



**Best Practices for Education for Sustainable  
Development in an Urban Context:**  
*Reflections on improving ESD from Boone, North  
Carolina, USA*

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**HÁSKÓLI ÍSLANDS**  
**MENNTAVÍSINDASVIÐ**

**Best Practices for Education for Sustainable Development  
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Thesis submitted in partial fulfilment of a MS-degree

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# Forward

This thesis is a culmination of the support given by my parents, Cathryn and Keith, my brothers, Nathan and Colin, and my loving and patient partner Jess. Their love and guidance helped me to follow my passions and gave me the inspiration to keep striving to do my best. This work has been a collective effort, and for that I will be forever grateful.

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Lastly, I would like to thank the University of Iceland and Appalachian State University. The former for providing me with a challenging and thorough education, and the latter for granting me access to their wonderful faculty, students and resources.

This thesis is written by me, *Drew Riemersma*. I have acquainted myself with the University of Iceland Science Code. I have followed the norms of ethics in research and full integrity in the acquisition and dissemination of information, and the interpretation of results. I refer to all the material that I have applied to others or to previous own works, whether in the form of suggestions, images, material or wording. I thank everyone who has contributed to me in one way or another, and I am responsible for what may be wrong. I confirmed this with my signature.

Reykjavík, 02.05.2019

\_\_\_\_*Drew Kelley Riemersma*\_\_\_\_\_

*"World and men do not exist apart from each other, they exist in constant interaction"-*  
(Freire, 1972, p. 27)

## **Abstract**

Education for Sustainable Development (ESD) takes many forms and varies widely between countries, states, and geographic regions. Although the content and prevalence of this education varies, all ESD should reorient the existing curriculum to address and increase awareness of issues related to sustainability, paying special attention to the local cultural, economic, and environmental conditions. By using regional issues and landmarks, students are exposed to pressing problems in both the natural and built environments. With the majority of the world's population living in cities, this study seeks to understand how to address complex issues in Sustainable Development (SD) and how to use the local built environment as a teaching tool regarding those issues. This study gathered data from 16 undergraduates and professors at Appalachian State University (ASU) where three focus groups and two interviews were held. Participants were tasked with discussing ways to increase student understanding and involvement in issues of urban sustainability and asked to choose images that could be used to discuss urban ESD. Findings suggest that by highlighting the best-to-worst continuum of urban sustainability, educators can develop an effective ESD based on regional issues and relevant landmarks. Additionally, findings indicate that using local examples of SD whereby humans and nature coexist could increase student understanding. Lastly, the pedagogies of Action Competence and Place-Based Education were affirmed. With the UN's 2030 Agenda showing a need for holistic education addressing social, economic and environmental issues, understanding best practices for urban ESD could help address local challenges in a changing world. In a city such as Reykjavik, using the built environment as a teaching tool could bridge the gap between urban life and Iceland's natural spaces. In U.S. cities, urban ESD could provide an alternative to Environmental Education centered around natural spaces that are growing farther and farther apart.

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## **List of abbreviations**

AC	Action Competence
EE	Environmental Education
ESD	Education for Sustainable Development
GMO	Genetically Modified Organism
IPCC	Intergovernmental Panel on Climate Change
OEE	Outdoor Educative Experience
PBE	Place-Based Education
SD	Sustainable Development
SDG's	Sustainable Development Goals
UN DESA	United Nations Department of Economic and Social Affairs

# 1 Introduction

The study described in this thesis outlines best practices for Education for Sustainable Development (ESD) in an urban context and took place in Boone, North Carolina, United States of America. It addresses how to discuss complex and controversial issues inherent within ESD and how those issues can be related to the local built environment as a teaching tool. Special attention was paid to the content and context of urban sustainability and how local challenges be used to highlight and discuss global challenges to Sustainable Development (SD).

During my bachelors' program in Environmental Studies, I became keenly aware of the challenges facing both the natural and built environment. I had spent four years and tens of thousands on an education to learn the ways in which humans interacted with (for better or worse) planet earth. I also became aware how little people understood about the problems facing our city and the ways and means with which to fix them. For my senior project, I worked with high school students teaching them about issues related to water quality. I decided to use a constructed wetlands project to teach about how humans clean grey water in much the same way as nature does. This experience provided me with the starting point for the research presented here.

In the final year of my undergraduate studies, I took a course entitled 'Sustainable Cities'. This course was an intensive look at how cities in the United States of America have and have not practiced sustainable development throughout its brief history. Although the professor considered the title of the course oxymoronic, I was intrigued by how he used his historical knowledge of Boise to introduce topics related to SD. During our long walks around the city, we visited historic buildings that were saved from the deconstruction projects of the Urban Renewal movement of the 60s and 70s (Collins & Shester, 2013). He discussed the social, economic, and environmental benefits and challenges of live/work/play infrastructure and how community identity could be used to build strong social and economic ties (Goldhagen, 2017). It was during this course that I decided to pursue a master's degree, to learn how best to introduce this concept of urban life as an experiment in ESD.

Much of the work done in traditional Environmental Education (EE) focuses attention on the problems in nature as something 'out there', as if nature and the environment is separate from humanity. Yet as we know from Kenneth Boulding's seminal work *The Economics of the Coming Spaceship Earth*, the earth is a closed system, where everything we produce, consume, and discard is kept forever within the system in some form (Boulding, 1966). And with the exception of sunlight, everything we will ever need exists on planet earth, often in abundance.

As basic as this statement is, it came as a surprise to me when I realized just how consequential this fact was and how rarely it was stated, if ever fully understood. It also struck me to see how (perhaps due to a lack of awareness of consequence), previous generations had done such a poor job at keeping the global environment, the earth, healthy and thriving for the next generation. But as Boulding states, "The structure and composition of an organization or society, however, can be maintained by inputs of fresh personnel from birth and education as the existing personnel ages and eventually dies" (Boulding, 1966, p. 3). This chance to change the status quo, to understand how to learn and discuss these challenges with my peers and future students, with all its subtext and implications, is the driving force behind this study.

This thesis consists of six chapters and three appendices. In the first chapter, I have outlined the purpose, inspiration and reason for this study.

The second chapter gives a broad overview of the environmental movement and transitions into a discussion of EE and ESD. Within this discussion, four pertinent pedagogies are explored including biomimetic learning, Place-Based Education, outdoor educative experiences and Action Competence. It ends with a real-world example of urban Sustainable Development in action.

The third chapter explains the connection between the built environment and ESD, the research questions and selected approaches, a description of the images and categories used, and the ethical concerns for this study.

In the fourth chapter, the findings of the study are presented. This includes the most common images chosen by the participants (within each category) including the rationale behind said choices. After which, the findings from the two discussion portions are outlined, including a discussion on the picture activity and the most common teaching methods suggested. It concludes with a summary of the overall findings.

A discussion of these findings is addressed in chapter 5. The findings are then used to explore potential answers to the research questions proposed. The implications and limitations of the findings are discussed, followed by recommendations for future research.

The final chapter concludes the study, outlining the research overall and its main findings and recommendations. Following the conclusion and references are three appendices. The first is a suggested workshop (based on my findings and the literature) for addressing complex and controversial topics in class. The second is a full list of the images used for this research, and the final appendix provides the picture activity card given to participants.

## 2 Review of the literature

The modern environmental movement rose to prominence in the 1960s and 70s (Woodhouse, 2014). From its beginnings as a way to promote the protection of natural landscapes, the preservation of endangered species, and reduce pollution, it has since engendered many different organizations and ideologies with a variety of aims and desired outcomes (Woodhouse, 2014). In recent years it has come to include social and economic considerations as well as environmental protection. The addition of these indicators has widened the scope of the original movement and led to a more holistic understanding of anthropocentric and ecocentric mores (Mertig & Dunlap, 2001). The balance of improving social, economic and environmental factors has come to be known as Sustainable Development (SD) which seeks to 'meet the necessities of the present generation without harming the future generation's capacity to meet their own' (Cassen, 1987). Yet in the 30 years since this well-known definition was written, SD has grown to encompass more than just human development and wellbeing.

In 2015 the United Nations General Assembly published *Transforming our World: The 2030 Agenda for Sustainable Development* (known colloquially as the 2030 Agenda) which highlights 17 Sustainable Development Goals (SDGs). These goals are comprised of 169 targets covering everything from access to education and energy to gender equality and global warming (UN DESA, 2018). Unlike the environmental movement of the past, the UN's SDG's provide governments and municipalities with broad and interdependent targets that form an extensive future outlook that includes issues of human rights, equality and morality as well as traditional environmental education such as climate change mitigation, natural resource use and land use planning as indicators of success (UN DESA, 2018).

The aim of ESD is primarily to address issues of sustainability in the local context while connecting them to larger regional, national and/or global trends (Jucker & Mathar, 2015). This process allows students, as Smith (2002) and Gruenwald (2008) argue, to interact with the world by being in it. In 2005, United Nations General Assembly declared a Decade of Education for Sustainable Development (2005-2014), the aim of which is to 'incorporate ESD into all aspects of education and learning' (Jucker & Mathar, 2015). This means a move away from traditional classroom schooling into more temporary learning environments (Jucker & Mathar, 2015).

The discussion on the difference between Environmental Education (EE) and ESD has been heavily debated (see, for example, (McKeown & Hopkins, 2003; Sterling, 2001; Tilbury, Keogh, Leighton, & Kent, 2005), yet unlike EE, ESD is regarded more of an educational ideal; one where its success or failure is in constant flux and difficult to quantify. However, simply learning *about* environmental problems in EE is not enough (see (Hart &

Nolan, 1999; Kollmuss & Agyeman, 2002; Rickinson, 2001). Unlike EE, ESD is not strictly a study of science, humans and the natural world. It takes into account social and economic factors as *well* as environmental ones. Similarly, ESD being an educational ideal means that teaching about Sustainable Development can be done in many classes, majors, or courses. Unlike EE which is most often taught in science courses, the onus is shared among many teachers in many disciplines. By utilizing the holistic nature of the UN's SDGs, teachers are more able to discuss and implement the study of SD into a wider variety of disciplines. The SDG's for example can be used to discuss equity and human rights in areas such as economics, political science, geography, history, and social studies. The holistic nature of this educational ideal connects students to all aspects of human flourishing and sustainability, which is necessary to address the challenges future generations will likely face (Martin, Dillon, Higgins, Strachan, & Vare, 2014). In regards to the built environment (and as I will discuss in later chapters), these challenges include issues in urban ecology, energy, municipal waste and transportation. For now however, I will focus on providing the reader with an overview of ESD, give reason for its necessity, and explore different ways educators have implemented the practices of ESD into the classroom and beyond.

## 2.1 Education for Sustainable Development, Necessity and Current Status

Inherent within ESD is a social learning process whereby students are encouraged to determine the value of natural resources, social structures, and community stability; one where the current state of affairs can be compared and contrasted with future desired outcomes (Jucker & Mathar, 2015). As a case study in the Netherlands suggests, moral reasoning can be applied in ESD in order for learners to come to conclusions and/or propose solutions to controversial issues. These issues can range in severity and scope, yet solving them often requires in depth understanding of actors, motivations, and consequences, both good and bad, of any action that is taken. Researcher Helen Kopnina found that by using vignettes related to ESD, school children were able to think critically about moral dilemmas, and distinguish between a variety of values related to the environment (Kopnina, 2014). This research proposes that ESD can be beneficial in introducing students to multiple viewpoints related to the valuation of natural resources as well as promoting pluralistic democratic learning outcomes (Kopnina, 2014). Providing students with an opportunity to learn about the complexity and hindrances to human flourishing is a significant challenge, yet has grown increasingly important as we make the transition to a more sustainable future.

With the continued threat of global climate change comes a need to educate the public on the need for a transition to a low carbon future (IPCC, 2018). The move towards a clean energy economy will help not only to curb environmental degradation, but the associated social threats such as forced migration, drought, natural disasters and food insecurity (Berchin, Valduga, Garcia, & de Andrade Guerra, 2017; Piguet, De Guchteneire, & Pécoud, 2011). Curbing this threat is undoubtedly a massive undertaking, one that requires an understanding of the social, economic and environmental factors at play within each problem area such as energy and infrastructure development as well as the potential barriers to successful implementation of any proposed policies aimed at solving the issue itself. Similarly, engaging these future stakeholders about the need for renewable energy and green building development provides an opportunity to discuss the political, economic and social factors therein (Ulubeyli & Kazanci, 2018).

Between 2005–2014 the United Nations initiated the International Decade for Education for Sustainable Development. This global effort “sought to bring to the fore the need for politicians, policy-makers and practitioners to seek ways by which ESD can become part of the fabric of formal and informal education” (Robertson, 2012, p. viii).

In the Summary for Policymakers, the Intergovernmental Panel on Climate Change (IPCC) report outlines that the risks associated with climate change are projected to affect all aspects of human flourishing including economic instability, public health, water supply, and disproportionately affect vulnerable and coastal populations (IPCC, 2018). One solution to this problem is to develop ESD aimed at informing students of these issues and engaging them in the search for possible solutions. Finding solutions, however, requires an understanding of the issues as well as real world understanding of both sustainable and unsustainable practices. With the majority of the world population living in cities, access to natural spaces that students can learn from and in are growing further and further apart.

By the year 2050, 75% of the world's population is projected to live in cities with 75% of global CO<sub>2</sub> emissions currently being produced by cities (Burdett & Sudjic, 2011). With urbanization playing an ever-increasing role in global climate change, urban students engaged with ESD can develop a critical eye and a more holistic understanding of the dilemmas therein (Kopnina, 2014).

A recent study from Spain found that awareness of the connection between the three dimensions of sustainability remains low, with teachers unable to develop holistic ESD with many citing the environmental aspect of sustainable development as a troublesome connection to make (Valderrama-Hernández, Alcántara, & Limón, 2017). A similar study found that although educators believed ESD should be more integrated into the curriculum, implementation into the existing paradigm varied largely, and awareness of how to do so was low as well (Sinakou, Pauw, Goossens, & Van Petegem, 2018).

The disconnection between the current educational systems and ESD has led many researchers to develop frameworks aimed at addressing the need for concrete metrics for successful ESD implementation (Faham, Rezvanfar, Mohammadi, & Nohooji, 2017; Freidenfelds, Kalnins, & Gusca, 2018). Freidenfelds et al. (2018) research outlines the need for connections between educators, students, policy, community and governments, and parrots the difficulties expressed above. Fahams et al. (2017) research recommends raising awareness of environmental issues to students by outlining the related policy decisions and the behaviour change necessary for effective sustainable development. With a need for large scale systemic change, this research suggests that providing students with the opportunity for real world understanding of and impediments to SD is critical for a sustainable future, yet our current model of traditional education is unable to provide the connectivity necessary for this change to take place. The job of educators is therefore to provide a place for students to explore this space and their place in it, to provide as Dewey argues, a quality experience that can be used to inform the students decisions moving forward (Dewey, 1966).

## 2.2 Four approaches to ESD

In their work, *Learning for a Change: Exploring the Relationship Between Education and Sustainable Development*, authors Paul Vare and William Scott outline two basic approaches that have been taken when teaching ESD; ESD 1 and ESD 2. The former is focused on informing students of an issue related to SD and provides them with possible solutions to solve them. ESD1 also highlights the social and political problems that produce the symptoms in the first place. The latter is concentrated on promoting critical thinking about the issues and looks at questions and contradictions that exist in sustainable development. ESD 2 also highlights the need for educating students about the ongoing nature and development of ESD itself (Vare & Scott, 2007). As outlined above, Fahams et al. (2017) research focuses on raising awareness and is typical of ESD 1, whereas Freidenfelds et al. (2018) research stresses the need for critical and constantly evolving thinking and is suggestive of ESD 2. These two methods are not necessarily clear divisions in regards to pedagogy, but trends the authors found within the ESD literature and among those that teach it. In the context of studying the best practices for ESD in an urban context, the policy changes necessary for sustainable cities require citizens to engage with stakeholders and the voting public, and understand complex governmental and social frameworks. It also requires an understanding of tradeoffs and negative externalities. Whether they are business owners, public servants or private citizens, ESD taught in an urban setting should set students up for success for promoting and implementing sustainable practices within their communities.

Given the transitory nature of social, economic and environmental systems, the authors (Vare & Scott, 2007) recommend blending the the aspects of ESD 1 and 2, forming a yes/and approach when teaching. This practice gives educators and students the freedom to understand what the problem is, how we got here, and what individual and social changes are necessary to solve them. It allows students the freedom to explore the facts, build on existing knowledge, and aids in developing an educative experience, one that can be reflected upon moving forward. This type of systems based critical thinking is aimed at student participation within in the learning process and in this context, the process of finding solutions to issues within cities. Lastly, this yes/and approach is useful in helping students discover their own agency within the context of their community, as well as the global community at large (Jucker & Mathar, 2015; Smith, 2002; Vare & Scott, 2007).

Next, we will explore four approaches ESD (in no particular order) and their connections to ESD 1 and 2. Among them are biomimetic learning, Place-Based Education, outdoor educative experience, and Action Competence. We will explore their strengths and weaknesses as well as their ability to be used to discuss ESD in an urban context.

### 2.2.1 Biomimetic learning

Dr. Philip Reed of Old Dominion University in Virginia has written extensively on how to connect students to the natural and built environments. By studying biomimicry and bioprospecting, students are able to see not only how reliant we are on environmental systems, but on other organisms as well (P. Reed, 2004, 2005). Biomimicry and bioprospecting are studies of how humans can and do mimic nature in building an development and how humans use extant organisms to make our lives better and more sustainable. He offers teachers guides and activities aimed at helping students develop their understanding of economic, social, and environmental challenges that engage them in the search for solutions. These solutions include using waste as a resource, gathering and using energy efficiently, and favouring optimization rather than maximization (P. Reed, 2004). As students become engaged with the material and learn about how humans can and do use nature as a building block, they are challenged with a problem and asked to use some aspect of the natural world to confront and solve the issue. Examples include rain shelters in the shape of leaves and manufacturing adhesives naturally found in sea life. This practice uses nature as both a model and a mentor for a more sustainable future.

The study of biomimicry has led some researchers to develop a curriculum based on “an imitation of or inspiration from the natural world” (Tavsan, Tavsan, & Sonmez, 2015, p. 491). Due to the environmental and economic costs of building infrastructure, architectural

design students in Turkey were given the task of creating a project based on naturally occurring structures such as turtle shells or termite mounds. The study concluded that this method of biomimetic learning increased student interest, wonder, and motivation as well as helped students connect concepts that may have otherwise been overlooked (Tavsan et al., 2015). Work such as this gives educators and students alike the ability to connect with the environmental, social, and economic benefits of sustainable development. Due to its ability to draw examples directly from the natural world and implement them in the built environment, biomimetic learning offers educators the chance to highlight issues within as well as solutions to sustainability problems. This style of learning also promotes critical thinking and emphasizes the need to develop better and carefully considered infrastructure. As a result, biomimetic learning has aspects of both ESD 1 and 2, is a possible best practice for urban ESD. However due to the science based nature of this learning style, its applicability to other coursework outside of science curriculum may be lacking.

### 2.2.2 Place-Based Education

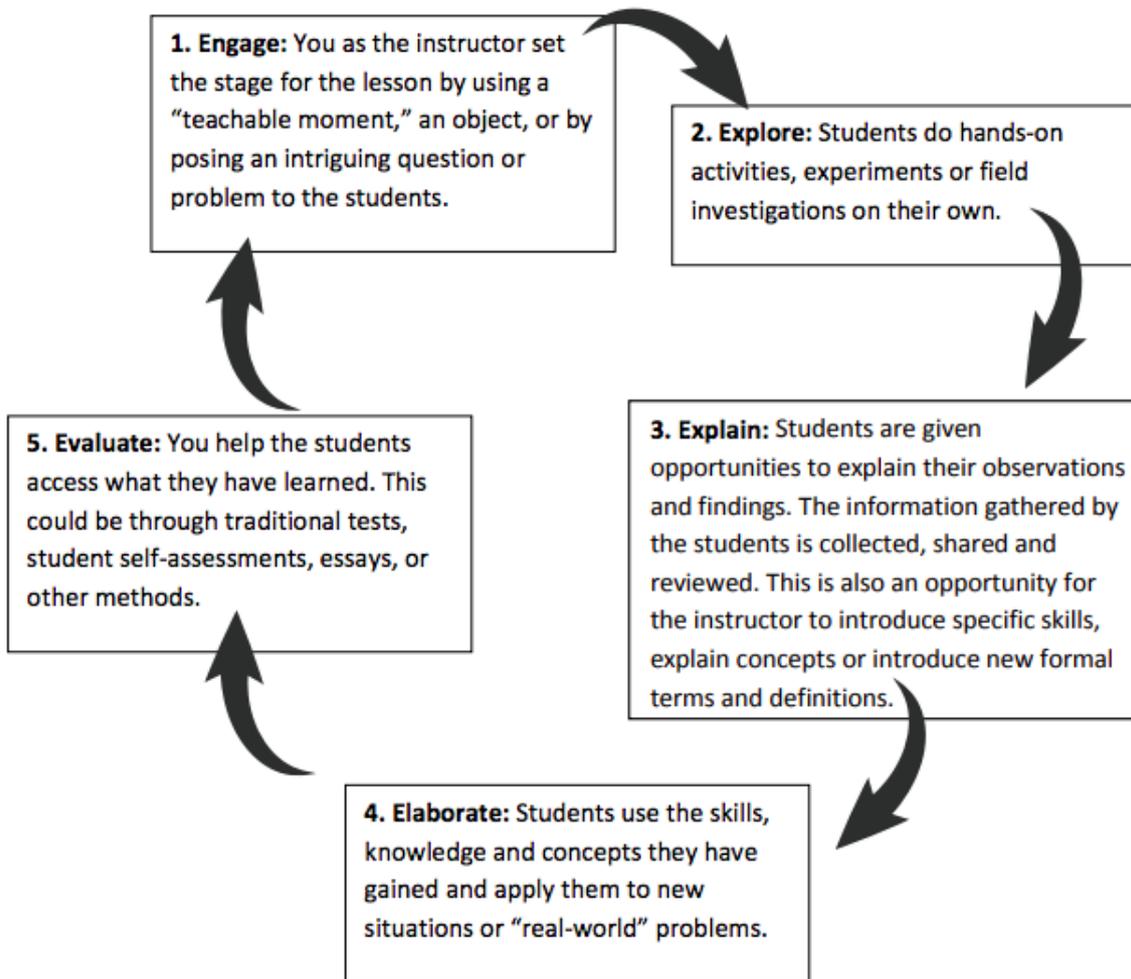
With the rise in global urbanization, students are increasingly being raised and taught in cities and urban environments, far from natural landscapes used to educate them about environmental systems. As mentioned, educators have a difficult time teaching students about the environmental aspects of sustainable development (Faham et al., 2017; Freidenfelds et al., 2018). One proposed solution is known as Place-Based Education (PBE) (Smith, 2002). In *Place-Based Education: Learning to Be Where We Are*, Gregory Smith argues for a move away from the traditional models of education, and to engage students with the land by being on it. He states that, “An investigation of local natural phenomena can have comparable benefits and serve as the foundation on which investigations of more distant or abstract phenomena can be constructed” (Smith, 2002, p. 588). As the educational theorist John Dewey argues, knowledge gained through experience “influences the formation of attitudes of desire and purpose” (Dewey, 1966, p. 39) and allows educators the ability to use aspects of the built environment to illustrate to students how human activities affect the social and physical world around them. In this way, PBE helps students and educators address real-world problems and find real-world solutions to those problems. PBE is focused on bringing students out of the classroom and into the world. It asks students to engage with their community and discuss where and how it could be improved. Similarly, it is able to highlight the ongoing need to develop better ways of living. For these reasons, PBE also contains elements of both ESD 1 and 2. However, depending on the location and resources within a particular school, a study of what is outside could be limited. If the area in question has limited access to transportation, public services or natural spaces, learning about the

inequalities inherent within school districts and communities could lead to a mis-educative experience, one where student interest in the subject is stymied.

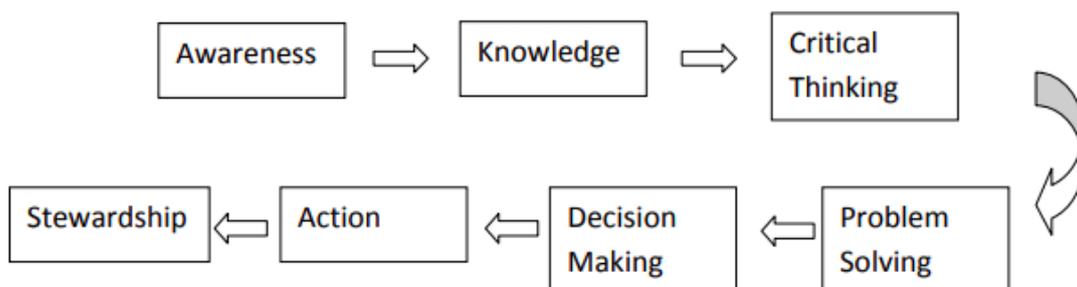
With the need to develop holistic ESD becoming increasingly important, educational insights such as biomimicry and PBE can influence the way we approach the topic, giving educators and students alike the ability to see beyond traditional modes and help connect us to the environmental, social, and economic aspects of sustainable development. In regards to urban ESD, PBE also provides educators from multiple disciplines the opportunity to break away from traditional modes of education, using local places as a teaching tool and providing the guidance and direction necessary for a more sustainable city.

### 2.2.3 Outdoor educative experiences and ESD

Writings and studies about engaging students with an ecological 'sense of place' often focuses on outdoor and nature based education as a means to teach sustainability practices (see, for example, (Loynes, 2002; Nicol, 2003; Smith, 2002; Wattchow & Brown, 2011; Williams, 2012). Recently, urban educators face challenges connecting the three aspects of sustainable development, with the environmental dimension being the most challenging (Faham et al., 2017; Freidenfelds et al., 2018). To remedy this, some educators have ventured to bring students out of the school building and into the natural environment. The EnviroSchools Program in New Zealand has had great success and has been recognized by researchers and the community to be "comprehensive, both for the educational needs of students and the delivering of sustainability-focused initiatives into families and their communities" (Williams, 2012, p. 39). This program aims to give students outdoor educative experiences (OEE) and experiential learning opportunities whereby educators plan an experience based on the natural and man-made environments in and outside the classroom in order to teach students about how humans, natural ecosystems, biodiversity and geography interact. To give another example, the Environmental Educators of North Carolina (EENC) offers training courses for employees of the North Carolina State Parks Service. There, educators learn how to talk with students and visitors about the parks flora, fauna and landforms in a way that promotes inquiry and understanding. To facilitate this, the educators are taught how to employ the 5E Learning Cycle and the environmental education learning process (Figures 1 and 2) when developing curriculum. The aim of these resources is not only to promote understanding and critical thinking of the material among students and participants, but to ultimately develop a sense of stewardship and action among them. The process leads from engagement and awareness of an issue to ownership of and positive action towards solving it. These figures, an in depth explanation of them, and their relevance to urban ESD are discussed below.



**Figure 1 The 5E Learning Cycle, outlined by the North Carolina Department of Environmental Quality (Office of Environmental Education and Public Affairs, 2018)**



**Figure 2 The environmental education learning process, outlined by the North Carolina Department of Environmental Quality (Office of Environmental Education and Public Affairs, 2018)**

By teaching and employing these lessons into ESD, educators can learn that awareness of and engagement in an issue regarding sustainability is the first and most crucial step to discussing SD practices. Without it, students may be unable to connect with or care about the issue in question. Only after students have conceptualized the the problem can they move onto exploring their knowledge and interests regarding it. This exploratory step provides students with an opportunity to engage directly with the natural or built environments and discover questions they may have or problems they see. In any outdoor educative experience, the job of the educator is to facilitate experiential learning through elements of the environment that are already at hand. After the knowledge building and exploratory steps, students are asked to think critically and explain what they have discovered. This step allows educators the opportunity to gauge the level of understanding the students have regarding the material or issue as well as introduce new ideas into the equation that may be relevant later on. Once the student has found, explored, and explained their interest with the material, they are asked to extrapolate that information into the real world or into another context. In other words, they are asked to break the material down to its base components and use that information to make a hypothesis about a similar phenomenon elsewhere. (It is worth noting here that direct engagement with and experience in the world around them is crucial to the later stages of critical thinking). Finally, the students are asked to make decisions regarding the material which may include testing, projects, etc. after which some call to action can be made by the educator. With the knowledge, critical thinking, problem solving and decision making complete, the final destination is stewardship.

In a class focused on how nature forms a circular economy, this call to action and stewardship could be leaning to use waste as a resource or gathering and using energy efficiently (P. Reed, 2004). In a class on carbon emissions and climate change, the action and stewardship could be a willingness to adopt greener modes of transportation. Although this type of response is not by any means guaranteed using this method, allowing students the time and space to discover the issue and their place, in what Dewey refers to as fact-based comprehension through meta-cognition, is at the heart of outdoor educative experiences (Dewey, 1966). In essence, this type of place-based educative experience focuses on the learner's experience with their surroundings and considers that "learning cannot be considered separate from their embodied interactions and connections with the place" (Wattchow & Brown, 2011, p. 73).

In relation to ESD 1 and 2, it is easy to see that OEE not only highlights but organizes many facets from both practices, namely awareness of an issue, promotion of critical thinking, and observing the ongoing nature of sustainability. It does not however provide the students with possible solutions or introduce social or political elements, but instead asks them to think critically, discuss different factors and find solutions for themselves. In sum,

OEE offers ESD a foundation for meaningful discussion and critical thinking regarding urban sustainability issues.

#### 2.2.4 Action Competence Education and ESD

The concept of Action Competence (AC) was first introduced in Denmark in the 1980s (Mogensen & Schnack, 2010). It stresses the need for students and teachers to not only be aware of environmental and social issues but be a part of the solution to them. As its namesake suggests, this pedagogy stresses the need not only for action but an understanding of the competencies necessary to make that action effective. AC attempts to address ESD holistically by regarding environmental and social issues as problems to be solved, where conflicting interests are often at stake (Mogensen & Schnack, 2010). This is very relevant to urban ESD where social and political pressures could conflict with sustainability initiatives.

Much like ESD, AC seeks to establish the relationship between both the environment and human health and wellbeing. For city dwellers, this relationship could be energy development and production and pollution of the air or degradation of natural resources. In this way, it differs from more traditional Environmental Education as a study of nature outside of humanity and is, therefore, more closely related to ESD. AC encourages students and teachers to work together to find solutions to issues of sustainability while taking into account pertinent and delimiting factors within the society they wish to amend. Due to its nature as an educational ideal, AC offers little in the way of guidance for how to deal with these complex problems and relies instead on the ability of the educators and students to explore them together.

Due to the constantly changing social, environmental and economic landscape, the needs of any given community will likely change. Students of AC and ESD are encouraged to see the world as a changing and developing place, where the needs of one community must be understood within the context of that community. Therefore, by developing best practices for ESD in the built environment, students will be “working with indicators in a way which focuses on quality enhancement rather than control ... reducing the gap between ideology and reality in relation to ESD” (Mogensen & Schnack, 2010, p. 109). A positive consequence of ACs nature is that it encompasses many aspects of both ESD 1 and 2, bringing awareness to an issue while simultaneously considering the far reaching effects of system change.

## 2.3 Greyfields as an example of ESD in Action

Using cities as a starting point for ESD has the potential to inform students about the challenges and potential for large scale change in the most densely populated places on the planet, providing students with a look into an otherwise overlooked aspect of human development. By using the built environment as a lens with which to see a sustainable future, underutilized spaces or blighted neighborhoods can be seen for their potential for sustainable development such as urban renewal projects or community gardens and green spaces. By highlighting the social aspect of SD, the built environment may also give educators the ability to highlight ways in which people have improved their communities using political power or grassroots movements. Similarly, by highlighting the economics of city development, educators can discuss SD in a more holistic light.

According to the Congress for New Urbanism (CNU), new urbanism is an urban design movement that stresses the need for environmentally friendly development and/or redevelopment of urban areas (CNU, 2001). According to their Charter, CNU works for redevelopment that promotes walkability, economic growth, mixed-income housing, and equal access to products, services, and transportation (CNU, 2001). These metrics and indicators are similar, indeed, to the Sustainable Development Goals outlined in the 2030 Agenda.

In the article “Greyfield Malls: A National Problem”, the CNU highlights what are known as greyfield sites. These are often dilapidated urban or suburban shopping malls located in established neighborhoods. Once popular fixtures of the American landscape, these areas are often economically stagnant and are an unsustainable development to the surrounding areas, offering fewer economic opportunities than when they were first built. While many towns and cities have neighborhoods and buildings that are underserved or underutilized, the size, location and prevalence of these rundown shopping malls offer a unique opportunity for city planners and sustainable development advocates to put the principle ideas of ESD into action in an urban setting.

In the United States, obsolete shopping malls “dot the American cityscape... [and] finding them doesn’t require much expertise.” (CNU, 2001, p. 1). These areas are often located near interstate off ramps and have an average size of +/- 45 acres. The same report identifies over 200 malls in the U.S. that are vulnerable of becoming greyfield sites (CNU, 2001). By reimagining existing infrastructure, reinvestment into these buildings can support sustainable development goals by addressing urban blight and poverty, bolstering underserved populations as well as providing new housing and retail space in well-established neighbourhoods.

Using sustainable city and urban design models, the CNU offers a look into how the principles sustainable development can be used to as a tool to educate and invigorate communities and classrooms and encourage the new generation to look at both the natural and built environments as a dynamic and ever-evolving landscape.

Sustainable efforts and actions such as these provide an educational opportunity with which to discuss not only the concepts of sustainable development but barriers to implementation such as governmental challenges or public opinion that can affect a turn towards a sustainable future. The movement away from (and the subsequent abandonment of) large shopping centers opens up the opportunity to turn these spaces into social and economic hubs for already established and often dwindling neighborhoods, taking a once prolific part of the American city and giving it a new life as a multi-use and mixed-income housing and business district. Within this model of reduced building costs, reusing existing infrastructure, and recovering economic and social capital is the opportunity highlight ESD in the classroom and community, as well as help fulfill goal 9 of the UN's Sustainable Development Goals which highlights the need for sustainable development in industry, innovation and infrastructure (UNGA, 2015).

## 2.4 Summary

The implementation of ESD varies widely by country, as programs seek to be both locally relevant and culturally appropriate (McKeown & Nolet, 2012). Yet with increasing global sustainability issues comes a need to understand and address issues relevant to the local community (M. S. Reed, Fraser, & Dougill, 2006). Although pedagogical approaches such as biomimetic learning (P. Reed, 2004, 2005), Place-Based Education (Smith, 2002), outdoor educative experience (Dewey, 1966; Wattchow & Brown, 2011) and Action Competence (Jensen & Schnack, 1994) are useful in defining how one should seek to engage students with the natural environment and encourage action, they are unable to define what and how ESD could approach regional topics useful in illustrating issues and facilitate discussions related to sustainability in the local built environment. Although the indicators and metrics are useful for gauging student and community engagement with the topic, they are unable to give educators insight into what issues are most relevant or useful for a particular community to tackle.

In order to determine the best practices for ESD in an urban setting, the ideas, advice and understanding of those invested in the community should be gathered. As shown, there are many different ways to implement ESD including biomimetic learning, Place-Based Education, outdoor educative experience and Action Competence. While all of these approaches have significant benefits for student learning and urban ESD, no single approach

can adequately outline the ways in which urban educators can use elements of the built environment to discuss and address issues related to Sustainable Development. Similarly, they do not specifically address how to discuss complex or complicated topics inherent within SD.

Through this review of the literature it has become apparent that existing pedagogies provide educators with valuable insights into both the challenges present in and competencies necessary for effective ESD. First and foremost, students must be engaged with the material. They cannot be expected to care about something they have no experience with, even if that something is the sustainability of the earth. Bringing awareness to and providing opportunity for understanding of the issue itself is the first step to effective ESD. In studying biomimetic learning, we saw that using the natural world as both a mentor and a metric can aid in student engagement (P. Reed, 2004; Tavsan et al., 2015). As OEE suggests, this learning should be facilitated but not directed by the educator themselves. The student is, in a sense, responsible for their own learning outcomes. The objective of the educator is to provide a platform of guidance and support from which the student can freely and openly question and engage with the material. In studying PBE and the EnviroSchool Program, we learned that using the environment surrounding the student can foster a locally relevant experience that can then be used to explore more distant and abstract phenomena and can benefit not only the students but their families and communities as well (Williams, 2012). This process of discovery is then bolstered by the addition of Action Competence which highlights the need for students and educators to work together, taking into account social and environmental mores. Yet the challenge of how to discuss complex and controversial topics inherent within ESD remains.

This research seeks to give insight to educators on how to address complex and controversial problems within ESD, and how those issues can be related to the local built environment and the challenges therein. As mentioned, research indicates that locally relevant environmental education is effective in promoting holistic ESD (Williams, 2012). To my knowledge, no study has been found that discusses how to holistically approach ESD for urban students. Although the specifics of any ESD curriculum should be based on the needs and issues within the community, this research serves as a proverbial diving board, illustrating ways and ideas that may make the implementation of ESD more effective in an urban setting.



### 3 Methodology

The purpose of this study is twofold. First, to understand how educators and students best address and discuss complex issues inherent with ESD and second, how those issues can be connected to the local built environment for use as a teaching tool in ESD. The former provides a framework with which to discuss the latter. By understanding the best practices for discussing complex concepts, educators can use this framework of best practices to inform the way the local built environment and ESD can be used as both an exploration of and a study in SD. For this study, I chose to learn about these concepts and urban ESD from undergraduate students and their professors who were familiar with SD. This was done as a practical matter because of my access to the faculty and student body at Appalachian State University as well as their ability to discuss ideas related to ESD and their experience with it.

In this chapter, I outline how my research interests are both practical for ESD in general and if successful, provide educators with some guiding principles for how to teach ESD in an urban context by using the local built environment as a teaching tool. I then outline my research questions and the methodology chosen to provide answers to those questions. Next, I discuss my choice of categories and images used within the research. It concludes with a discussion of the ethical concerns therein.

#### 3.1 Linking the built environment and ESD

Currently, over half the world's population lives in a city with that number expected to reach 60% by 2030 (UN DESA, 2016). With increasing urbanization unlikely to subside, there is a growing need to address issues such as the challenges of energy equity (Satterthwaite, 2009), the social and economic injustices of pollution and waste (The L. P. H., 2018), and access to reliable and clean forms of transportation (Maibach, Steg, & Anable, 2009). Although addressing any one of these issues is a monumental challenge, they are problems that must be addressed if we are to meet the 17 Sustainable Development Goals (SDG's) set out by the U.N. (UN DESA, 2018). Similarly, these issues illustrate the challenges and controversial topics that educators must discuss and engage students with when discussing SD and the built environment. With the future of our world unknown, preparing students with the tools necessary to advance sustainable development goals is paramount to a healthy and thriving planet.

## 3.2 The research questions and selected approaches

Understanding how to effectively discuss the challenges of ESD with urban students and the local relevance of those challenges requires an understanding of two different but equally important factors. First, what aspects of the local built environment are most useful for student engagement and how can a discussion or coursework regarding SD be most effectively implemented? To answer this, this research seeks to answer two main questions, each with its own subquestions.

1. What are the best practices for discussing ESD in an urban context?
  - a. How can the content and context of the local built environment be used to discuss issues of sustainability?
  - b. How, if at all, could local sustainability issues be effectively used to discuss global challenges in SD?
2. How can educators who work in an urban context best discuss issues of sustainability with their students?
  - a. What methods or teaching tools seem to be the most helpful when discussing complex and/or controversial topics?
  - b. From the perspective of students and teachers, what should be the main elements of course that teaches urban ESD?

In the first question, the focus is on developing a basic framework for ESD in the built environment by understanding what features of urban life can be used to discuss SD. This requires an understanding of what sort of elements within urban life could be engaging for students as well as relevant for that location. By shifting the focus from classroom to the community, local sustainability issues become a possible teaching tool. This question seeks to answer what those tools are specifically and how addressing them could lead to a discussion of more global challenges.

Once the elements of urban ESD have been established, the second question seeks to understand how to discuss them effectively. In other words, how can these complex and controversial issues be discussed in an impactful way and what elements should a class on urban ESD have?

Answering these questions requires specific knowledge about what aspects of the built environment provide the richest vein for discussion, as well as what methods educators and students find the most helpful when talking about challenging and controversial topics. In order to uncover both statistical trends in what aspects of the built environment are most likely to produce fruitful discussion, as well as the teaching methods that are most recommended for said discussion, a qualitative methodology was needed. By asking

participants to select images that encapsulate sustainability in the built environment and by discussing their experiences with difficult and complex subjects, this mixed methods approach informs the research with both a broad and deep understanding of an issue (Almalki, 2016).

It was decided, therefore, to develop a research methodology that would provide the necessary qualitative data. By carrying out focus group interviews and individual interviews, and allowing all participants to numerically select images and provide feedback to the research questions, I would be able to analyze both numeric and dialectic trends in image preferences, as well as understand what types of teaching tools worked best when discussing complex issues. Lastly, by understanding what type of conversation and classes students and teachers prefer and utilizing the knowledge gained from the literature, we can begin to see what elements and organization are needed to form a workshop, seminar or class regarding urban ESD.

Next, I will discuss the methods used for the focus groups and individual interviews as well as the selection of images and SD categories used therein.

### 3.2.1 Focus group and individual interviews

In mid January, a pilot focus group was held with two co-workers. The aim was to do a dry run to work out the kinks as well as ask for feedback on the questions and activity. During this test I discovered that the script I had prepared was much too long. Participants wanted the discussion to begin quickly after the introduction.

In the original script, participants were asked what teaching tools specifically were most effective when discussing complex/controversial topics. These included video/audio programs, group projects, and experiments. Often times participants could not think of a specific case where those tools were used, but instead offered their own suggestions. Due to this, it was decided to simply name off the options and allow participants the freedom to respond how they wished. The pilot taught me to ask broadly speaking of a time when a controversial issue was discussed effectively and how that conversation was facilitated. This provided both the context and content by answering what was discussed and how. Overall, changes made after the pilot were minor and data from the pilot was not included in this research.

Three focus group interviews and two individual interviews were conducted in February of 2019. Each of the focus groups contained 3-4 individuals. Combined with the individual interviews, a total of 12 participants were consulted. One group was made up of college professors and two groups were made up of undergraduate students. Both individual

interviews were conducted with professors. All participants were current faculty or students at Appalachian State University (ASU) in Boone, North Carolina, USA.

Professorial participants were selected from a wide variety of relevant departments and/or had research interests in connection to the Sustainable Development Goals and ESD. This mix was done to ensure a wide variety of viewpoints and opinions, and to gather data on different teaching styles and approaches. These departments included Biology, Sustainable Development, Geography and Planning, Sustainable Technology and the Built Environment, and the Department of Outdoor Recreation Management.

After a list of professors from these departments was gathered, they were emailed and asked to participate. Professors who agreed were sent relevant information on the time and place of the meeting.

Student participants were asked from an urban planning class taught by a professor who participated in the focus group themselves. This was done to increase the likelihood that the students involved would be familiar with SD, and be able to use the professor's experience and willingness to participate as a starting point for the discussion. Before the class began, a brief introduction along with a short description of the research question was given to the students, after which a signup sheet was passed around for interested students to sign up. In total, six students signed up from four different majors.

All interviews were recorded and divided into two parts: (1) an activity section and (2) a discussion section. At the beginning of each focus group, participants were asked for permission to record the conversation, promised anonymity, and asked to provide their department and/or major, research interests, where they were brought up, and what Sustainable Development meant to them. This was done to understand the background of the participants as well as what each participant believed or understood about Sustainable Development. Similarly, this provided the group with a starting point for the following activity and in-depth discussion.

For the activity section, each focus group was shown 40 images, broken up into four distinct categories: energy, urban ecology, transportation, and municipal waste. (The reasons for these categories and the argument for the selection of the images chosen is discussed in sections 3.3.1 and 3.3.2). Each category contained 10 images for a total of 40 images. Participants were asked to select three images from each category that they believe could best be used to discuss SD either with their students (in the case of the professors) or with their peers. Participants were then asked to select one image from each category (from the three previously selected) and write a short description of why they chose that particular image. The result being 12 images selected by each participant with four corresponding answers.

For the activity discussion portion, participants were asked a series of questions about why they chose their images. Questions included, “What were some common themes you found when picking your images?” and “As a teacher (or student), what aspects of the images did you attract to?”. The purpose of these questions was twofold. First, to give the participants a chance to speak at length about their choices and further their thoughts, and second, to encourage them to condense what aspects of the images were most important or compelling to them.

Next, participants were asked to go around the table and discuss a time when a controversial issue or complicated concept was discussed in class and describe what kind of teaching tools were used. Participants were given suggestions as to what these might be such as video/audio programs, field exercises, city tours, group projects, and classroom experiments. Due to the complex and controversial nature of SD, this question was used to determine what type of teaching tools worked best/were most memorable when discussing complicated subject matter. And finally, participants were asked, “How, if at all, was this issue or concept compared to another context?”. This final question gave participants the ability to dive into an important aspect of ESD; The ability to discuss how local issues are reflected within the global community (Jucker & Mathar, 2015). Similarly, this question was essential in providing this research with information about the best practices for how to discuss and connect local challenges with more global ones. Following this discussion, participants were thanked for their time and perspective and asked if they had any follow-up questions for me or about the research in general.

### 3.3.1 The selection of four categories

For this study, I proposed the use of four categories which, when addressed in the context of ESD, address eight of the 17 UN SDG's. These categories include energy, urban ecology, transportation, and municipal waste. Using the images instead of the real built environment allowed me to get feedback on a wide variety of topics, ideas and places. Similarly, it allowed me to answer questions regarding educating students about the SDGs, which cover more concepts and considerations than any single town or city could provide on its own. Table 1 outlines the categories chosen for this study and their corresponding SDG's.

**Table 1 Four categories used and their corresponding SDG's**

Urban Ecology	Energy	Municipal Waste	Transportation
 <p><b>15</b> LIFE ON LAND</p>	 <p><b>7</b> AFFORDABLE AND CLEAN ENERGY</p>	 <p><b>12</b> RESPONSIBLE CONSUMPTION AND PRODUCTION</p>	 <p><b>9</b> INDUSTRY, INNOVATION AND INFRASTRUCTURE</p>
 <p><b>11</b> SUSTAINABLE CITIES AND COMMUNITIES</p>	 <p><b>13</b> CLIMATE ACTION</p>	 <p><b>6</b> CLEAN WATER AND SANITATION</p>	 <p><b>3</b> GOOD HEALTH AND WELL-BEING</p>

When trying to decide which aspects of SD to focus on, it is helpful to understand the connectivity of the SDGs and their connection to urban life. Although no single curriculum, class, or study could adequately address the in's and out's of all 17 SDGs, addressing some of them in four distinct categories gave me a place to start. Furthermore, by investing time, money, education and effort into one SDG, the result could have a positive impact on others. For example, if a community invests in renovating and repurposing an industrial block into affordable housing or collaborative office space, the community could be addressing SDG's 12, 9 and 11 (shown above) as well as Goal 8 (decent work and economic growth) and/or Goal 10 (reduced inequalities). As shown above, the categories of energy, urban ecology, transportation and municipal waste can be used to highlight and address at least eight SDGs. By studying participants perception of urban sustainability through these lenses, educators can choose which goals and categories to discuss while providing freedom and

example to explore the connectivity of urban sustainable development and the SDG's more generally.

Climate change has been deemed as the biggest threat to the health and wellbeing of our current generation (IPCC, 2019), therefore understanding and discussing renewable and low carbon energy options in relation to ESD was imperative in this research. And although increasing urban ecology and green space is not as imperative for reducing global temperatures as reducing CO<sub>2</sub> emissions, studies in the effect of urban heat islands (UHI) and associated local temperature rises have shown that increasing urban vegetation is necessary to reduce the UHI effect and can contribute to more sustainable cities (Maimaitiyiming et al., 2014).

According to the IPCC, global emissions from the transportation sector have more than doubled since 1970. From that, 80% of this increase was due to road vehicles, and 40% of that was from urban transportation (Edenhofer, 2014). Similarly, air pollution from this increased transportation can negatively affect urban populations, with poor and young populations showing increased exposure to, and negative health effects from said pollutants (Houston, Wu, Ong, & Winer, 2004; Silverman & Ito, 2010). Discussing urban mobility and transportation was, therefore, key to understanding the best practices for ESD in an urban setting.

Proper disposal of and reductions in municipal waste is critical for a sustainable community (den Boer & Den Boer, 2005; Rigamonti, Sterpi, & Grosso, 2016; Roeleveld, Klapwijk, Eggels, Rulkens, & van Starckenburg, 1997). Whether this is wastewater or drinking water that must be treated or solid waste that can be buried, burned or recycled, understanding the role consumption and production has on the built and natural environment is key to fulfilling Goals 6 and 12 and of the SDG's and contributes to a holistic understanding of urban ESD.

### 3.3.2 The selection of 40 images

In order to understand the degree to which these topics can be used to discuss ESD, 10 photos were compiled to represent each category (40 in total) that highlighted different challenges of SD in the built environment. The images were chosen based on their ability to highlight some aspect of the built environment and/or issues related to sustainability. This includes but is not limited to (as discussed in 3.3.1), urban ecology, energy, municipal waste and transportation.

While providing participants with a broad selection of images to choose from was important, images were not chosen in any particular order. Images were to be bright, eye-

catching, and generally contain a multitude of aspects to draw in the participants' attention. This means that the location and age of the photos are often unknown.

The website [unsplash.com](https://unsplash.com) was used as a search engine for all images. This provided me with free access to a large range of high-quality photos. Next, because this webpage is a curated search engine for photographers, results from a search of, say 'municipal waste' would not always produce a wealth of relevant content. It was, therefore, necessary to try many different search terms (not necessarily related to waste), giving the images a diversity in both content and scope. While some images are close-ups of one aspect related to SD in the built environment (such as overflowing trash bags), others show a larger scale effort to reduce or dispose of waste.

Images related to energy proved difficult to find. In order to show as many sides as possible, I selected images that showed large scale energy generation such as dams, solar arrays, and traditional coal-fired power plants, as well as city skylines at night and smaller scale energy production for individual homes or communities.

While energy, municipal waste, transportation, and urban ecology are challenging topics to cover in photographs, the results and comments from participants showed trends in preference for all categories but one. (For a full list of the images used and their corresponding numbers, see Appendix III)

### 3.3 Ethical concerns

Undergoing any type of research can pose ethical concerns for both the researcher(s) and participants involved. When dealing with personal information or the ideas and input of participants, one must be careful to represent, to the best of their ability, the thoughts, feelings, and emotions of those who choose to participate. Similarly, when there are concerns as to the ethical nature of how information was gathered and disseminated, all the ways and means used to obtain that information must be stated plainly.

In order to encourage participation in the focus groups, dinner was provided for both professors and students alike. All participants were given an overview of the research questions and what to expect before the focus group or interview, and all gave verbal confirmation to have the conversations recorded for transcription purposes. Similarly, any personal information provided, including where participants grew up, their major/department and research interests were used only as a unit of analysis, and are linked to a particular group only if doing so gave insight into the research questions or the answers provided.

To protect the anonymity of all participants, the recordings gathered from both focus groups and interviews were deleted after the transcription process was complete and any mention of their names or other irrelevant personal information was redacted.

After the group or interview was complete, participants were encouraged to reach out if there were any concerns regarding what was shared.

## 4 Findings

In this chapter, the findings are divided into three sections and a summary, each related to the two research questions. These include (1) what are the best practices for discussing ESD in the built environment and (2) how can educators best work on issues of sustainability with their students? The relevant findings include the images chosen by participants, the responses regarding their image choice, suggested teaching methods/tools and recommendations for discussing complex or controversial issues.

In the first section of this chapter, the findings are displayed for how participants responded when asked to choose images from the four categories that could best be used to discuss SD in the built environment. This includes tables showing the most common image choices for all four categories as well as the favorite images chosen from each category and a selection of the reasons provided. The second section is an overview of the most common and thought-provoking responses to the research questions. The third section highlights the teaching methods and themes that were said by educators and students to be most effective when discussing complex/controversial topics such as SD. The chapter concludes with a summary of the findings.

### 4.1 Images chosen from picture activity

A total of 12 individuals (six professors and six students) were given an activity form (see Appendix III) and asked to choose three images from each of the four categories including energy, urban ecology, transportation and municipal waste. Each category contained 10 images to choose from. For each category, participants were asked to choose three images, choose their favorite image from that selection and give a brief description of why they chose that particular image. An 'additional comments' section was given for participants to leave comments regarding the activity or a description of photos they wished to have seen.

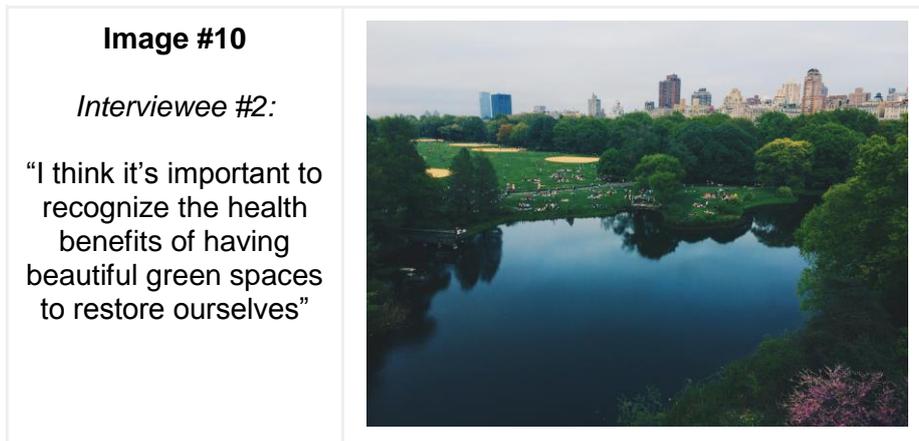
The following findings will contain a synopsis of the most popular images followed by two graphs for each category; one showing the frequency with which a particular image was chosen, and the other showing the number of favorites an image received.

### 4.1.1 Urban ecology

For the urban ecology images, #1, #2 and #3 were chosen most often, followed by #10. These four images, their corresponding numbers, and a selection of reasons for the choices are shown below.

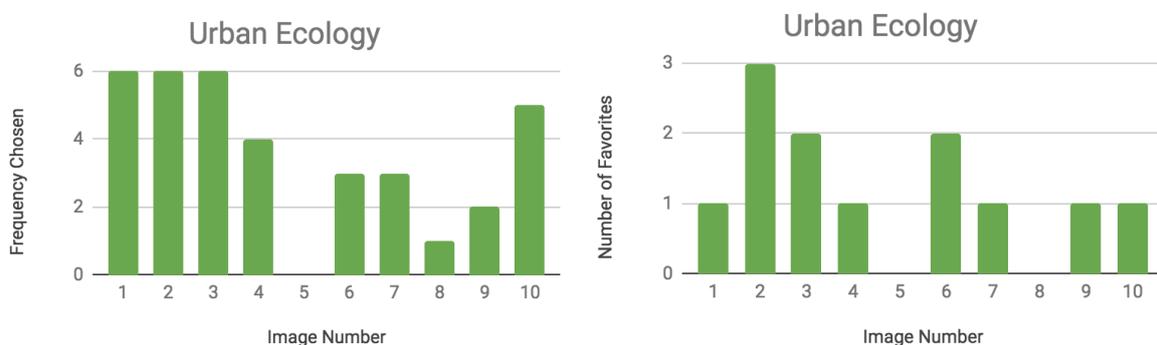
**Table 2 The most common urban ecology image choices and reasons provided**

<p><b>Image #1</b></p> <p><i>Group C, Participant A:</i></p> <p>“...ecology in an urban setting doesn’t have to take away, ... [it] can coexist within it.”</p>	
<p><b>Image #2</b></p> <p><i>Group B, Participant B:</i></p> <p>“Integration of green space ... rather than specific greenspace patches ... shows how individuals can contribute to creating green space.”</p>	
<p><b>Image #3</b></p> <p><i>Group B, Participant C:</i></p> <p>“Utilizing ... vertical growth and space is crucial to limiting the impacts that sprawl and cities create ...”</p>	



Images chosen from the urban ecology category all show integrated green space within the urban environment. They highlight mature growth and plant life that is aesthetically pleasing and settled within the city. Three of the images show people interacting with or surrounded by natural elements. While responses varied, participants favored the integration of green space within the city as well as utilizing vertical growth. Central Park in New York City, USA was popular due in part to its ability to take one out of the city and into a natural and restorative place. Similarly, participants preferred images that show urban ecology as humans coexisting with the natural world. On the other hand, images #8 and #5 were picked the least and feature an indoor arboretum and an empty street with plant life, respectively.

Below are two bar graphs that present, from left to right, the findings for most frequently chosen images (Figure 1, left) and the amount of favorites an image received (Figure 2, right).



**Figure 3 Frequency of urban ecology images chosen by participants**

**Figure 4 Number of favorites received per urban ecology image**

In Figure 1, images #1, #2, #3 and #10 were the most frequently chosen with #4 coming in close at 5th place. The four most common choices are shown above in Table 2. Images #5 and #8 were chosen the least with zero and one vote, respectively. In Figure 2, image #2 was picked as a favorite three times with #3 and #6 each selected twice. The

image that received the greatest amount of favorites shows a small streetscape with people on scooters and motorbikes surrounded by buildings and integrated plant life. Images #1, #4, #7, #9 and #10 were each picked once while #5 and #8 were not selected as a favorite by any of the participants.

### 4.1.2 Energy

Table 3 below shows the most common images chosen for the energy category as well as a selection of the reasons provided. Energy images, #1, #2, #9 and #10 were chosen the most. These four images, their corresponding numbers, and a selection of reasons are shown below. After Table 3, a description of the images as well as common themes given for the image choices is stated. Following this, Tables 3 and 4 show the frequency and number of favorites each image received.

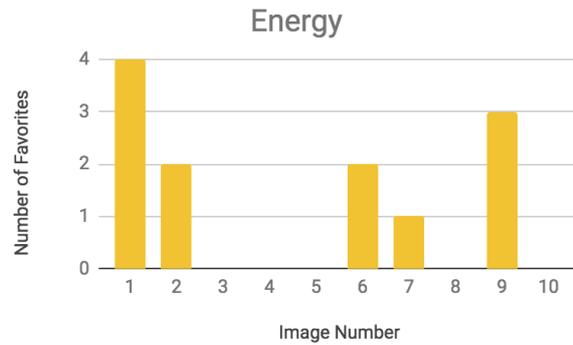
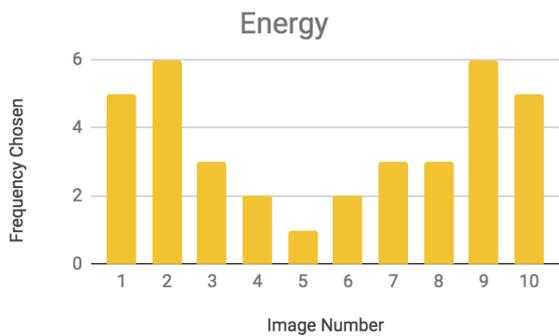
**Table 3 The most common energy images chosen and reasons provided**

<p style="text-align: center;"><b>#1</b></p> <p><i>Group B, Participant B:</i></p> <p>“Shows the integration of “green” energy into a community at a scale that is largely relatable.”</p>	
<p style="text-align: center;"><b>#2</b></p> <p><i>Group A, Participant B:</i></p> <p>“Integrated design, (thermal/electric) use [of] available resources.”</p>	

<p><b>#9</b></p> <p><i>Group A, Participant A:</i></p> <p>“The picture ... is dramatic--most students don't ... know what a powerful thing a dam is ...”</p>	
<p><b>#10</b></p> <p><i>Group B, Participant A:</i></p> <p>“Renewable energy is not the only thing to consider, managing all resources and waste is important”</p>	

The four most common images chosen could be considered on opposing sides of energy development and infrastructure. Although all four present renewable energy options, images #1 and #2 highlight integrative energy solutions whereby solar panels and passive solar heating are used within a small community or single family home. Images #9 and #10 on the other hand feature large scale energy development through hydroelectric and solar power generation. The reasons given for choosing #1 and #2 above are similar to that of urban ecology; sustainable development which is integrated into the built environment. Participants reasons for selecting large scale energy production images often focused on the impact that energy development has on society and sustainable resource management.

Below are two bar graphs that present, from left to right, the findings for most frequently chosen images (Figure 3, left) and the amount of favorites an image received (Figure 4, right).



**Figure 5 Frequency of energy images chosen by participants**  
**Figure 6 Number of favorites received per energy image**

Images #1, #2, #9 and #10 were the most popular choices, all receiving at least five votes and are shown in Table 3. The six images from #3-#8 all received three or less votes, three of which showed cities at night and two of which showed nuclear and coal-fired power plants. Image #1 received the most favorites with four votes followed by #9 with 3. Images #3, #4, #5 and #8 were not chosen as a favorite by any of the participants.

### 4.1.3 Municipal waste

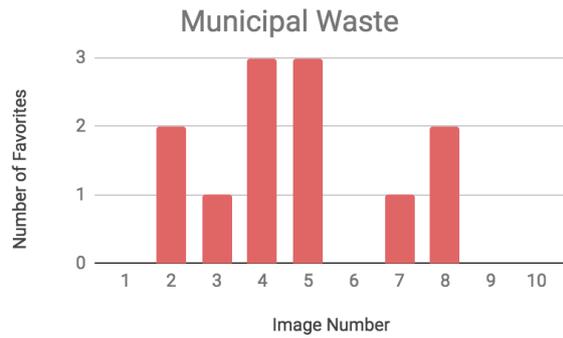
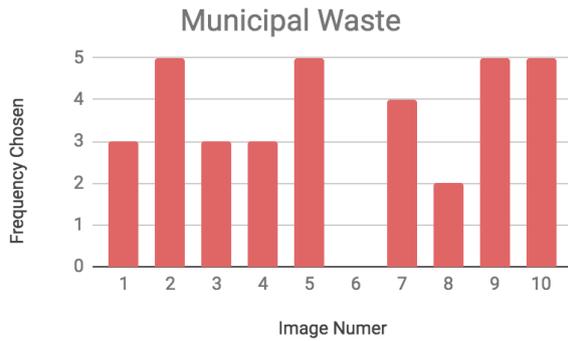
Table 4 below shows a selection of the most common municipal waste images selected. For the municipal waste, #2, #5, #9 and #10 were chosen the most with #2, #4, #5, and #8 being the most favorited. A selection of four of these images, their corresponding numbers, and a selection of reasons for the choices are shown below, after which graphs highlighting the most frequent and favorite images chosen are addressed.

**Table 4 The most common municipal waste images chosen and reasons given**

<p><b>#2</b></p> <p><i>Group B, Participant C:</i></p> <p>“We...don’t give easy access for people to recycle,...mult. containers are a seemingly simple advancement...”</p>	
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<p><b>#4</b></p> <p><i>Group C, Participant A:</i></p> <p>“Everyone has seen overflowing trash receptacles, especially if you live in an apartment. I think this is really relatable and could generate a lot of discussion”</p>	
<p><b>#5</b></p> <p><i>Interviewee #2:</i></p> <p>“I think until you smell..and see..people actually living in these places...I think about [how] a lack of infrastructure shapes...lives”</p>	
<p><b>#8</b></p> <p><i>Group C, Participant B:</i></p> <p>“I think #8 shows a realistic representation of waste in an urban environment. It shows recycling...and the bins seem well used.”</p>	

Most participants chose images that highlighted municipal waste on a human scale. The reasons often reflected some aspect of being able to relate to this aspect of SD. Images #2 and #8 both show multiple waste stream recycling efforts. Although image #2 was chosen more frequently than #8 and shows recycling bins that are much cleaner, image #8 received the same number of favorites. It is also worth noting that #8 was chosen by one participant for the fact that it showed a more realistic example of recycling in an urban environment. Similarly, image #4 was chosen in part because an overflowing trash can is a relatable image to many. In image #5, the reason given has to do with a personal experience with large scale waste mismanagement. Figures 5 (left) and 6 (right) below show the frequency and number of favorites each image received.



**Figure 7 Frequency of municipal waste images chosen by participants**  
**Figure 8 Number of favorites received per municipal waste image**

As shown in Figure 5 and as mentioned, the waste management category was the most evenly split of the four. Out of the ten images selected, eight were within two votes of each other. The most popular by frequency were images #2, #5, #9 and #10 which all show aspects of either proper or improper waste management service. In other words, they highlight the best and worst of sustainable development. Images #4 and #5 were the most popular by favorites, each receiving three votes. Both of these images show waste overflowing into the street or into the community. This is followed by #2 and #8 which as mentioned, show recycling bins in various stages of cleanliness.

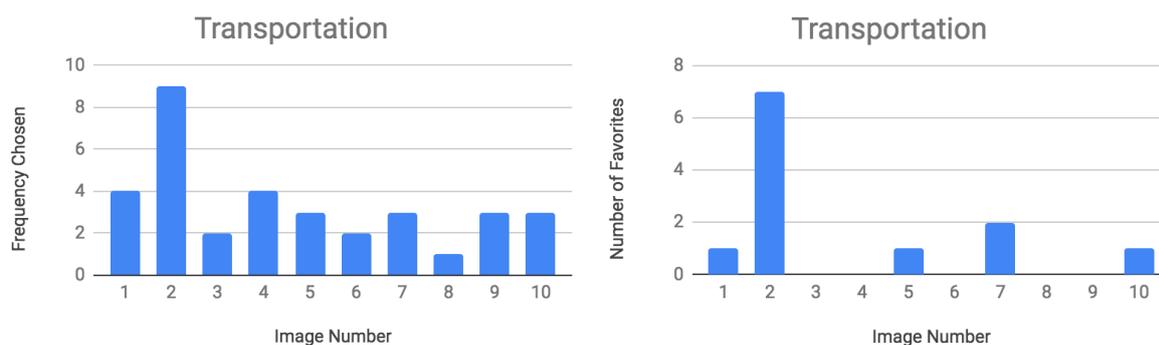
#### 4.1.4 Transportation

Table 5 below highlights the transportation images that were chosen the most. Images #1, #2, #5, #7 and #10 were the most popular by favorites with image #2 being the most popular by a large margin for both frequency and favorites. This category has the largest discrepancy between images. A selection of four images (including the most favorited images) along with the reasons chosen are highlighted in the table below.

**Table 5 The most common transportation images chosen and the reasons given**

<p><b># 1</b></p> <p><i>Group B, Participant A:</i></p> <p>“There is an importance to preserving pedestrian areas in cities.”</p>	
<p><b>#2</b></p> <p><i>Group A, Participant D:</i></p> <p>“Highlights multimodal systems &amp; active streets for <u>all</u> citizens.”</p>	
<p><b>#7</b></p> <p><i>Group C, Participant A:</i></p> <p>“It has a multitude of different transportation [options] ... It would be easy ... to start a conversation using this picture.”</p>	
<p><b>#10</b></p> <p><i>Interviewee #2:</i></p> <p>“I see a picture like this ... [and] I think about the ways in which we organize work ... what if we had staggered work hours ... how do we get more creative?”</p>	

All four images above highlight a wide variety of streetscapes and various modes of transportation. Other than image #10, all the above images were chosen in part because of their ability to highlight some aspect of multi-modal transportation. They feature pedestrians, cyclists and motorists and light rail systems. Image #10 was chosen by interviewee #2 because of its ability to be used as a discussion on traffic and congestion and possible solutions to this common problem. As mentioned, image #2 was chosen the most by a the largest margin in all categories. It features an active streetscape with cyclists, cars, light rail and human scale urban design. In Figure 7 (left) and 8 (right) we will look at the frequency and favorites of the transportation images.



**Figure 9 Frequency of transportation images chosen by participants**

**Figure 10 Number of favorites received per transportation image**

The most popular image by both frequency chosen and favorites was image #2 with nine votes and seven favorites. With a total of 12 participants, this is a considerable margin. The distribution of the remaining nine was separated by three votes, none of which were selected more than four times. Human scaled, multi-modal transportation was by far the most popular image choice.

## 4.2 Activity conversation and common themes

After the picture activity was complete, all participants were asked two questions regarding their choices; (1) What were some common themes you found when picking your images? and (2) As a teacher/student, what aspects of the images did you attract to?

Participants gave a variety of answers to each question, however common themes emerged for both educators and students. When educators were asked the above questions, half (N=6) of them responded that they chose their images based on their ability to highlight the good/bad, best/worst of SD as the following quotes from educators portray. For some, the images seemed to be either sustainability focused or not. The challenge for them was to

select images that could be used to discuss SD, even when the image showed an unsustainable practice.

[I picked] what I thought were good examples ... then I look[ed] at...the pictures that [have] have negative connotations, then...I split the difference...I took an ugly duckling picture [that] reminded me of something positive about sustainable [development].

For this individual, the challenge was in finding some aspect within the image that, weather or not it was positive, could be used to talk about SD. Using what was provided as a teaching tool seemed important to this individual. Yet for others, the purpose in choosing images that highlighted the best/worst continuum of SD was in providing students with a context for the end goal. If, for example, the purpose of the class was to highlight the benefits of SD, an image that shows an active streetscape could prove beneficial. However, if the educator is trying to engage the students with a problem to be solved, an image showing mismanaged waste could be useful.

In some cases, I was looking for the best thing, in others, I was looking for the worst thing. Depends on whether you're trying to design something functional and beautiful, or whether you're trying to solve a problem.

Providing a context for a course or study, weather that be positive change or promoting the benefits of SD seemed important to this person when choosing their images. Put another way, the context should inform the content, the image inform the class.

Lastly, others simply expressed that the images themselves provided ample room for a discussion of SD within the built environment.

It seemed like there was a good assortment ... of what I consider to be the worst case...and the best case scenario.

Two of the educators chose their images based on the ability of the image to show sustainable development holistically from a systems perspective, and highlight the need for integration of natural and built environment processes. For the first, it was important to show a variety of methods used to both discuss and practice sustainable development. Namely, high and low tech options, or utilizing biomimicry as well as technological advancements within the field.

[I picked] ones that are physically depicting ... cutting-edge for sustainable development ... ones that are ... utilizing either natural processes or technology to enhance the living environment without increasing carbon footprint.

For this individual, it was important to give students a wide range of examples on how SD could be implemented into our lives. For another, the images provided a way to discuss the circular economy and highlight nature's ability to recycle and reuse its resources. Put another way, the images were an opportunity to explore the holistic relationship humans have with the earth.

I think...to make any progress [in SD], we have to understand the system ..., understanding connections, relationships, interactions...because too often we pick a piece and we think that fixes it ... We have to understand how the 'whole' works.

For the students, two of them (N=6) also mentioned ideas related to the good/bad continuum of SD and/or systems-based thinking as the reason for their image choices. Yet the students often chose their image based on their ability to personally connect to it. This personal connection extended into exploring the relationship that our choices regarding SD also have consequences. For instance, if we give credence to the superiority of renewable energy, we might overlook other problems.

Some of mine were ... images that were very easy to understand, so for example, the windmills with trash. Which shows that solving that problem is not the only problem we have to deal with when talking about sustainability and energy management.

Dealing with the complexity and connectivity of the SDGs is challenging to be sure, yet other students chose their images on the basis of their ability to show the basic difference between sustainability and unsustainability.

I saw good examples and bad examples in the pictures. Like things ... we [should move] towards and things we should [turn] away from. So I picked a mixture of good and bad.

Out of the six students interviewed, four mentioned that having a personal or human connection to the images was important to their choice. For one student, the context was the most important, relying on common knowledge and themes that would resonate with those

you are trying to teach. The idea being that we should start a discussion based on what people already know.

For me, the images I chose were ... images that I believe the general public in America could personally relate to, rather than a ... foreign concept that they may not be familiar with.

While one student chose images that people could relate to rather than ones that are alien to them, another stressed the need to highlight aspects that present SD as something that is built into a society and culture. In this way, the image could provide a window into a sustainable future and a coexistence between humans and nature.

I chose images that also incorporate other aspects of modern society ....That it's in practice ... and people are interacting with the environment that [was] presented.

However, for the majority of students being able to connect with and understand what was in the image remained the essential reasoning behind their choice.

I would say for me ..., it starts [by] being able to relate to and understand whatever is in the photos.

Similarly, having an interest and investment in the topic was important as one Geography and Planning student explained.

The images that stand out to me were images I knew some kind of background on. I'm going to look at the subway system and the bicycles because I know about those things ... I was drawn to ... things I was interested outside of these photos.

By and large, students chose images that were relevant to them in relation to SD. Nevertheless, one student suggested that showing only images that are interesting and relatable could be detrimental to the cause of advancing SD in the built environment. In this exchange, the student reflected on how personal connection and interest in ESD may either be an educative or miseducative experience.

If I was looking at this as a story, the interesting images [were] really cool. But ... if you're trying to get a discussion [going] that is not necessarily going to serve the point ....There is a balance between something being interesting ... and what the intention ... is behind a particular image. And trying to balance those, so you draw student attention [without] derailing the conversation.

In summary, professors selected images based on their ability to be used to either advance a discussion of SD or explore its benefits. While some saw the good and bad continuum, others saw an opportunity to explore the ways in which we can advance ESD through discussing the circular economy and the utilization of high and low tech options for the advancement of the SDGs. Similarly, students viewed the images on this good/bad continuum, yet many were drawn to images they already knew something about. This personal connection was important to the majority and, perhaps unsurprisingly, each chose images that in some way related to their major. Finally, the balancing act of finding relevant and educative experience was examined.

### 4.3 Teaching methodology, tools, and student engagement

After the activity conversation was complete, participants were asked a series of questions that would help to define the best practices for discussing complex or controversial issues that are often inherent within ESD. During this conversation, participants were asked to pull from their experience as either educators or students to explore what teaching methodologies and tools were used when discussing these issues. The questions were as follows; (1) Can you tell me of a time when you've discussed complicated concepts of controversial issues with your students/peers? If so, did you use video or audio programs, field exercises or city tours, group projects or classroom experiments? and (2) How if at all did you compare the issue or dilemma to another context? Finally, participants were asked to touch on the connection of local to global in relation to the previously discussed concept or idea.

All questions were aimed at providing an understanding of both the context and content for a discussion regarding complex/controversial ideas inherent when teaching ESD. These topics are challenging when talking about ESD, therefore discussion from both educators and students focused on three primary areas: teaching methodology, teaching tools, and student engagement.

#### 4.3.1 Teaching methodologies

When discussing effective teaching methods, five of the six professors brought up some form of case study methodology with varying levels of classroom integration. These centered around reading, discussing, and engaging with case studies relevant to the topic at hand.

The first example was proposed by a professor of toxicology. The class was centered around the DDT debate from the 1960s after Rachel Carson's book *Silent Spring* brought awareness to the general public about the effects insecticides had on humans and the

environment. In this exercise, the professor uses the age-old debate to create a science advisory council with their students. Students were tasked with choosing a side, for or against DDT (50/50 split) and to argue their case with fellow classmates about the advantages and disadvantages of DDT. In this case study method, the students are given all the knowledge known at the time, provided with an awareness of the issue, possible solutions to it, and the social and political ramifications of their choice.

[I created] this scientific debate [with my students] on 1960's technology and know-how. I try and get them to think about being in that time and place.... It requires investment for the student to look at one thing...one person's outlook on the subject.... By the time they're done, they are very well informed.

Providing students with the evidence for this threat to the environment helped them to understand the real world challenge of dealing with issues inherent within SD. Tasked with making a decision, the students invested time and energy into their defense, going so far as to dress in period garb during the class. Students who studied this particular case were exposed to the reality that their choices, opinions and actions can have lasting effects on the environment and human health.

The next example was used when discussing another complex and controversial topic; issue of genetically modified foods. When asked the same question, this professor chose to focus on the competence their freshmen students exhibited when receiving new information and discussing this controversial issue for perhaps the first time.

We were talking about GMO's [so] I got...abstracts...publications, [and] recent studies about GMO's, their health impacts and the evidence. I divided the class up into pro's and con's, and I was really impressed with the level of sophistication..., the general level of knowledge [that the students showed].

While discussing controversial topics is inherent within ESD, this professor saw the usefulness of breaking the argument down to its most basic facts and allowing students to dispute the merits of GMO's from a place of open awareness.

While some professors chose to use the case study methodology to explore competencies with their students, another used this same methodology to consider social and environmental justice issues regarding SD, and engage the students with the reality of governmental decision making and the actors therein. That is to say he used case studies to promote critical thinking, explore contradictions and the ongoing nature of ESD. In this way

he helped students understand who the stakeholders and decision makers are within a particular issue. He explains...

I like to use a case study methodology where we have a question, a theory at the beginning of class. We work through the case study, [and] we say, "What does the theory look like on paper? Now, what does it look like in practice?" And we deconstruct it. At the end of class, they should be able to answer the question.... That methodology is particularly useful when...asking students to think about situations with which they have zero experience.

Lastly, two other professors mentioned some other form of case study methodology; one who used a local reservoir to discuss alternative uses of resources which brought awareness to an issue and lead to a discussion of possible solutions, and the other (an urban planning professor) discussed 'transferable developments' to discuss land use and land use change. This method pointed out social and political problems fundamental to urban planning and design, such as the roll large housing developers have as agents of land use and zoning changes in cities.

In summary, the case study methodology was suggested by almost all professors who participated in this study. This was used to discuss everything from environmental justice issues to the social, political and economic forces that drive change in a city. While some used it to draw awareness to an issue and address possible solutions, others used it to promote critical thinking, present contradictions and convey the ongoing nature of ESD.

### 4.3.2 Teaching tools

When asked how students and educators preferred to learn and teach complicated/complex subject matter, a variety of teaching tools were suggested. The question described above directed participants to call to mind a time when a problem or dilemma was made easier by using some sort of teaching tool, especially when what was being taught or discussed was complex and hard to quantify. In total, there were six teaching tools suggested by both students and professors and included (1) civil discussion, (2) engagement in a single local issue, (3) exploring different contexts of an issue, (4) computer modeling, (5) gamification, and (6) experimentation/field-work with a basis in PBE. As a reminder, the question posed to participants was, "Can you tell me of a time when you discussed a complicated concept or controversial idea in class and if so, did you use...?" Below are examples of the answers given including challenges faced when using them, in the order mentioned above. To begin, one student suggested that properly defining a discussion vs. debate is important for student learning outcomes. They found that the word debate can lead to an impassioned argument

The only drawback [to labeling it a debate] was...it can get really heated... the best way to address controversial topics and see the other side is to have a civil discussion and not label it a debate, have an open floor discussion.

During this conversation, another participant explained why debates can be difficult, citing their fear of speaking up in class, even when they would like to and are knowledgeable about the topic. This was a common theme among the focus groups and was often followed by a conversation about the male tendency to rule over the conversation.

I've never really been very verbal in class ... I get very upset ... it's an environment where people don't know the depths of [sustainability]...It's hard for [students] to go deep ... It's the atmosphere that I don't find fully comfortable.

Labeling a classroom talk as a civil discussion led one student to suggest this alternative. In this teaching tool, the student recommended highlighting the economics of sustainability as it relates to green energy and building regulation as a starting point. This was the start of discussing the benefits of engagement with a single issue.

Talking about the logical and rational explanations for why [sustainability] is a good idea tends to draw a better response...it tends to work better [than a debate].

Engagement with a single issue was thought to be a valuable approach by both students and educators. Such an approach allows for the opportunity to study a problem within a clear and defined context, one where the constraints can allow for clean divisions on what is relevant to the topic at hand and what is not. The holistic nature of SD provides students and educators with ample openings for discussion in a wide range of topics, yet for these participants it was useful to start from a common place. This tool was used widely to bring mutual and shared awareness of an issue and discuss possible solutions. Throughout this process, students would be asked to highlight issues, social, political or otherwise, that they witnessed in regards to it. Through this process students were asked to think critically, and as one professor recalled, did so with sophistication and understanding. It allowed the students the ability to see challenges that they will face when pushing for a more sustainable future, giving them the opportunity to look up and see a more holistic view by asking critical questions about sustainable development.

As one student suggested, looking into a particular issue as it relates to the local built environment provided them with the chance to be a part of something bigger than

themselves, all the while feeling appreciative for the awareness of this issue and its potential implications.

I'm doing research with automated vehicles, and...that's a controversial topic...We're...taking that conversation [to] the public..and we're...on [the] street corner. I think it helped me [understand] how fortunate I am to realize this is coming and think about it.

As mentioned, using local issues related to SD was a common teaching tool suggestion by both parties. For the student quoted above, this provided a chance to see how automated vehicles would effect Boone and its people in the future. For one professor, this tool presented an opportunity to look into an existing issue within the community at large and engage the students in the search for understanding and answers.

In North Carolina, we've been dealing with...a coal ash spill....It's an issue that...resonates with the students.... I took my students to meet with the stakeholders in a community...grassroots organization. They spent the first half of the day deeply engaged with that issue and then... they developed a set of questions..."Who has the decision making power? What role does poverty play?" and "What are the environmental toxicants...and how do they impact people's health?"

Tacking this issue with the class gave insight into the ongoing nature of SD and the roll community organizers have in promoting more sustainable practices. It placed the students into the issue itself and provided an educative experience that looked at the social, economic and environmental consequences of unsustainable practices. Furthermore, another educator stressed the need to use local examples in class, and encouraged others to trust in the students ability to use this experience to color future insights about the topic as their knowledge and experience expands.

I try as much as possible to use examples or landmarks in town.... I try to go as local and as recognizable as possible...I think most of our students are smart enough to take that concept and apply it to something else.

During this research, both students and educators gave examples of how a local issue was used to advance understanding and explore different facets of Sustainable Development. While some reflected on future issues such as automated vehicles, others spoke of using the environmental and public health crisis of a coal ash spill as an educative experience that may contribute to future insights regarding fairness and equity in energy

development. As such, the question posed to participant of how a local issue could be used to explore a different context for the same issue was both relevant and necessary. It in fact, was offered up as its own teaching tool. As we explored in the literature, one roll of ESD is to prepare students to compare and contrast the current state of affairs with future desired outcomes (Jucker & Mathar, 2015). For example, when discussing the roll genetically modified organisms (GMO's) in food, the experience and opinion of a well-to-do suburban mom could be much different to that of an impoverished one.

When I talk about food, we often have...these conversations where privileged white people buy their non-GMO food...and women who [work] in Bolivia...just need potatoes for their kids....So making clear to students that solutions are context specific..., helping them think about scale in that way.

In these two contrasting examples, the desired outcome is for mothers to have healthy and sufficient food to their children. There is a privilege in having the ability to support non-GMO industries that others simply don't have. The question posed to the students then becomes how to accomplish goals 2 and 3 of the SDGs which campaign for zero hunger and good health and wellbeing? It is this type of controversial issue that students must grapple with if we are to promote effective ESD. This discussion of using local examples and then extrapolating them to other aspects of SD was ripe among educators. Although the specifics and content of the discussion can vary, professors strongly agreed that this tool was useful in helping student understand a problem more holistically.

I agree wholeheartedly that we should have a close-up example and then generalize it to the rest of the world....I would use examples [that]...force my students to look at what they would do [in another context].

Looking at an issue in another context was aided by using local examples as a starting point. It allowed educators the freedom to engage students with the material and explore different circumstances with the same framework. For one professor, this local to global teaching tool also provided a window for the students to look into another culture that they may be unfamiliar with, examine the basic needs that humans have and explore how these needs relate to the SDGs.

I use a lot of contrasting between the US and developing countries as it relates to energy...We talked about the hierarchy of needs...And ... social justice and global equity...Thinking about access to energy and quality of life..., just to give a broader global perspective.

The next teaching tool suggestion came from the students. It explores the role that technology can have when exploring premises that may be difficult to understand, in part because of their complexity but also the tools ability to provide information to a hypothetical situation or potential future outcome. Computer modeling was suggested as a teaching tool by two students to better understand relations and concepts, as they explored different topics related to urban ESD such as automated vehicles (AV's) and climate models.

We will use a 3D model of the intersection...[and] interact with the intersection before and after automated vehicles have been introduced.

Using computer modeling software to explore traffic patterns before and after automated vehicles is both relevant for ESD and the workplace. In a changing world, this knowledge can help future professionals to understand the impact that AV's will have on building resilient and innovative infrastructure within cities. This objective is in concert with SDG #9 outlined in Table 1.

The benefits of computer modeling also benefit students who have a difficult time connecting to the material. This tool provides students with concrete metrics to complex dilemmas that are difficult to conceptualize by reading alone.

For me, it's the modeling type of activities....I think that helps [me] stick the concepts easier...It helps to be able to see it happen instead of just reading about it.

Gamification was the next teaching tool to be suggested. This is defined as making a potential real-world situation into a game, one that has all the nuance and appearance of reality. For example, players may be given cards signifying a dollar amount and the time it takes to perform a certain action. This could be anything from the diagnosis of a disease or illness to an environmental impact assessment. Anything that the students may encounter in their profession. This tool came highly recommended by one educator as a roleplay for critical thinking and decision-making. In his game, groups of environmental toxicology students are given a fictional plot of polluted land and a certain amount of money. Students are asked to run tests for this land with the resources given and decide if their client should purchase the land. He explains...

I try to make these groups as interdisciplinary as possible...so they can supplement each others knowledge base...And the kids really enjoy [the game]...It's a logical thing to...look at all the facts and [determine what] they can accomplish.

Later, the same professor elaborated further on why this game, why utilizing and acting on available information and with available resources is so important for students to understand.

Science is only powerful when it's predictive, it's not helpful when...you're talking down your nose....You've got to listen [to scientists and experts] when the time is right.

Lastly, the topic and benefits of experimentation and field work, where the emphasis was on place-based learning, was discussed by students. Much like gamification, this outdoor educative experience was said to aid student learning outcomes by direct interaction with and interpretation of complex systems and procedures. This process gave the students a sense of scale regarding the issue and the position that they could play in finding solutions to problems in SD. In the first example, the student reflected on their hydrology field work, where they were tasked with collecting data for the county records.

Being able to...have a lab every week where you actually went out into a well field [and collect data]...was really practical. And it made the material real....It puts the onus on you as a student because...this will actually impact something down the line...I think that adds an extra layer onto it. You're like, "I'm doing the thing, I'm doing the science!"

She later contemplated on the effect that this type of educative experience had on her overall understanding of the material. It closely mimics that of other students experiences with PBE.

I think being able to see what's going on....[I need to] interact with the material in some way. I think that is crucial to...understanding complex systems, is having different modes of information processing....So being able to see or do something with [the information] and interact with it.

When participants were asked what type of teaching tools were best used to discuss complex and controversial topics, six themes were cited most frequently. These were civil discussion, engagement in a single local issue, exploring different contexts of an issue, computer modeling, gamification, and field-work with a basis in PBE. Students favored civil discussion, computer modeling and field work as teaching tools whereas educators spoke highly of engagement with a single issue, exploring different contexts within that issue, and using gamification to demonstrate the challenges and complexities of real world SD.

However, students did recognize that class debates can lead to mis-educative experiences that can thwart a student's willingness to participate or speak up in a class discussion. Barring in class debates, these teaching tools were reported by participants to have benefits for student learning and promote educative experiences.

### 4.3.3 Student engagement and personal connection

When teaching ESD, student engagement and personal connection are important factors to consider. Having a personal connection to the material was important for the majority of the students. As mentioned, many students choose their images based on what they knew about sustainable development as it related to their major. While three expressed that getting their hands dirty in the field made the material both engaging and personal, one expressed the difficulty in connecting to complex issues within SD that are not as easily visible in first world countries such as food insecurity. Solving this issue is consistent with goals 2 and 10 of the SDGs which seek to end hunger and reduce inequalities.

If you're [talking about] food insecurity...there can be...a disconnect of taking these global issues seriously.

Taking an issue seriously, or engaging students is the first step in the 5 E learning cycle (Figure 1). Without it, exploring the complexities of ESD and finding solutions becomes more difficult. When students are engaged and invested in a topic, learning comes easier. Yet with some ESD topics such as solving the issues of poverty and hunger, a student may have no direct experience with the damaging effects those social ills have. While it is undoubtedly a good thing when someone has no experience with these ills, it may make it difficult to see this challenge as such. The reflection above prompted the question, "Can you think of a time when you were given an example [of an issue] and you felt connected to it, like it made an impression on you?" After which, all three participants responded with personal stories. These stories illustrate how experiential learning can happen outside the classroom and the role that drawing on a student's personal experience can have when discussing issues related to sustainability. For each of these stories, the student's understanding of the issue developed over time. For some, the experience of telling the story was the first time they had connected a principle of SD to themselves. In the first story, the student reflects on how developing nations often lack sustainable water resources.

I studied in Peru last summer and [studied] the issue of water access...and how it's disappearing.... It's similar to water quality in Bogota [Columbia] where...I've been visiting my whole life. I didn't realize [the issue] when I was little. But whenever I hear about stuff

like that in developing countries, I think, “Wow, I really experienced that.”

The next student responded with a story of how the burden of waste management can be unequally shared depending on a county's resources and location. In this exchange, the scale of the issue is put into human terms as they discuss the two 16 meter trailers of trash that are hauled to a poor county in the region.

That just jogged my memory...talking about waste management and waste reduction...[my friend] use to run the [garbage] route for the town of Boone....[He took] two trucks a day to Lenoir County...That's how much waste we're producing...and we are just dumping it on another municipality. Instead of dealing with it ourselves, we're pushing it on someone else.... Realizing it was dumped on someone else was an eye-opening experience.

For this student, knowing someone who works in one of these problem areas and hearing about his experience was enough to put the problem in perspective. For the next student, the problem of climate change was made real to them by studying native plant life and the recession of keystone species. This experience led the student to look at their own backyard in a new light.

Last summer I was working with...the Biology Department...on a native phenology garden [to track the impacts of climate change on plants]. I never really thought about how [climate] effects the growing habits [of plants] and how it can completely eliminate species. [Since then] I've been seeing changes in the living things [around where I grew up].

When students were asked to discuss a time when they formed a personal connection to an issue, each responded with a story that could be tied back to ESD. For the first, unequal access to water was connected to their mother's homeland of Colombia. For the second, the issues of sustainable cities and communities and responsible consumption of goods was made a reality by sharing an experience with a friend. For the third, the effects of climate change were witnessed first hand through field work and PBE.

While forming personal connections and engaging students with material is a necessary challenge, drawing on the students' individual experience with issues related to sustainability brought awareness and clarity. It highlighted social, economic, environmental and political problems as well as the contradictions in and ongoing nature of ESD.

## 4.4 Summary

The results of this research are in three parts. The first presented images participants chose to discuss ESD in the built environment. The urban ecology images that participants favored highlighted humans interacting and coexisting with nature. For the energy category, participants chose images that showed energy infrastructure in the built environment or images that highlighted the impact of large scale energy developments. For municipal waste, participants preferred images that displayed human scaled waste management problems and solutions. Lastly, participants overwhelmingly chose one transportation image that exhibited multimodal transportation systems and human scaled architecture.

The second part included the reasons educators and students chose their images. Educators who selected images with positive connotations suggested using them to discuss the benefits of ESD and integrative technology. Conversely, the negative images that were selected were suggested to be used for problem solving and end goal planning. For students, having a connection with the image was the most important reason behind their choices. They chose images that could be relatable to them and their peers, and favored images that highlighted the integration of sustainable practices.

The third part addressed suggested teaching methods, tools, and the role of student engagement. Professors overwhelmingly favored a case study methodology for its ability to be used to engage with a single issue, explain different contexts within that issue, and the benefits of gamification. For students, the use of civil discussion, computer modeling and field work with a basis in PBE was suggested. The section ended with the role personal connection has for students when discussing ESD.

## 5 Discussion

The purpose of this study was twofold; First, to understand how to address complex and controversial topics inherent within ESD and second, how those issues can be connected to the local built environment as a teaching tool.

For this chapter, the findings are discussed as they relate to these research questions as well as the literature review. The chapter is in four sections. The first section outlines the best practices for urban ESD, the second explores how the built environment can be used as a teaching tool. The third section examines how to address complex and controversial topics. It ends with a table outlining the main elements that should be included in a course that teaches urban ESD. The final section explores the implications and limitations of the findings, followed by recommendations for future research.

### 5.1 Best practices for urban ESD

In a way, urban ESD is no different than any other ESD. Its aim is to engage students in finding solutions to issues related to Sustainable Development, to explore the relationship between the current state of affairs and future desired outcomes (Jucker & Mathar, 2015). This process is aided by the adoption of pedagogical approaches such as biomimetic learning (P. Reed, 2004; Tavsan et al., 2015), Place-Based Education (Smith, 2002) outdoor educative experience (Dewey, 1966; Robertson, 2012) and Action Competence (Mogensen & Schnack, 2010). As discussed earlier, these approaches all have aspects stated in either ESD 1, ESD 2 or both.

Throughout this research, participants were asked what type of learning experience was most memorable and helpful for understanding complex topics. For educators, the use of case studies provided them the opportunity to explore aspects present within both ESD 1 and 2. Using a case study as a teaching tool allowed them to make students aware of an issue as well as the possible solutions. It also provided a platform to discuss social and political issues. Similarly, case studies were used to promote critical thinking and look at the questions, contradictions and ongoing nature of sustainability. From the findings in this research and the literature cited, using a case study methodology is a suggested best practice for urban ESD.

The activity portion provided examples of what to look for in the built environment when discussing urban ESD. The findings recommend finding local sites that are easily recognizable to students and also can be held up as either good or bad examples of Sustainable Development. Likewise, locating areas in town that highlight the social, economic, and environmental benefits of ESD was a proposed best practice. Conversely,

selecting areas that could easily be improved by implementing sustainable practices may also be a beneficial experience. For example, findings from the urban ecology picture set indicate that participants were drawn to images that feature the integration of nature within the built environment. This brings to mind the idea of pocket parks, small parks that are often created by the community in empty lots or irregular pieces of land. Engaging students by creating a pocket park in their community may increase involvement with SD efforts. This practice of looking for something that can be improved and creating something beautiful and functional is a proposed best practice. This process may also provide an opportunity for an educative experience, one that engages students in the process of community participation and experiential learning.

Utilizing the 5 E method is also a recommended best practice. However, as data from this study suggests, the engagement should be with something the students can readily connect with, something that already holds their interest. During the picture activity, students reported that they selected images related to their major, to their interests in some way. In regards to transportation, a large percentage of both students and educators picked an image that highlighted multimodal transportation. This alludes to an opportunity for educators to discuss sustainable transportation options within their city, as most everyone can relate to unsustainable roadways or access to bike lanes and bus stops. During this process, there is an opportunity to explore the global issues present with equitable access to transportation and what sustainable transportation looks like.

Lastly, the data and literature indicate that preparing a class that emphasizes PBE with a focus on Action Competence may allow students to build knowledge and experience with issues related to SD. This class should seek to use relatable locations and ideas, and address a local issue linked to SD. It should prepare students to address the challenges they will likely face, expose them to decision making tools and relevant actors, and provide an opportunity to explore a more global phenomenon connected to the issue they are dealing with.

## 5.2 Understanding the built environment as a teaching tool

As mentioned, utilizing the local built environment as a teaching tool requires an understanding of what aspects about that environment attract people and why. During the picture activity, participants were asked to select images to be used in urban ESD. Participants chose images highlighted the impact of large scale energy developments and preferred images that displayed human scaled waste management problems and solutions. Educators and students also recalled that guided field experiences were both powerful and effective for ESD. This demonstrates that field experiences to public service locations such

as a local waste management sites or energy production plants could help students engage with their own built environment in a more sustainable way.

As this study suggests, Place-Based Education (with that 'place' being one's built environment) can serve as an investigation of the local, which can then be used to explain and explore more abstract ideas (Smith, 2002). Furthermore, what this study sought to do is define what about the 'local' is ripe for a fruitful discussion about SD and how that discussion can best be implemented.

The purpose of the picture activity was to understand what about SD in the built environment most impacted participants and why. It served to provide a foundational knowledge for educators that wish to use their own town or city as a study in ESD.

As suggested, finding local settings and places that highlight the good/bad, best/worst continuum of SD is a good place to start. Furthermore when discussing the four categories mentioned, places that highlight the coexistence of humans with nature were highly recommended, as well as locations that boast a high degree of transportation options.

As one educator recommended, this can serve as the basis for a conversation on equity or other issues of environmental and social justice, and provide an opportunity to engage the students with community action committees or other stakeholders. This finding is in line with the Action Competence approach which helps students understand environmental and social issues as problems to be solved, one where conflicting interests are often at stake (Mogensen & Schnack, 2010).

### 5.3 Addressing complex and controversial topics

Based on these findings, the literature and the recommendations of both students and educators, I've developed a bulleted list (Table 5) and a seminar (see appendix) aimed at providing guidance when discussing complex and controversial topics. Although the efficacy of the list and course has yet to be studied, it pulls from the 5 E Learning Cycle (Figure 1), the environmental education learning process (Table 2) and the and experience of educators and students. Below is a brief synopsis of how to address challenging topics in ESD using the advice and experience from research participants as well as the literature reviewed.

As one educator suggests, we should start from a place of agreement and awareness. Understanding that people come from a variety of backgrounds and political leanings. Next, if there is a common narrative or trope surrounding the issue, set this conversation apart from it. Explore another focus or shift attention to an overlooked aspect of the issue. As one student explained, be logical and rational, discussing all relevant details of the issue including economic, social and environmental implications. Exploring these implications may shine new light and interest on an otherwise tired topic.

Address the issues and challenges surrounding human equity by asking questions that promote critical thinking, as one professor explained when discussing transportation and mobility in the inner city. For instance, what can we learn about the inequalities of transportation developments based on a given populations health and wellbeing? How, if at all does demographics influence the decisions of policy makers? Who is at risk in our community?

Next, it is important to discuss the decision making tools and trade-offs that are relevant for properly addressing the issue, exploring the effects that a certain decision will have. Often times this requires asking the right questions and addressing the right people. This is the ‘competence’ piece in AC. One professor recommended developing a matrix which highlights the pros, cons, and externalities of a given choice, while another recommended using logical extremes.

Making an issue real and relevant was often cited as difficult. As discussed, students can have a tough time breaking out of their own bubble and seeing the forest through the trees. One professor suggested that after tools and tradeoffs have been discussed, meet with stakeholders and community activists engaged with the issue. This provides the students with a real world look into the actors and activists engaged within their community and highlights a challenge that is already being addressed. This educative experience also gives students the opportunity to use what they have learned from the previous step.

Lastly, using all the tools, understanding and strategies attained, address the problem and answer all relevant questions. A breakdown of these steps and examples from the interviews are submitted in Table 5 below.

**Table 6 Addressing challenging topics in ESD from research conducted by Drew Riemersma in 2019.**

Addressing complex and controversial issues in ESD	Examples:
<ul style="list-style-type: none"> <li>● Start from a place of agreement</li> </ul>	What do we want for our children?
<ul style="list-style-type: none"> <li>● Break away from the standard arguments</li> </ul>	Can we use wind power to fly planes? Can we smelt aluminum with solar?
<ul style="list-style-type: none"> <li>● Be logical and rational, discuss facts</li> </ul>	Develop a matrix for the issue. Are sustainable practices good for businesses? Address personal challenges relevant to the issue.

<ul style="list-style-type: none"> <li>• Discuss the issues and challenges of equity and fairness</li> </ul>	Does poverty benefit anyone? Does pollution and waste follow poverty? Who should benefit from public goods and services?
<ul style="list-style-type: none"> <li>• Discuss decision-making tools and trade-offs</li> </ul>	Greatest good for greatest amount of people? Who should be consulted with before making a decision?
<ul style="list-style-type: none"> <li>• Meet with and engage stakeholders</li> </ul>	Consult with workers, activists, businesses, anyone who is/will be impacted.
<ul style="list-style-type: none"> <li>• Using all the tools, understanding and strategies learned, address the problem</li> </ul>	Come to a decision in a fair and democratic way, acknowledging trade-offs and making compromises

The steps outlined above are pulled from the recommendations and experiences of educators and students at ASU, the 5 E Learning Cycle the the EE learning process from . Figures 2 and 3. These figures show this process as a continuum outlined by the North Carolina Department of Environmental Quality (Office of Environmental Education and Public Affairs, 2018).

While discussing issues related to ESD in the built environment requires a knowledge of what sustainability might mean for a particular community, it also requires an understanding that sustainable development means different things to different people. The interviews began by asking participants to discuss what Sustainable Development meant to them. Although many pulled from the Brundtland definition (see Chapter 2) for inspiration, the responses included ideas such as smart city planning, longevity over profit, maximizing resource use, coexistence between the built and the natural environments and a functioning closed system.

All of these responses were telling as to what was important to the participant, where their passions lie. It is no surprise then that working within the framework of personal connection and engagement was a strong indicator for the success of ESD in the built environment. This finding was also affirmed by all six student participants who chose their images based on their ability to connect with, interact with, understand or relate to the image, and suggests that Place-Based Education--using the local built environment as a teaching tool--is a possible best practice for ESD. Similarly, this engagement with an issue is illustrated by the first step in the learning cycle.

## 5.4 Implications, limitations and suggestions

The implications of this research recommend utilizing the local built environment when teaching ESD as an effective way to engage students with the ongoing nature of SD. It also suggests that when done effectively, addressing complex and controversial topics can lead to increased understanding of local and global challenges, prepare students for a future in SD, and increase positive learning outcomes overall. Similarly, this process might bring to light regional issues and their connection to global SDGs. As signified, this research is pertinent to educators that wish to use their local built environment to explore and discuss ESD in an urban setting. It provides a methodology for discussing complex and controversial topics such as transportation, municipal waste, energy infrastructure, and urban development. Due to the relatively narrow scope of these four categories, discussions regarding other issues of urban sustainability should be researched further. A similar study should be conducted concerning the SDGs and urban ESD challenges not addressed herein. Correspondingly, the connection between these topics and other SGD's should also be explored. The research methods used such as the picture activity and the subsequent conversations need to be replicated in a future study for further analysis and affirmation. Lastly, the efficacy of a workshop that uses the model proposed (Table 5, Appendix I) for addressing complex or controversial topics in ESD should be conducted.

## 6 Conclusion

The purpose of this study was to understand how to address complex and controversial issues inherent within ESD and how those issues can be connected to the local built environment as a teaching tool. The participants in this study provided their opinions, judgement, and experience to define best practices for ESD in the built environment. They also shared how aspects of the built environment can be a valuable teaching tool for SD and how best to address complex and controversial topics. In the first part of this study, participants were asked to choose images from four categories that they believed would be most helpful when discussing SD and explain why. In the second part, participants were asked to bring up a time when they discussed a complex/controversial topic and to provide guidance on what kind of teaching tools were most beneficial to their understanding and the understanding of their students or peers. The picture activity and subsequent discussion suggests that highlighting the good/bad continuum of SD and using a familiar setting would be beneficial to student understanding of SD in the built environment, while the discussion on complex/controversial topics suggests that diving deep into a local issue related to SD, and engaging students in the search for answers, could help with student participation and investment.

The implications of this research are twofold. Firstly, educators who wish to engage their students with ESD should look to areas and places that already impact student lives, and find ways for students to become immersed in the process (Jucker & Mathar, 2015; Mogensen & Schnack, 2010; Smith, 2002). Secondly, working towards a common goal is complex and can require reframing existing arguments, discussing facts as well as externalities, and engaging community members in the search for solutions.

The findings of this research are relevant to educators and schools who wish to engage urban students with sustainable development practices and encourage stewardship and action.

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# Appendix I- Addressing complex and controversial topics: A seminar proposal

During the course of my research, I found that the question, “How do you best address complex and controversial topics” was a rich vein for discussion. While some offered concrete examples from years of teaching, others gave personal accounts of a time when they had a break-through with someone that they disagreed with.

Using these stories and advice, I decided to come up with a battle plan for addressing these contentious issues. This seminar-style course could be applied to many issues in Sustainable Development such as access to water, climate change, environmental justice or inequality. It could also be beneficial when a class is divided on an issue, or the issue has become overrun with mainstream thoughts and opinions.

During my time as a Catholic missionary, we ran day-long retreats called ‘Encounter Days’ for middle and high school students. These E-Days (as we called them) were all centered around a specific topic including sex, love, respect, faith and so on. No matter the theme, however, the days events, skits, talks and discussions would follow the same format. The only difference was the content therein and aim of the discussions. From my own experience and this research, it’s best to tackle one issue at a time and dive into participants personal connections. I also believe it’s important to hear from people working within the industry who can give a real sense of the gravity of a given issue.

As mentioned, each ‘SD-Day’ would be centered around a theme. For the purposes of this lesson plan I have chosen water quality as it is both easy to connect to and broad in its potential for discussion. As mentioned in this research, however, the topic should be locally relevant to an issue that directly impacts the students. The discussion questions should seek to connect the issue to the students personally and the experts/stakeholders that speak should be local community members that are working to solve or have been impacted by the issue itself. Videos and experiments used should also be relevant to the topic and highlight a different side from what is often portrayed in the media or common discourse.

**Table 7 Sustainable Development Day: Water Quality**

9:00	Podcast Opening	<a href="#">Pulse of the Planet-Home Ground</a> (Relevant for all topics)
9:02	Discussion	What is the environment?
9:12	Discussion	What is water good for? Who should have access to it? Make sure to address

		farming, food and fertilizers.
9:22	Experiential Learning Activity/Experiment	<a href="#">No-till vs. Till soil</a>
9:37	Small group #1, 3~4 people	How does water affect your life? What implications would contaminated water have on you and your family?
9:47	Discussion	Ask small groups to share. Discuss issues of equity and fairness. Address a local water quality issue.
9:57	Small group #2	Who would you talk to about these issues in your community? Who are the stakeholders? Who can make the change happen?
10:17	Engage with stakeholders	Bring in experts and community members working on the issue.
10:47	Engage with issue that needs fixing, find class consensus on local issue	Give examples of past proposals submitted and provide a writing guide. Separate into sections and give sections to small groups.
11:00	Break	
11:15	Small group #3	Write proposal, have groups break up work load. After, come back and piece it together.
12:00	Wrap up/Call to action	Discuss addressing problems head on. Using tools learned and recognizing all those who are affected by it.
12:10	Final video	Video that addresses problems, shows people in action, one that's fair and balanced.

## Appendix II- The forty images

Below are the forty images used for the activity portion of this research. They are broken up into each of the four categories presented to participants along with the numbers assigned to each image. All images were taken from the free photo sharing website *unsplash.com*.

### Urban Ecology

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Image 1



Image 2



Image 3

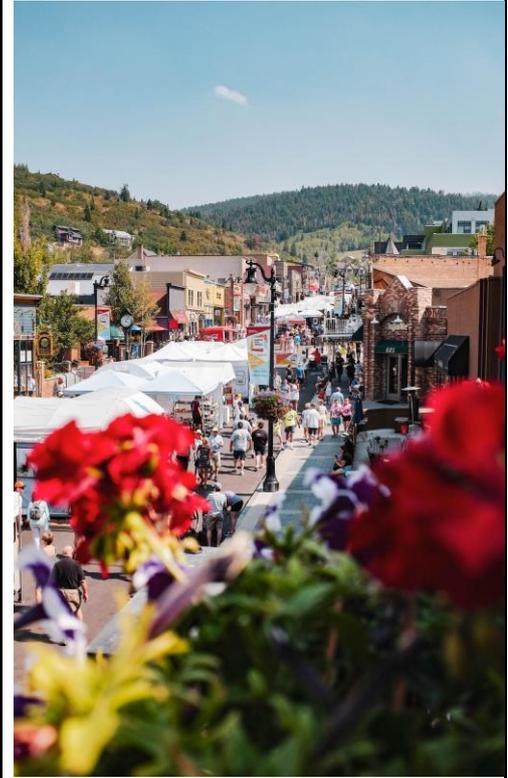


Image 4



Image 5

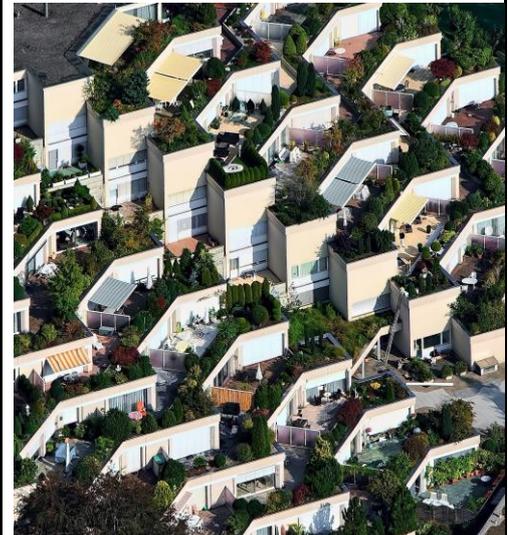


Image 6



Image 7



Image 8



Image 9



Image 10

# Energy



Image 1



Image 2



Image 3



Image 4



Image 5



Image 6



Image 7

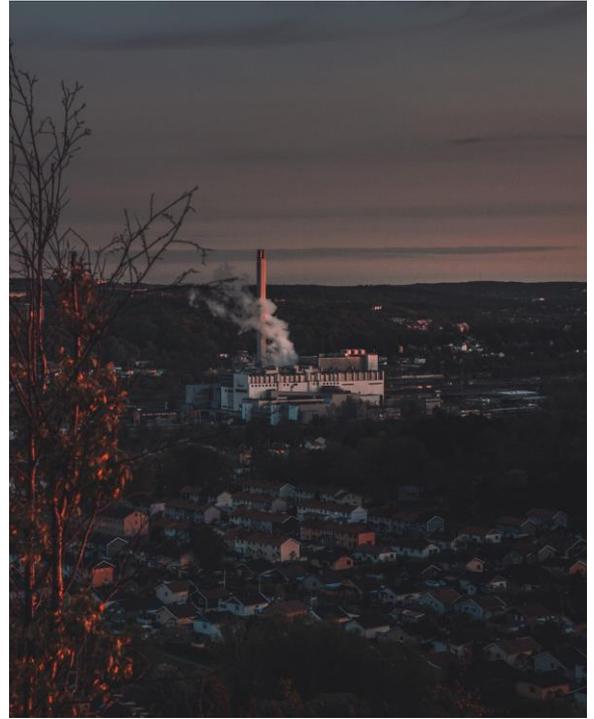


Image 8



Image 9



Image 10

# Municipal Waste



Image 1



Image 2



Image 4

Image 3



Image 5



Image 6



Image 7



Image 8



Image 9



Image 10

# Transportation



Image 1



Image 2



Image 3



Image 4



Image 5



Image 6



Image 7



Image 8



Image 9



Image 10

## Appendix III- The picture activity card

**Instructions:** Pick three photos from each of the four groups of photos (*Urban Ecology, Energy, Municipal Waste, and Transportation*) that you believe could best be used to discuss Sustainable Development as it relates to the built environment. Provide the picture numbers in the spaces provided, then pick your favorite from that selection and give a brief description (in the *reason* section) on why you chose that image.

Participant Letter \_\_\_\_\_

### ***Urban Ecology (pick 3)***

Picture # \_\_\_ # \_\_\_ # \_\_\_

# \_\_\_ Reason: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### ***Energy (pick 3)***

Picture # \_\_\_ # \_\_\_ # \_\_\_

# \_\_\_ Reason: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### ***Municipal Waste (pick 3)***

Picture # \_\_\_ # \_\_\_ # \_\_\_

# \_\_\_ Reason: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### ***Transportation-***

Picture # \_\_\_ # \_\_\_ # \_\_\_

# \_\_\_ Reason: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Additional  
Comments:** \_\_\_\_\_

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