teachers. Although this perspective oversimplifies the inherent complexity between connecting these two fields, it also identified leverage points such as:

- connections in existing teacher education coursework to sustainability literacy;
- high prevalence of social justice in studied courses;
- teacher education faculty willing to holistically integrate sustainability literacy into existing curricula;
- students identifying sustainability literacy categories in coursework; and
- student growth of understanding throughout the studied course progression;

that could serve to strengthen the connection between sustainability and teacher education. The intrinsic perspective, which looks at learners instead of the outcomes, presented itself in this study through how preservice teachers were learning about the sustainability literacy categories. Finally, the critical perspective, which looks towards social justice, was apparent in the discussions around meeting the needs of all students. Although not necessarily the focus of the study, there were places identified in the study where critical theory could be more intentionally discussed through educational sustainability and teacher education. Conclusions drawn from the findings and implications for the use of these findings are discussed in the paragraphs that follow.
Although the teacher education courses studied were not sustainability courses, content from each course was connected to at least one sustainability literacy category, identifying a place to more intentionally connect the two fields together. Faculty articulated ways in which their courses addressed specific sustainability literacy categories and students were able to identify the presence of specific sustainability literacy categories in their courses. This means that there are places within the curriculum where intentional learning of sustainability literacy could take place.

An implication of this conclusion is the need to identify places within teacher education programs where sustainability literacy could be further implemented. This creates natural places for teacher educators to work with sustainability educators to intentionally identify and integrated sustainability content and pedagogy into the existing teacher preparation curriculum. The conducted study identified four courses within a teacher preparation program that had a high likelihood of containing one or more of the sustainability literacy categories. These four courses are only a fraction of the courses that preservice teachers actually take throughout their undergraduate experience. This means that there are likely other places where sustainability literacy could be more holistically included in the teacher education program through intentional integration in existing courses, instead of the creation of new courses focused on the sustainability literacy categories.

**Sustainability Should be Integrated into Teacher Education**

If integrating sustainability knowledge, skills, and dispositions into teacher education courses is a desired goal, then sustainability must be explicitly integrated into teacher education standards to guarantee its inclusion in teacher education programs. While it is possible to
Integrate sustainability literacy categories into the existing teacher preparation coursework, these categories are not necessarily part of the existing teacher education standards. This means that there is little incentive for teacher educators to include them in their curricula. Upon completion of a teacher education program, the preservice teacher should have the knowledge, skills, and dispositions necessary to earn a teaching license and begin teaching. As part of earning a teaching license preservice teachers often need to complete a variety of assessments (i.e. edTPA, content tests, and pedagogy assessments), of which competence on specific teaching and content standards are assessed. In this study preservice teachers were prepared using the INTASC standards and needed to pass the edTPA. The INTASC standards appeared on syllabi for the studied courses and were coded during data analysis using the sustainability literacy framework. Some of the sub-standards, specifically, were coded as sustainability literacy categories, while others were coded as teaching practices not related to sustainability literacy categories. Although there are places where there is overlap between teacher education and sustainability literacy, ultimately teacher education programs have criteria set, outside of sustainability, which will make it challenging for a holistic integration to take place.

Thus, for true change to occur in how teachers are licensed or the requirements of teacher education programs, there need to be broader policy discussions. These policy discussions will need to happen at the state-level as each state has their own set of regulations and requirements for earning a teaching license. Changes to these requirements ultimately require a legislative decision, which is then enforced by each state’s department of education. This means that sustainability scholars, teacher educators, and K-12 teachers and administrators will likely need to work together to determine important criteria for teachers to meet, and effectively petition for these changes to be made.
Recommendations

Collaboration with Sustainability Educators and Teacher Educators

Based on the presence of sustainability literacy categories within existing coursework in a teacher preparation program, it is recommended that sustainability educators and teacher educators work together to continue identifying natural segues within the teacher preparation program to support sustainability literacy. When the faculty members in this study were asked if teacher preparation programs should include sustainability literacy, they all agreed that it should be holistically integrated through the program, even though many were unsure what that would look like in practice. This acknowledgment of a potential holistic integration provides an opportunity to foster deeper connections in the curriculum and pedagogy.

Thus, a first step for the program under study and other teacher education programs would be to evaluate current courses and their curriculum for natural segues with the sustainability literacy categories. After identification of where the sustainability literacy categories are already present or could be present, special attention should be paid to which of the categories are missing or misrepresented and conversations should take place to address these areas. Finally, sustainability educators and teacher educators need to create intentional experiences which support the sustainability literacy categories in these courses, leveraging the opportunity to scaffold and build knowledge of the sustainability literacy categories throughout the entire teacher education program. This collaboration could also open the door for broader policy discussions about the intentional inclusion of sustainability in teacher education standards that could have a greater impact on the requirements around teacher licensure.
Further Studies of Capstone Course Case

The original intent of this study was to garner as much information from students and faculty in the Capstone Course case as was collected for the Early and Mid-Course cases. However, due to a variety of factors, including most of these students being off-site in extensive internships, there was a low response rate from them. Thus, further studies around students in their capstone experience through a teacher education program are encouraged. Teacher educators and field experience supervisors are encouraged to create a required assignment that incorporates the sustainability literacy categories into the capstone experience. Creating this type of requirement has three main benefits. First it highlights the importance of sustainability. Second, it situates the sustainability literacy categories in a classroom experience with K-12 students. Finally, it has the potential to serve as indirect professional development for in-service teachers supporting the student in the capstone experience to learn about the sustainability literacy categories and potential pedagogical approaches.

Students at the Capstone level have the potential to share considerable information, not only about how they were taught and how they are processing this information, but also about how they are applying what they have learned as they begin teaching in their internship experience. Depending on the focus of future studies it is recommended these students be interviewed prior to starting and upon completion of their internship experience, as when they are teaching in their classroom placement, their energy and effort is focused differently than when they are on campus.

Continued Refinement of Sustainability Literacy Framework

As further work continues in educational sustainability there is a need to refine the sustainability literacy framework used in this study. This study used a sustainability literacy
framework that was based on a literature review. It identified four categories of sustainability literacy across multiple types of data. The framework was evaluated by sustainability scholars and suggested changes were made based on their input. The framework served its purpose and was able to help identify places where the sustainability literacy categories were being addressed throughout all three cases. In addition, the framework can serve as a tool for others looking to identify the sustainability literacy categories within existing coursework. We encourage further refinement of the framework based on results of continued studies within educational sustainability.

**Limitations**

This study adds to the emerging literature around sustainability in teacher education programs. Taking a holistic approach, this study not only looked at sustainability through four distinct sustainability literacy categories, it also studied a sequence of courses that almost all students in a teacher education program must take to earn their degree. As with any study there were limitations. As shared previously, the sustainability literacy framework was created for this study because there was no existing tool of its nature at the time, meaning that it had not been road tested for validity and reliability. This framework will need to continue to evolve as research around sustainability literacy and teacher education programs is conducted. In addition, to maintain anonymity of the case study participants, there were inconsistencies around the structure of the cases that were studied, even though the tools used, and the data collected was consistent. Finally, almost all data collected was self-reported data, while participants had no reason to be untruthful in their responses, their answers were only as accurate as their ability to describe their understandings. While this is a limitation with any self-reported data, in this study data collected were low-stakes, and multiple data types were collected to ensure validity.
Summary

This mixed-methods case study with a cross-case analysis was designed to illuminate how preservice teachers were being educated in the knowledge, skills and dispositions associated with sustainability literacy, and the understanding of sustainability literacy being developed by these preservice teachers based on their education. Multiple types of data were collected and analyzed from a sequence of courses, organized into three cases, required of almost all preservice teachers at a public university. Conclusions included the following: First, there are places within the existing teacher education curriculum where sustainability literacy can more intentionally be integrated. Secondly, for sustainability literacy to be treated as integral to the curriculum rather than as an add-on, policy changes will need to be made to teacher education standards, as the current standards do not explicitly account for sustainability. Sustainability educators and teacher educators are encouraged to engage in dialogue about the intentional integration of sustainability literacy into the existing curriculum using the leverage points identified in this study.
**Epilogue**

This research and subsequent dissertation find itself entering a very different world than the one in which it was conceived and conducted. For context, the study and data collection were completed before COVID entered the United States and much of the analysis was completed in the early stages of lockdown, but prior to the nation-wide protests in support of Black Lives Matter and racial equity. Although the study and much of the analysis were completed pre-COVID, the conclusion, implications, and recommendations have the potential to leave an impact on teacher education and more importantly, sustainable teacher education moving forward, in a post-COVID world.

Each sustainability literacy category was identified through the literature as being important to the creation of a sustainability literate populace. However, in light of current events and the results from the study, further focus on the sustainability literacy category of social justice is critical. Social justice themes were highly prevalent in all of the cases studied. Even though social justice was highly prevalent much of the focus was on building foundational knowledge. Now is the time to create opportunities for preservice teachers that move past foundational knowledge into enactment of culturally sustaining pedagogies in their future classrooms. Preservice teachers need permission and encouragement to push on existing systems of injustice. And, they also need support for how to react and continue forward when met with resistance from their colleagues, principal, or school board. If we truly are to create sustainable societies, we need to find ways to equip our preservice teachers with the knowledge, skills, and dispositions to embody equity.
References


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https://doi.org/10.1080/13504620902928422


https://doi.org/10.1177/002248718103200302
Appendix A. Codebook

When coding interviews, course materials or short-answer responses from surveys, the first step is to identify if the item being coded falls into one of the five categories below. These categories include four categories of sustainability literacy and one category for teaching practices. The criteria articulated is used to distinguish one category from the next. The criteria are not a checklist. An item may meet one or more of the criteria to be placed in the category. If an item meets the criteria for two or more categories the item is coded to the category with which it meets more of the criteria. If the item meets both categories equally context is considered, determining which category there is more alignment. If context cannot assist in coding the item then two categories can be assigned, however this should be done sparingly.

Table A1. Categories

<table>
<thead>
<tr>
<th>Sustainability Knowledge</th>
<th>Systems Thinking</th>
<th>Social Justice</th>
<th>Futures Thinking</th>
<th>Teaching Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Provides their own definition of sustainability, regardless of accuracy in the definition</td>
<td>• Articulates a complexity past just an ecological way of knowing</td>
<td>• Acknowledges personal perspective or bias (i.e. Western)</td>
<td>• Focusses on the needs of the future</td>
<td>• Does not directly address one of the four categories of sustainability literacy competencies but discusses teaching practices</td>
</tr>
<tr>
<td>• May recognizes that sustainability is more than just an ecological way of knowing</td>
<td>• References economic and/or social components as sustainable</td>
<td>• Focuses on achievement of all students</td>
<td>• Addresses how current decisions impact future systems</td>
<td>• Discusses place-based learning; project-based learning; assessments; teacher actions</td>
</tr>
<tr>
<td>• References a link between one aspect of sustainability and another</td>
<td>• Emphasizes diversity in teaching materials and methods</td>
<td>• Identifies future goals and discusses action steps</td>
<td>• Articulates how a decision or action now will impact future generations</td>
<td></td>
</tr>
<tr>
<td>Sustainability Knowledge</td>
<td>Systems Thinking</td>
<td>Social Justice</td>
<td>Futures Thinking</td>
<td>Teaching Practices</td>
</tr>
<tr>
<td>--------------------------</td>
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<td>---------------</td>
<td>-----------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>• Identifies faculty as facilitators of learning experiences</td>
<td>to achieve these goals</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Key Words**

sustainability; environment; environmental ed; interdisciplinary integrated, linked, connected, causes

Universal Design for Learning; differentiation; Non-Western/Western; diversity; differences; culture; inclusion; inclusivity; understand; accept; recognize

visioning; anticipatory thinking; foresighted thinking; intergenerational; future; in the future; they will do; when they Classroom; teachers will; we model/show;
After coding for category, a second layer of coding will be done to determine the depth with which the category is covered or addressed. The initial inspiration for coding for depth is drawn from Sterling (2011) when thinking about education of, for and as sustainability. Each category from above should also receive a level code.

*Table A2. Levels*

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Basic acknowledgement of category</td>
<td>• Mentions specific classes, course work, or teaching practices related to the category</td>
<td></td>
</tr>
<tr>
<td>• Does not link category to the classroom in any way</td>
<td>• Explains how the category integrates into the classroom</td>
<td>• Clearly articulates ideas that show student reflection and/or self-examination on beliefs and assumptions tied to the category</td>
</tr>
<tr>
<td></td>
<td>• Connects the category to student learning</td>
<td>• Describes a transformative learning experience for the student related to the category</td>
</tr>
<tr>
<td></td>
<td>• Articulates student interaction with the category in the classroom</td>
<td>• Discusses a student change in behavior related to the category that occurred because of what happened in the course</td>
</tr>
<tr>
<td></td>
<td>• Discusses learning activities that move past a transmissive approach and engage students in other ways of learning</td>
<td>• Describes classroom practices that were or could be used to encourage deeper understanding of this category</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Competencies</td>
<td>Knowledge, skills, and actions needed to understand, and problem solve an issue or concern (Wiek et al., 2011)</td>
<td></td>
</tr>
<tr>
<td>Content Knowledge</td>
<td>Knowing and understanding the content taught to others</td>
<td></td>
</tr>
<tr>
<td>Early-career teachers</td>
<td>Practicing teachers with fewer than 5 years of teaching experience (Clandinin, Downey &amp; Huber, 2009).</td>
<td></td>
</tr>
<tr>
<td>In-service teachers</td>
<td>Teachers who are currently practicing, often with students in grades K-12.</td>
<td></td>
</tr>
<tr>
<td>Literacy</td>
<td>Broader than just knowing how to read, literacy encompasses a holistic understanding focused on knowledge, skills, dispositions, and agency. An example is sustainability literacy which focuses on the knowledge, skills, dispositions, and agency needed to be sustainability literate.</td>
<td></td>
</tr>
<tr>
<td>Pedagogical Content Knowledge</td>
<td>Knowing and understanding how the content is to be taught to others.</td>
<td></td>
</tr>
<tr>
<td>Pedagogy</td>
<td>The specific process, skills, and knowledge needed to know how to teach content to learners</td>
<td></td>
</tr>
<tr>
<td>Preservice teachers</td>
<td>Future teachers who are in any part of a teacher preparation who are usually students at a higher-education institution. Frequently referred to as students.</td>
<td></td>
</tr>
<tr>
<td>Primary or elementary teachers</td>
<td>Teachers who teach students in primary school. This corresponds to grades kindergarten to 5th grade or students roughly 5 to 11 years in age.</td>
<td></td>
</tr>
<tr>
<td>Secondary teachers</td>
<td>Teachers who teach students in secondary school. This corresponds to grades kindergarten to 6th grade or students roughly 11 to 18 years in age.</td>
<td></td>
</tr>
</tbody>
</table>
Appendix B. Instrument & Protocol

Faculty Survey
The following questions are designed to gather information about the course you teach as part of the teacher education program.

Results from this study will be used in combination with other data metrics to build an understanding of how sustainability literacy competencies are taught within the teacher preparation program. Please note, that there are no wrong answers to these questions, and you are encouraged to answer them completely and honestly.

Please answer the following questions to the best of your ability.

Demographic Information:
What are the last 4 digits of your work phone number?

What course do you teach this semester?

How many sections of the course do you teach?
1
2
3
4
5+

Questions
I have received formal training or education on sustainability topics.
1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree
If respondents answer 4 or 5 they will be prompted to Explain your answer to the previous question.

I feel prepared to teach about sustainability literacy in my course.
1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree
Explain your answer:

This survey references categories of competencies in sustainability literacy. These categories are be defined as follows:
General Knowledge of Sustainability – Nolet (2009, p. 415) defines sustainability as “an emergent paradigm that considers environmental, economic, social, and political systems as interconnected systems rather than discrete entities; involves transformation of values and belief systems as well as technological, market, or policy
approaches to problem solving; views social and economic justice and intergenerational equity as inextricable from environmental stewardship; cannot be achieved if current rates of consumption and environmental degradation remain unchanged; and emphasizes personal and collective practices consistent with responsible global citizenship.” Knowledge of sustainability includes but also builds past an environmental or ecological way of knowing and recognizes the complex relationship between environmental, economic, and social processes (Mintz & Tal, 2014). Knowledge of sustainability also includes a deeper understanding of the interplay between the content that is taught and how that content is taught. This course addresses knowledge, skills, and dispositions associated with general knowledge of sustainability. 1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Explain your answer:

Systems Thinking – Traditionally, there has been a desire to simplify systems; to focus on the parts instead of the whole. Systems thinking encourages a return to thinking about the whole and how the whole is connected to other components within a broad network with the understanding that one small change in a system can have wide-reaching effects (Capra & Luisi, 2016). This focus on systems recognizes that one aspect of sustainability, say an environmental decision, will have ripple effects into other aspects of society. In addition, there is also the need for students to understand the complex interplay within environmental and natural systems (Nolet, 2009; Yavetz et al., 2009).

This course addresses knowledge, skills, and dispositions associated with systems thinking. 1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Explain your answer:

Social Justice – The United Nations and UNESCO have articulated a need through various initiatives, including the Sustainable Development Goals to provide equitable and inclusive learning opportunities for all students. In the United States, specifically, the desire for education for all has been identified, but arguably not achieved due to deeply embedded systems which support and propagate an unfair and unjust educational system (Alim & Paris, 2017; Grande, 2015; Holmes & González, 2017; UNESCO, 2016). Culturally responsive teaching, culturally relevant pedagogy, and culturally sustaining pedagogies are all methods which work to recognize and support the inclusivity of all students in the current education system.

This course addresses knowledge, skills, and dispositions associated with social justice. 1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Explain your answer:

Futures Thinking - Sometimes called anticipatory thinking, intergenerational thinking, or even long-term thinking, futures thinking begins to look past the here and now and envisions the future (Frisk & Larson, 2011; Nolet, 2017;
2009; Wiek et. al., 2011). Frisk & Larson (2011) remind their readers that if the focus is to meet the needs of the present without comprising needs of the future, there is an inherent need to address how actions today influence the future. In working to accomplish this goal, teachers and students must understand the impact that current decisions have on systems in the future, while also anticipating how to prevent unintended, harmful consequences to occur (Frisk & Larson, 2011).

This course addresses knowledge, skills, and dispositions associated with futures thinking.

1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Explain your answer:

In teaching this course I utilize experiential learning experiences, transformative learning experiences and/or non-western or indigenous ways learning (e.g. through field work, hands-on learning activities or other learning experiences).

1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Explain your answer:

In teaching this course I utilize culturally responsive teaching practices, culturally relevant pedagogy, and/or culturally sustaining pedagogy (e.g. learning materials are from authors of varying backgrounds; used a variety of student experiences to guide instruction).

1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Explain your answer:

In teaching this course I ask students to critically think, problem solve, and/or creatively think (e.g. through the use of case studies, problem-based learning activities, or other experiences).

1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Explain your answer:

In teaching this course I ask students to be reflective in their learning (e.g. through journaling, discussions about learning or other experiences).

1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Explain your answer:
Student Survey (Early and Mid-Course Case)

Demographic questions:
Which course are you enrolled in this semester (Fall 2019)?

What is your major? Please select all that apply.
Early Childhood Education
Elementary Education
English Education
Family and Consumer Science Education
Foreign Language Education
Mathematics Education
Music Education
Physical Education
Science Education
Social Studies Education
Special Education
Other:

What grade level(s) do you anticipate you will you be certified to teach when you earn you teaching license?
Select all that apply.
K, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

What year are you in college based on your earned credits?
First-year student
Sophomore
Junior
Senior

This survey references categories of competencies in sustainability literacy. Before each category there will be a brief description of the category. Please use this information to answer the questions to the best of your ability.

General Knowledge of Sustainability – Knowledge of sustainability includes but also builds past an environmental or ecological way of knowing and recognizes the complex relationship between environmental, economic, and social processes (Mintz & Tal, 2014). Knowledge of sustainability also includes a deeper understanding of the interplay between the content that is taught and how that content is taught.
This course addresses knowledge, skills, and dispositions associated with general knowledge of sustainability.
1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree
If answer was 4 or 5, Prompt with: Please provide an example

Systems Thinking – Traditionally, there has been a desire to simplify systems; to focus on the parts instead of the whole. Systems thinking encourages thinking about the whole and how the whole is connected to other components within a broad network with the understanding that one small change in a system can have wide-reaching effects (Capra & Luisi, 2016).

This course addresses knowledge, skills, and dispositions associated with systems thinking.
1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree
If answer was 4 or 5, Prompt with: Please provide an example

Social Justice – The United Nations and UNESCO have articulated a need through various initiatives, including the Sustainable Development Goals to provide equitable and inclusive learning opportunities for all students. Culturally responsive teaching, culturally relevant pedagogy, and culturally sustaining pedagogies are all methods which work to recognize and support the inclusivity of all students in the current education system.

This course addresses knowledge, skills, and dispositions associated with social justice.
1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree
If answer was 4 or 5, Prompt with: Please provide an example

Futures Thinking - Sometimes called anticipatory thinking, intergenerational thinking, or even long-term thinking, futures thinking begins to look past the here and now and envisions the future (Frisk & Larson, 2011; Nolet, 2009; Wiek et. al., 2011). In working to accomplish this, teachers and students must understand the impact that current decisions have on systems in the future, while also anticipating how to prevent unintended, harmful consequences to occur (Frisk & Larson, 2011).

This course addresses knowledge, skills, and dispositions associated with futures thinking.
1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree
If answer was 4 or 5, Prompt with: Please provide an example

In this course I participated in experiential learning experiences, transformative learning experiences and/or non-western or indigenous ways learning (e.g. through field work, hands-on learning activities or other learning experiences).
1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree
Please provide an example:
In this course I participated in experiences that were culturally responsive, culturally relevant, and/or culturally sustaining (e.g. learning materials were from authors of varying backgrounds; faculty used a variety of student experiences to guide instruction).

1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Please provide an example:

In this course I was asked to critically think, problem solve, and/or creatively think (e.g. through the use of case studies, problem-based learning activities, or other experiences).

1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Please provide an example:

In this course I was asked to reflective on my learning (e.g. through journaling, discussions about learning or other experiences).

1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Please provide an example:

As a reminder, your participation in this study is completely voluntary. If you want to withdraw from the study you may do so now before submitting your responses, by closing your browser window.

Thank you for your time.
Student Survey (Capstone Course Case)
Demographic questions:

Are you student teaching this semester (Fall 2019)?
Yes
No – Thank you for your interest, at this time you do not meet the established criteria for this research study.

What is your major? Please select all that apply.
Early Childhood Education
Elementary Education
English Education
Family and Consumer Science Education
Foreign Language Education
Mathematics Education
Music Education
Physical Education
Science Education
Social Studies Education
Special Education
Other:

What grade level(s) do you anticipate you will be certified to teach when you earn you teaching license?
Select all that apply.
K, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

Which of the following courses are you enrolled in or have you taken? Please select all that apply:
Redacted – Early Course Case
Redacted - Mid-Course Case
Redacted - Mid-Course Case

This survey references categories of competencies in sustainability literacy. Before each category there will be a brief description of the category. Please use this information to answer the questions to the best of your ability with respect to your entire experience in the teacher education program at REDACTED.

General Knowledge of Sustainability – Knowledge of sustainability includes but also builds past an environmental or ecological way of knowing and recognizes the complex relationship between environmental, economic, and
social processes (Mintz & Tal, 2014). Knowledge of sustainability also includes a deeper understanding of the interplay between the content that is taught and how that content is taught.

The teacher education program, addresses knowledge, skills, and dispositions associated with general knowledge of sustainability.

1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Explain your answer:

Systems Thinking – Traditionally, there has been a desire to simplify systems; to focus on the parts instead of the whole. Systems thinking encourages thinking about the whole and how the whole is connected to other components within a broad network with the understanding that one small change in a system can have wide-reaching effects (Capra & Luisi, 2016).

The teacher education program, addresses knowledge, skills, and dispositions associated with systems thinking.

1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Explain your answer:

Social Justice – The United Nations and UNESCO have articulated a need through various initiatives, including the Sustainable Development Goals to provide equitable and inclusive learning opportunities for all students. Culturally responsive teaching, culturally relevant pedagogy, and culturally sustaining pedagogies are all methods which work to recognize and support the inclusivity of all students in the current education system.

The teacher education program, addresses knowledge, skills, and dispositions associated with social justice.

1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Explain your answer:

Futures Thinking - Sometimes called anticipatory thinking, intergenerational thinking, or even long-term thinking, futures thinking begins to look past the here and now and envisions the future (Frisk & Larson, 2011; Nolet, 2009; Wick et. al., 2011). In working to accomplish this, teachers and students must understand the impact that current decisions have on systems in the future, while also anticipating how to prevent unintended, harmful consequences to occur (Frisk & Larson, 2011).

The teacher education program, addresses knowledge, skills, and dispositions associated with futures thinking.

1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Explain your answer:

In the teacher education program, I participated in experiential learning experiences, transformative learning experiences and/or non-western or indigenous ways learning (e.g. through field work, hands-on learning activities or other learning experiences).

1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Explain your answer:
In the teacher education program, I participated in experiences that were culturally responsive, culturally relevant, and/or culturally sustaining (e.g. learning materials were from authors of varying backgrounds; faculty used a variety of student experiences to guide instruction).

1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Explain your answer:

In the teacher education program, I was asked to critically think, problem solve, and/or creatively think (e.g. through the use of case studies, problem-based learning activities, or other experiences).

1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Explain your answer:

In the teacher education program, I was asked to reflective on my learning (e.g. through journaling, discussions about learning or other experiences).

1 – Strongly disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, 5 – Strongly Agree

Explain your answer:

As a reminder, your participation in this study is completely voluntary. If you want to withdraw from the study you may do so now before submitting your responses, by closing your browser window.

Thank you for your time.
Faculty Interview Protocol

How would you describe sustainability?

What intentional decisions have you made in your course design to support sustainability or to teach about sustainability?

Tell me about an assignment that you think highlights or exemplifies sustainability in your class.

To what extent do you think that sustainability could or should be integrated into the teacher preparation curriculum? Why? How do you think this could be done? (Do you think it can be?) As an add-on generic course or integrated into all curriculum areas?

What, if any, difficulties/barriers do you envision with such integration? Are there aspects of the campus or curriculum which create particular difficulties or supports in this respect? What are they? Why? How could these barriers be overcome? How could you leverage these supports?
Appendix C. Invitations, Consents, & Approval

Faculty Invitation

My name is Elizabeth Potter-Nelson. I’m a doctoral student in Educational Sustainability at UWSP. Dr. Paula DeHart, professor emeritus in the School of Education, is my committee chair/major professor. My research interests are grounded in the study of preservice teachers and teacher education programs. For over a decade I taught high school physics and chemistry in Illinois and Wisconsin. During my time in Illinois I also served as a science department chair. As department chair, I began to see the interplay of various educational systems in a broader context outside of just my daily classroom interactions with students, colleagues, and curriculum. Being in a smaller district with a high faculty turnover rate, I was able to work closely with early career teachers both in their hiring and development. These early experiences in Illinois and Wisconsin cemented a desire for me to enroll in a doctoral program, where I could begin looking, in earnest, at the various systems and interactions that influence public education and teacher preparation.

Since starting the doctoral program in the Summer of 2017, I have immersed myself in educational sustainability, working to understand the history, theory, content, pedagogy, and practices of sustainability through coursework, readings, and personal experiences. Much of the literature is still very theoretical and I would like to start understanding how this theory manifests itself in the experiences of preservice teachers and their coursework. My current research project for my dissertation takes an understanding of sustainability education and looks to see how sustainability literacy competencies are taught and understood in teacher education programs. My hope is that through my research I can recognize the challenging work of preparing preservice teachers for the field, while also identifying areas where sustainability can be holistically infused into the existing educational framework.

My plan is to study four courses which are common to most primary and secondary preservice teachers throughout the teacher preparation program at REDACTED. Within each of those courses I would like to evaluate course materials, survey faculty and students, and conduct an interview of faculty for the prevalence of sustainability literacy competencies. I am reaching out to you because you teach one of the identified courses, which is part of the teacher education program at REDACTED.

I know that this is a lot to ask, so I appreciate you taking the time to consider my request. I am happy to answer any questions you have, as are Dr. DeHart, or Dr. Joy O’Neil, the Director of the doctoral program. I can be reached by email at liz.potter-nelson@uwsp.edu or by phone. Please let me know by <<Insert Date>> if you are interested in participating in this study. We can then set up a time to go through the informed consent document and begin the research process.

Thank you for your consideration.

Liz Potter-Nelson
Doctoral Student in Educational Sustainability
Student Invitation

Hi! My name is Elizabeth Potter-Nelson and I am a doctoral student, here, at the University of Wisconsin-Stevens Point in Educational Sustainability. I have spent 14 years in public education throughout Iowa, Illinois, and Wisconsin and all of those experiences have shaped my desire to research preservice teachers, and teacher education programs. I want to understand how to help preservice and early career teachers start and remain successful in the teaching profession.

Since starting the doctoral program in the Summer of 2017, I have immersed myself in educational sustainability, working to understand the history, theory, content, pedagogy, and practices of sustainability through coursework, readings, and personal experiences. That being said, much of the literature is still very theoretical in nature. My goal is to begin to bridge the gap between theory and practice by trying to understand how sustainability literacy is taught in teacher education programs. In doing this I will be researching four different courses at REDACTED that are common to most primary and secondary preservice teachers.

As students in one of these four courses, I am asking you to complete an anonymous survey about the experiences you have had in this course. No identifying information will be collected and your participation in the study is completely voluntary and will not affect your grade in the course. The survey should take no more than 20 minutes to complete. The results of the survey will be published in my dissertation and could result in future publications.

If you are interested in participating in this survey you can access it at the following shortened URL: <<insert URL>>. The survey will close on December 31, 2019.

Thank you for your time and consideration.
Faculty Consent

Elizabeth Potter-Nelson, doctoral student in Educational Sustainability at the University of Wisconsin-Stevens Point (UWSP) would appreciate your participation in a research study designed to determine how sustainability literacy competencies are taught and understood in the teacher education program at REDACTED. You are being asked to complete a few different components of this study with varying time commitments:

- **Share course materials** – Share your course materials including but not limited to syllabus, assignments, reading lists, etc. One way to accomplish this is by adding the student researcher, Elizabeth Potter-Nelson, to your course in Canvas as an observer. Sharing of course materials will take anywhere from 10-60 minutes, depending on how you share the course materials.
- **Survey** – Complete a survey about the course you teach. The survey should take no more than 20 minutes of your time.
- **Brief Interview** – Participate in a semi-structured interview. This will take approximately 30 minutes of your time.

The total approximated time for participation is about 1 hour. Your participation is completely voluntary. The benefit of this study is a greater understanding of how sustainability literacy competencies in the categories of general sustainability knowledge, systems thinking, social justice, and futures thinking present themselves in the teacher education program at REDACTED.

There is no anticipated risk to you as a result of your participation in this study other than the inconvenience of the time to complete the different aspects of the study. You could, however, experience some discomfort if you share examples from your experiences in the course that were uncomfortable to you or if you feel your course does not align with the sustainability literacy competencies. While there may be no immediate benefit to you as a result of your participation in this study it is hoped that I gain valuable information about how sustainability literacy competencies are taught and the understandings that is made by students of these competencies.

Given the nature of this research project, multiple data points are being collected. You may also choose not to participate as an alternative. The information that you provide will be collected and stored in the following ways:

- The shared course materials will be accessed by the student researcher through Canvas or a method of your choosing. Your course will be referred to as an early course (REDACTED), middle course (REDACTED and REDACTED), or capstone course (REDACTED). Faculty will not be named but will be referred to as the faculty of an early course, middle course or capstone course, as appropriate.
- The survey will be collected through Qualtrics. You will be given an anonymous link to complete the survey. You will share the last four digits of your work phone number as a way for the student researcher to identify you, but you will not be named.
- Interviews will be conducted and recorded on a mp3 recording device. The interviews will be securely uploaded and transcribed using NVivo Transcription services.

All data will be stored on the student researcher’s password protected device in a password protected folder. The last four digits of your phone number linking you to the data will be stored in a separate password.
protected which corresponds to the course you teach will be stored separately on the student researcher’s password protected device. Any downloaded data will be kept in a password protected file on the researcher’s password protected device and will not be available to anyone not directly involved in this study.

Your participation in this study is completely voluntary. If you want to withdraw from the study, you may do so at any time without penalty. Only anonymous information provided will be retained. All identifiable information will be removed from the study and destroyed or deleted.

Once the study is completed, you may receive the results of the study. If you would like these results, or if you have any questions in the meantime, please contact:

Liz Potter-Nelson  
School of Education  
University of Wisconsin – Stevens Point  
Stevens Point, WI 54481  
(REDACTED)  
liz.potter-nelson@uwsp.edu

If you have any complaints about your treatment as a participant in this study or believe that you have been harmed in some way by your participation, please call or write:

Anna Haines, PhD  
Professor, Natural Resource Planning  
Director, Center for Land Use Education  
800 Reserve Street  
College of Natural Resources  
University of Wisconsin, Stevens Point and Extension  
Stevens Point, WI 54481  
715.346.2386  
irbchair@uwsp.edu

Although Dr. Haines will ask your name, all complaints are kept in confidence.

I have read and understand the information provided to me; that my participation is voluntary and I may withdraw at any time.

Name (print): ___________________________________________ Date: ______________

Signature: ________________________________________________
Student Consent

Elizabeth Potter-Nelson, doctoral student in Educational Sustainability at the University of Wisconsin-Stevens Point (UWSP) would appreciate your participation in a research study designed to determine how sustainability literacy competencies are taught and understood in the teacher education program at REDACTED. You are being asked to complete a survey that should take no more than 20 minutes of your time. Your participation is completely voluntary. While there is no direct benefit to your participation, an indirect benefit of this study is a greater understanding of how sustainability literacy competencies in the categories of general sustainability knowledge, systems thinking, social justice, and futures thinking present themselves in teacher education courses.

There is no anticipated risk to you as a result of your participation in this study other than the inconvenience of the time to complete the survey. You could, however, experience some discomfort if you share examples from your experiences in the course that were uncomfortable to you. While there may be no immediate benefit to you as a result of your participation in this study it is hoped that valuable information about how sustainability literacy competencies are taught and the understandings that are made by students of these competencies will be gained.

While this information could be obtained by interviewing you, we feel that the survey is the quickest and easiest method for obtaining this information. You may also choose not to participate as an alternative. The information that you give us on the questionnaire will be recorded in Qualtrics. Information that could identify you is not being collected. And, any information shared during the short answer portions of the survey that could identify you will not be released. The primary purpose of this research is to inform the researcher’s dissertation research. However, there could be potential publications which result from this research. All completed surveys will be kept in secured in the University’s version of Qualtrics. Any downloaded data will be kept in a password protected file on the researcher’s password protected device and will not be available to anyone not directly involved in this study.

Your participation in this study is completely voluntary. If you want to withdraw from the study you may do so prior to completion of the survey as no identifiable information will be intentionally collected in the survey. If you decide to exit the survey, all answered questions will not be stored. You may stop completing the survey at any time by closing your browser window. Results will not be stored unless you submit your answers at the end of the survey. Submitting this survey verifies your consent to participate in the study.

Once the study is completed, you may receive the results of the study. If you would like these results, or if you have any questions in the meantime, please contact:
Liz Potter-Nelson
School of Education
University of Wisconsin – Stevens Point
Stevens Point, WI 54481
Redacted
liz.potter-nelson@uwsp.edu
If you have any complaints about your treatment as a participant in this study or believe that you have been harmed in some way by your participation, please call or write:
Anna Haines, PhD
Professor, Natural Resource Planning
Director, Center for Land Use Education
800 Reserve Street
College of Natural Resources
University of Wisconsin, Stevens Point and Extension
Stevens Point, WI 54481
715.346.2386
irbchair@uwsp.edu

Although Dr. Haines will ask your name, all complaints are kept in confidence.

By clicking the button below, you acknowledge that your participation in the study is voluntary, you are 18 years of age, and that you are aware that you may choose to terminate your participation in the study at any time and for any reason.
I consent, begin the study.
I do not consent, I do not wish to participate.
Dear Paula,

The above-referenced human-subjects research project has been approved by the University of Wisconsin-Stevens Point Institutional Review Board (IRB) Committee. This approval is limited to the activities described in the approved protocol, and extends to the performance of these activities at each applicable sited identified in the application for IRB review. In accordance with this approval, the specific conditions for the conduct of this research are listed below, and informed consent from subjects must be obtained as indicated. Additional conditions for the general conduct of human-subjects research may be detailed below.

Additional Conditions:

All individuals engaged in human-subjects research are responsible for compliance with all applicable UWSP Research Policies. The Principal Investigator is responsible for assuring all protocol personnel review and adhere to applicable policies for the conduct of human-subjects research.

The IRB maintains an official protocol file for each study to meet the University’s regulatory obligations for record keeping. Principal Investigators are responsible for maintaining all records related to the protocol, and are required to share with the IRB. The IRB is not responsible for maintaining study documents for researchers.

Your project approval expiration date is listed above. Exempt protocols have an automatic 5-year approval period. As a courtesy to you, and to reduce administrative burden, the IRB will request an annual update from the Principal Investigator on the status of this study. It is your responsibility to inform the IRB if the project is complete or still in operation. If the study needs to remain open after year 5, you must submit a new protocol. Lapses in approval should be avoided to protect the safety and welfare of enrolled subjects. When you plan to close your study, submit a Protocol Closure Form to irbchair@uwsp.edu.

No changes are to be made to the approved protocol or study documents (i.e., consent forms, surveys, etc….) without prior review and approval of the IRB. To modify an existing protocol, complete the Protocol Modification Form and submit to irbchair@uwsp.edu.
If there are any injuries, problems, or complaints from participants, you must notify the IRB at irbchair@uwsp.edu within 24 hours.

If you have any questions, please contact me. Good luck with your project.

Sincerely,

Anna Haines, Ph.D.
IRB Chair
ahaines@uwsp.edu
715-346-2368
c: Liz Potter-Nelson
### Appendix D. Data

<table>
<thead>
<tr>
<th>Item</th>
<th>n</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
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<th>Mdn</th>
<th>Min</th>
<th>Max</th>
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<td>1. I have received formal training or education on sustainability topics.</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2.67</td>
<td>2.08</td>
<td>2</td>
<td>1</td>
<td>5</td>
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<td>2. I feel prepared to teach about sustainability literacy in my course.</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4.00</td>
<td>1.00</td>
<td>4</td>
<td>3</td>
<td>5</td>
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<tr>
<td>3. This course addresses knowledge, skills, and dispositions associated with general knowledge of sustainability.</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4.67</td>
<td>0.58</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. This course addresses knowledge, skills, and dispositions associated with systems thinking.</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>4.33</td>
<td>0.58</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. This course addresses knowledge, skills, and dispositions associated with social justice.</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>5.00</td>
<td>0.00</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>6. This course addresses knowledge, skills, and dispositions associated with futures thinking.</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>3.67</td>
<td>1.53</td>
<td>4</td>
<td>2</td>
<td>5</td>
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<tr>
<td>7. In teaching this course I utilize experiential learning experiences, transformative learning experiences and/or non-western or indigenous ways learning.</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4.67</td>
<td>0.58</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. In teaching this course I utilize culturally responsive teaching practices, culturally relevant pedagogy, and/or culturally sustaining pedagogy.</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4.67</td>
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<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. In teaching this course I ask students to critically think, problem solve, and/or creatively think.</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>4.33</td>
<td>0.58</td>
<td>4</td>
<td>4</td>
<td>5</td>
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<tr>
<td>10. In teaching this course I ask students to be reflective in their learning.</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>4.33</td>
<td>0.58</td>
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Early Course Case Faculty Cronbach’s $\alpha$

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Early Course Case Student Survey

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<th>Std Dev</th>
<th>Mdn</th>
<th>Min</th>
<th>Max</th>
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<tr>
<td>1</td>
<td>This course addresses knowledge, skills, and dispositions associated with general knowledge of sustainability.</td>
<td>51</td>
<td>0 5 16 21 9</td>
<td>3.67</td>
<td>0.89</td>
<td>4 2 5</td>
</tr>
<tr>
<td>2</td>
<td>This course addresses knowledge, skills, and dispositions associated with systems thinking.</td>
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<td>0 1 17 22 11</td>
<td>3.84</td>
<td>0.78</td>
<td>4 2 5</td>
</tr>
<tr>
<td>3</td>
<td>This course addresses knowledge, skills, and dispositions associated with social justice.</td>
<td>51</td>
<td>0 1 16 15 19</td>
<td>4.02</td>
<td>0.88</td>
<td>4 2 5</td>
</tr>
<tr>
<td>4</td>
<td>This course addresses knowledge, skills, and dispositions associated with futures thinking.</td>
<td>51</td>
<td>0 2 10 23 16</td>
<td>4.04</td>
<td>0.82</td>
<td>4 2 5</td>
</tr>
<tr>
<td>5</td>
<td>In this course I participated in experiential learning experiences, transformative learning experiences and/or non-western or indigenous ways learning.</td>
<td>50</td>
<td>0 4 1 28 17</td>
<td>4.16</td>
<td>0.82</td>
<td>4 2 5</td>
</tr>
<tr>
<td>6</td>
<td>In this course I participated in experiences that were culturally responsive, culturally relevant, and/or culturally sustaining.</td>
<td>50</td>
<td>0 2 4 24 20</td>
<td>4.24</td>
<td>0.77</td>
<td>4 2 5</td>
</tr>
<tr>
<td>7</td>
<td>In this course I was asked to critically think, problem solve, and/or creatively think.</td>
<td>50</td>
<td>1 4 2 24 19</td>
<td>4.12</td>
<td>0.96</td>
<td>4 1 5</td>
</tr>
<tr>
<td>8</td>
<td>In this course I was asked to be reflective on my learning.</td>
<td>51</td>
<td>0 3 9 21 18</td>
<td>4.06</td>
<td>0.88</td>
<td>4 2 5</td>
</tr>
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</table>

Early Course Case Student Cronbach’s α

<table>
<thead>
<tr>
<th>Items</th>
<th>Sample</th>
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<th>Cronbach Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items #1-8</td>
<td>n = 49</td>
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</tr>
<tr>
<td>Sustainability Literacy Competencies - Items #1-4</td>
<td>n = 51</td>
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<tr>
<td>Pedagogy Competencies - Items #5-8</td>
<td>n = 49</td>
<td>4</td>
<td>0.84</td>
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## Mid-Course Case Faculty Survey Results & Analysis

<table>
<thead>
<tr>
<th>Item</th>
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<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
<th>M</th>
<th>Std Dev</th>
<th>Mdn</th>
<th>Min</th>
<th>Max</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>I have received formal training or education on sustainability topics.</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3.67</td>
<td>2.31</td>
<td>5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>I feel prepared to teach about sustainability literacy in my course.</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>3.33</td>
<td>2.08</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>This course addresses knowledge, skills, and dispositions associated with general knowledge of sustainability.</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4.67</td>
<td>0.58</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>This course addresses knowledge, skills, and dispositions associated with systems thinking.</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4.67</td>
<td>0.58</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>This course addresses knowledge, skills, and dispositions associated with social justice.</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>4.33</td>
<td>0.58</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>In teaching this course I utilize experiential learning experiences, transformative learning experiences and/or non-western or indigenous ways learning.</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>4.00</td>
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<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>In teaching this course I utilize culturally responsive teaching practices, culturally relevant pedagogy, and/or culturally sustaining pedagogy.</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4.67</td>
<td>0/58</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td>In teaching this course I ask students to critically think, problem solve, and/or creatively think</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>3.33</td>
<td>1.15</td>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>In teaching this course I ask students to be reflective in their learning</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4.67</td>
<td>0.58</td>
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</table>

205
## Mid-Course Case Faculty Cronbach’s α

<table>
<thead>
<tr>
<th>Items</th>
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<tbody>
<tr>
<td>Items #1-10</td>
<td>$n = 3$</td>
<td>10</td>
<td>0.46</td>
</tr>
<tr>
<td>Sustainability Literacy Competencies - Items #3-6</td>
<td>$n = 3$</td>
<td>4</td>
<td>0.76</td>
</tr>
<tr>
<td>Pedagogy Competencies - Items #7-10</td>
<td>$n = 3$</td>
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<td>0.56</td>
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</table>
## Mid-Course Case Student Survey

<table>
<thead>
<tr>
<th>Item</th>
<th>Likert-Scale</th>
<th>Cronbach’s α</th>
<th>Sample</th>
<th>Items</th>
<th>Cronbach Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>39 0 3 8 20 8 3.85 0.84 4 2 5</td>
<td>0.79</td>
<td>38</td>
<td>8</td>
<td>0.79</td>
</tr>
<tr>
<td>#2</td>
<td>39 0 2 8 22 7 3.87 0.77 4 2 5</td>
<td>0.67</td>
<td>39</td>
<td>4</td>
<td>0.67</td>
</tr>
<tr>
<td>#3</td>
<td>39 0 1 8 24 6 3.90 0.68 4 2 5</td>
<td>0.81</td>
<td>38</td>
<td>4</td>
<td>0.81</td>
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### Cronbach’s α:
- **Sustainability Literacy Competencies - Items #1-4**: 0.79
- **Pedagogy Competencies - Items #5-8**: 0.71
<table>
<thead>
<tr>
<th>Item</th>
<th>n</th>
<th>Likert-Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 I have received formal training or education on sustainability topics.</td>
<td>1 0 0 0 1 0</td>
<td></td>
</tr>
<tr>
<td>2 I feel prepared to teach about sustainability literacy in my course.</td>
<td>1 0 1 0 0 0</td>
<td></td>
</tr>
<tr>
<td>3 This course addresses knowledge, skills, and dispositions associated with general knowledge of sustainability.</td>
<td>1 0 1 0 0 0</td>
<td></td>
</tr>
<tr>
<td>4 This course addresses knowledge, skills, and dispositions associated with systems thinking.</td>
<td>1 0 0 1 0 0</td>
<td></td>
</tr>
<tr>
<td>5 This course addresses knowledge, skills, and dispositions associated with social justice.</td>
<td>1 0 0 0 0 1</td>
<td></td>
</tr>
<tr>
<td>6 This course addresses knowledge, skills, and dispositions associated with futures thinking.</td>
<td>1 0 0 0 1 0</td>
<td></td>
</tr>
<tr>
<td>7 In teaching this course I utilize experiential learning experiences, transformative learning experiences and/or non-western or indigenous ways learning.</td>
<td>1 0 0 0 0 1</td>
<td></td>
</tr>
<tr>
<td>8 In teaching this course I utilize culturally responsive teaching practices, culturally relevant pedagogy, and/or culturally sustaining pedagogy).</td>
<td>1 0 1 0 0 1</td>
<td></td>
</tr>
<tr>
<td>9 In teaching this course I ask students to critically think, problem solve, and/or creatively think</td>
<td>1 0 0 0 1 0</td>
<td></td>
</tr>
<tr>
<td>10 In teaching this course I ask students to be reflective in their learning</td>
<td>1 0 0 0 0 1</td>
<td></td>
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</tbody>
</table>
Capstone Case Student Survey Results & Analysis

<table>
<thead>
<tr>
<th>Item</th>
<th>Likert-Scale</th>
<th>M</th>
<th>Stan. Dev.</th>
<th>Mdn</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>This course addresses knowledge, skills, and dispositions associated with general knowledge of sustainability.</td>
<td>9 0 1 0 7 1</td>
<td>3.89</td>
<td>0.78</td>
<td>4</td>
<td>2</td>
<td>5</td>
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<tr>
<td>This course addresses knowledge, skills, and dispositions associated with systems thinking.</td>
<td>9 1 2 1 1 4</td>
<td>3.56</td>
<td>1.59</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>This course addresses knowledge, skills, and dispositions associated with social justice.</td>
<td>9 0 1 2 4 2</td>
<td>3.78</td>
<td>0.97</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>This course addresses knowledge, skills, and dispositions associated with futures thinking.</td>
<td>9 1 1 1 2 4</td>
<td>3.78</td>
<td>1.48</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>In this course I participated in experiential learning experiences, transformative learning experiences and/or non-western or indigenous ways learning.</td>
<td>9 0 1 0 4 4</td>
<td>4.22</td>
<td>0.97</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>In this course I participated in experiences that were culturally responsive, culturally relevant, and/or culturally sustaining.</td>
<td>9 0 1 0 5 3</td>
<td>4.11</td>
<td>0.93</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>In this course I was asked to critically think, problem solve, and/or creatively think.</td>
<td>9 0 0 1 3 5</td>
<td>4.44</td>
<td>0.73</td>
<td>5</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>In this course I was asked to be reflective on my learning.</td>
<td>9 0 1 0 2 6</td>
<td>4.44</td>
<td>1.01</td>
<td>5</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>
Capstone Course Case Student Cronbach’s $\alpha$

<table>
<thead>
<tr>
<th>Items</th>
<th>Sample</th>
<th>Items</th>
<th>Cronbach Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items #1-8</td>
<td>$n = 9$</td>
<td>8</td>
<td>0.65</td>
</tr>
<tr>
<td>Sustainability Literacy Competencies - Items #1-4</td>
<td>$n = 9$</td>
<td>4</td>
<td>0.38</td>
</tr>
<tr>
<td>Pedagogy Competencies - Items #5-8</td>
<td>$n = 9$</td>
<td>4</td>
<td>0.77</td>
</tr>
</tbody>
</table>