

TEACHING URBAN ENVIRONMENTAL EDUCATION THROUGH THE CONCEPT
OF WASTE REDUCTION AND MANAGEMENT

by

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“It is our collective, and individual responsibility to preserve and tend to the world in
which we all live”

-Dalai Lama

DEDICATION

To my family and friends for your continuous support and encouragement throughout this process. And to Joe, for your unwavering belief in me.

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ABSTRACT

Wagner, M. Teaching Urban Environmental Science Through the Concept of Waste Reduction and Management. (2019)

This writing serves as an introductory unit to waste management and reduction to be used in a high school urban environmental education classroom. The research question for this capstone was, does teaching environmental science through waste reduction and management in an urban classroom affect student engagement and connection? The research outlined in this paper explores and examines the concept of an urban classroom environment, the importance of teaching environmental science, and tools and materials to incorporate a unit on waste into an environmental science course. The paper goes on to explain the importance of educating students about the waste crisis and explores ways to increase engagement when it comes to waste reduction in their communities. This topic was chosen due to its extreme relatability to students who reside in a metropolitan or urban area. It contains immediately applicable content that would serve to enrich a current curriculum or aid in developing a new one.

Key words: Waste, urban environmental science, curriculum

CHAPTER ONE

Introduction

Background

My journey into teaching started out when I was very young. I remember lining up my stuffed animals in my bedroom and taping lesson plans to my door. The animals were a very attentive student body, asking many questions and taking very thorough notes. From there I upgraded to student desks, purchased by my parents at a school auction. My lessons evolved into full seminars, taught in the sunny laundry room to yet another attentive imaginary audience. Years later, my cousin was gifted an overhead projector and old, worn out copies of a teacher's edition textbook. We would design extensive day-long lessons, with one of us teaching and the other minding the students' behavior. We were a great team and our lessons were "flawless."

In the beginning, I was very interested in studying English Language Arts. I spent hours brainstorming the lessons I would deliver. Going over the parts of speech that my 4th grade self had learned in class. In 6th grade, my interest shifted to science. I credit this shift to my upbeat 6th grade science teacher, who made science the most exciting subject of the day. She had a great classroom, with walls covered in posters and shelves lined with live animals and fish tanks. I was excited to teach my future students all about Minnesota's unique and enchanting ecosystems and teach them to identify the many plant and animal species I was so familiar with. Having grown up in the north central part of the state I was well versed in all things outdoor Minnesota. I was going to have tons of live animals, which the students would feed and tend to. In the spring, as the snow began

to melt and the weather warmed, we would hatch live ducklings. I would have a vast greenhouse, filled with field equipment and I would take my students on field trips out to the river to take water quality samples. I was ready for my own classroom.

What I was not ready for was reality. I got my first teaching job at an urban school district in a suburb of Saint Paul, Minnesota. Located on a busy street and surrounded by infrastructure, the school lacked any real green space. My program was located in the basement of the building, in what used to be a swimming pool. Gray, cold cement blocks served as our walls and the windows were small and narrow. We were not allowed to have pets, due to liability, and with a tight budget, there was little room for science supply spending or field trips. When we traveled outside we were asked to return to our classrooms because having students out of the building was distracting to the students located in other parts of our building. Instead of focusing on their studies, these students would latch onto the windows to watch the happenings going on outside. Stuck inside, with all of these variables I was stumped. How do I teach these kids science without stepping foot outdoors?

Many of my students were from different countries and were unfamiliar with Minnesota topography, or had grown up in Saint Paul and never left the city limits. They were unaware of our woodland animal populations and many could not decipher a maple tree from a birch. They were uninterested in learning about aquatic invasive species since many of them had never been to a lake, or if they had, they were not as invested in it as I was. Nothing I was teaching seemed to speak to them. They were disinterested and bored. I started searching for more relevant material to teach them, especially for those students

enrolled in environmental science. With limited options of outdoor exploration, I searched for ways to bring the outdoors in. I stocked my shelves with animal skulls, photos and rocks gifted to me by past teachers and relatives. I scoured online streaming services for nature documentaries to learn about different climates and animal populations. I brought in my personal recycling for us to sort and analyze. We did a waste report on our program and wrote letters to our local food suppliers. I worked to develop a curriculum that was relevant to my students and that they found interest in.

The topic they seemed to cling to the most was waste management. Waste management is a complex and intricate topic in environmental science that can be taught in any building or learning environment. Because of this, it is the perfect urban environmental education unit. It includes tangible lessons that are relevant to students. It includes the three main pillars of environmental science: economic, environmental and social. The topic of waste production is contemporary, urgent and impactful. Dowell (2006) stresses the importance of motivating students to study and understand the need for waste reduction. McKinney, Saxe, and Cobb (1998) stated that educators are bound by ethics to shape learners that will act responsibly and act to prevent further waste. Students can seamlessly and immediately transfer their classroom learning into their everyday lives in order to make a difference in their community and for the planet. Teaching about waste requires few materials and can be taught entirely indoors. Throughout this paper, I will research and present my findings on the following research question: *does teaching environmental science through waste reduction and management in an urban classroom affect student engagement and connection?*

Rationale

The purpose of this capstone project is to introduce a unit of study that can be used in the urban environmental science classroom that exemplifies the urgency of waste. Our world is currently in the midst of a colossal waste problem. With our disposable dishware and K-cup obsession, the throw away culture has become a modern disaster. Almost everything we buy nowadays comes in some sort of plastic packaging. Before it got to the shelves it most likely came out of an individually wrapped plastic bag, off of a pallet wrapped in more plastic. Some of it may be recycled, but for the most part this plastic will end up in a landfill or worse, our waterways. The waste issue affects all people and all nations. According to an article from the Los Angeles Times,

The United States, China, Brazil, Japan and Germany are the leading trash generators. The U.S. produced about 228 million tons of waste in 2006, a figure that climbed to 254 tons by 2013. China is close behind, with 190 million tons of waste per year. (Simmons, 2016, para. 4).

It reaches from businesses to homes to schools. Schools alone produce hundreds of pounds of waste per day, with most of this waste coming from food scraps, paper and throw away lunch trays, which are all unnecessary forms of waste. In 2010, the Minnesota Pollution Control Agency published a study in which they found that “over seventy-eight percent (78%) of school waste materials could be diverted from the trash to organics composting and container and paper recycling collection programs” (MPCA, 2010, p. 5). This study included a plethora of vital information regarding the current rate of waste production in Minnesota’s urban school districts. This study will be referenced

frequently throughout the body of the capstone. Waste generation and abuse is a large problem in our country and if we do not change our ways soon, we are destined to deal with the repercussions of our actions.

Students often enter the classroom each day with at least one waste product on them. Often it is a Big Gulp soda cup from the gas station down the street or bags of Hot Cheetos wrapped in another plastic bag. Next comes the many “let me get some-s” as the students who did not bring snacks flock to those who did with plastic cups and napkins ready to hold their bounty. I watch as plastic bottle after plastic bottle is tossed into the garbage can while the recycling bin next to it sits mostly empty. With frustration, I stoop to transfer the completely recyclable containers from the wastebasket to the recycling bin. Silently I collect all of the recyclables students are dumping into the trash. As I pile their waste out onto a desk at the start of the waste unit, it becomes immediately apparent that they are realizing just how much recyclable material they have been throwing into the garbage over the course of a few days. They immediately become interested in the concept of waste, and we dive into the curriculum.

Due to its ability to be immediately applied to life, students often find this unit relatable and engaging. They seem genuinely interested in how their behavior contributes to this problem and are curious to learn how they can make a difference in waste reduction. The topic of school waste also does not require any special funding, equipment or transportation. A study conducted by the U.S Department of Education found that a majority of urban schools were lacking in basic material resources, and often have lower sources of funding (U.S. Department of Education, 1996). This lack of funding leaves

little room for miscellaneous budgeting for science equipment or field trips. With waste, however, materials and content for study can be found right within the classroom.

Students can dive right into learning about waste in their own classrooms and buildings by monitoring waste levels and brainstorming ways to reduce their school's disposable footprint. Because of this, waste management and reduction is an interesting and accessible unit to cover in an urban environmental science classroom.

Description of Urban Environmental Education

Urban environmental education is the practice of teaching students how to be an environmental steward in a city or urban area. The discipline examines city structure and function with an environmental lens. Urban environmental education teaches students to be global citizens and arms them with the tools to become environmental leaders. The discipline also focuses on community and urban planning, restoration projects and the creation and applications of alternative energies for a changing world.

According to the book, *Urban Environmental Education* (2015), developed in partnership with Cornell and the National Association of Environmental Education, the goal of Urban Environmental Education is to transfer a student's learning from the classroom out into the real world, where they will continue to make a difference well beyond their years in school. The book stresses the importance of using the city as the classroom and allowing the students to apply their learning to the larger community. The authors found that this is most often accomplished by following one of the 5 common trends in urban environmental education, as shown in table 1 below (Pope et al., 2015, p. 13).

Table 1. <i>Trends in environmental education</i>	
Trend	Goal
City as Classroom	Facilitate learning about science, ecology, and the environment using urban outdoor or indoor settings.
Problem Solving	Address environmental and related social problems.
Environmental Stewardship	Foster community-based management of urban ecosystems and natural resources.
Youth and Community Development	Contribute to positive youth development, asset-based community development, community organizing, and social capital.
City as Social Ecological System	Develop an understanding of cities as social-ecological systems, re-imagine how to manage cities to achieve desired environmental and social outcomes.
Retrieved from <i>Urban Environmental Education</i> (Pope et al., 2015, p. 13)	

Overview

When reading this capstone project the reader can expect an extensive and intensive overview of the established literature regarding urban environmental education and teaching about waste production, reduction and management. This capstone will provide a unit of lessons about waste reduction and management that can be incorporated into any secondary science classroom, but that will fit seamlessly into an urban classroom. The lessons in the unit will require minimal equipment and little to no outdoor space. The reader shall gain a refreshed outlook on how to teach this often overwhelming and morose topic plaguing our world today. The capstone curriculum is aligned to Minnesota State Standards (2009 edition) and hits multiple life science benchmarks. It is

my hope, as the author, to offer transferable lessons and insight that will serve as a tool to be incorporated into an existing curriculum or to inspire a new one.

Conclusion

At the conclusion of this capstone paper, the reader will be taken through the current reality of urban environmental education and how to incorporate a relatable and interesting lesson on waste reduction and management. They will walk away with a complete set of lessons that could be applied to a high school science curriculum in the state of Minnesota and beyond. This will be done by first exploring the current research surrounding best practices and pedagogy in relation to teaching environmental science in an urban setting. Next, we will examine the current reality of waste in our country and the importance of teaching this concept. Due to the urgency of the waste epidemic, the need for this topic to be taught is immediate. Lastly, through innovative and engaging content, urban students and their teachers will be armed with the tools to make a difference and enact change in their cities and environments. The research question for this capstone paper is, *does teaching environmental science through waste reduction and management in an urban classroom affect student engagement and connection?* The following research will elaborate further on this vital topic.

CHAPTER TWO

Review of Literature

Introduction

Urban environmental education is a hot topic in the world of education today. As more and more people move to cities, schools are popping up in office buildings, in skyways, and in other downtown locations. This influx of urban schooling locations means that fewer students have access to school forests or on-site gardens. Oftentimes, school green spaces are minimal or non-existent. Couple this with tightening field trip budgets and sparse field equipment and schools are left with a science program starving for resources. Enter urban environmental education.

Overview

This chapter will explore literature related to teaching environmental science in urban areas, with little to no budget and limited or lacking outdoor space. First will be an overview of urban education, including a brief history and definition. Next, literature regarding environmental education will be reviewed. Lastly, we will marry the two concepts and explore teaching environmental education in an urban setting, along with its challenges and nuances. To conclude, the foundation for the project itself will be laid to introduce the curriculum design that is to follow in the third chapter. Throughout the following pages, literature will be reviewed and analyzed to help answer the research question of, *does teaching environmental science through waste reduction and management in an urban classroom affect student engagement and connection?*

Urban Education

Urban education is a rather recent term that brings together the unique situations and challenges of educating students who live in a mainly urban, or metropolitan area. In “But What is Urban Education” (2012), Milner defined urban schools as belonging to one of three different categories. He used the term “urban intensive” to name those being located in a city or area with more than 1 million residents. These areas would include the major metropolitan cities in the United States. He introduced the term “urban emergent” to describe schools that are in large cities, but not to the extent of the previous term. Lastly, he introduced the term “urban characteristic” to describe schools in areas with a boom in growth and often increased English language learner populations (p. 559) (see Table 2).

Table 2 <i>An Evolving Typology of Urban Education</i> (Milner, 2012, p. 560)	
Category	Definition
Urban intensive	These schools are those that are concentrated in large, metropolitan cities across the United States, such as New York City, Chicago, Los Angeles, and Atlanta.
Urban emergent	These schools are those that are typically located in large cities but not as large as the major cities. They typically have some of the same characteristics and sometimes challenges as urban intensive schools and districts in terms of resources, qualification of teachers, and academic development of students. Austin, Texas, Columbus, Ohio, and Charlotte, North Carolina.
Urban characteristics	These schools are those that are not located in big cities but may be beginning to experience increases in challenges that are sometimes associated with urban contexts such as an increase in English language learners in a community. Located in rural or even suburban areas.

Students in city environments may learn in a different way than their peers who attend a rural, or suburban high school or educational facility. What is important to students who live in a farming or rural area may not be the same as what students in an urban setting care about. Urban students may attend school in a high rise building, skyway, or within a business center. They may travel to school on a city bus or by walking to their destinations. Many students may take ride-sharing services to school using their own funds. Urban students may not share in the typical high school experiences of school sports teams or a large common spaces filled with lockers. Students who attend urban schools may travel to local restaurants for lunch or have lunch brought to them in paper bags because their school does not have a functioning cafeteria. A study conducted by the School Health Policy and Program committee showed that 27% of high schools they interviewed had open campus for lunch (Miura, 2009, p. 2). This means that these students would then be traveling to restaurants or nearby vendors to purchase lunch materials.

The differences between urban educational settings and those that are rural, or suburban are far and wide. Some of these differences may appear to be a hindrance to urban students or be seen as a damper on the traditional learning experience. This may be the case for some, but ultimately the differences between these educational settings allows for strengths to emerge and creative instruction and curriculum to take shape. Urban education, although filled with many obstacles, is a chance for schools to foster positive youth development within a metropolitan landscape (Delia, 2018, p. 2).

Misconceptions in Urban Education

As discussed above, urban education is simply instruction that takes place in a city or urban area that lacks traditional resources. Much of the available research about urban education paints the concept as the art of teaching students of color or socio-economically suppressed students. As described by Foote (2005), oftentimes urban students are described as “diverse, poor, or at-risk” (p. 371). Foote went on to describe how often, this is simply untrue. Urban education serves both privileged and underprivileged students in both affluent and economically suppressed areas. There is a difference, however, between high need urban education and traditional urban education. In dense urban areas, there are often more students enrolled, making resources scarce. These high class sizes are believed to be a direct link to lacking resources. There simply is not enough to go around (Maxson, Wright, Houck, Lynn, & Fowler, 2000, p. 40). It is due to this reason, plus many more, that teachers are forced to be creative in their curriculum. As my research question inquires, how does having a relevant curriculum help students engage in science? Examples of potential curriculum for urban education will be presented at the end of this paper. Creative curriculum that satisfies the needs of both urban students and environmental studies concepts will be discussed in the remainder of this literature review. Next, literature related to environmental education will be summarized.

Environmental Education

Environmental education was first conceived when a concern arose that students were lacking in scientific literacy (Pope et al., 2015, p. 13). Teachers and naturalists were encouraged to expose their students to as much of the outdoor world as possible. This included multiple urban locations, including sewage sites, trails and parks, populated schoolyards and streets, and public forests (Pope et al., 2015, p. 14). Since then, the concept of environmental education has ebbed and flowed, lacking a concrete framework or set of benchmarks and standards. Often lumped with other life sciences, environmental education has become similar to a living organism. It morphs and alters its appearance depending on whether it is being taught in a school, nature center, museum or national park. Environmental education differs from Biology in that it focuses not just on living systems and processes, but on the interactions of all living and nonliving things.

Environmental education also focuses on the anthropogenic influences of human life on the environment. A study conducted by Flanagan, Galloway, Pykett and Smallwood found that when interviewed, urban middle and high schoolers held the preconceived notion that humans are helping the planet and are improving the natural ecosystems. Whereas only one third of these students stated that they were concerned with human impact (2019). The teachers in this study stressed the importance of teaching about the interdependence of all living things, which is a cornerstone of environmental science.

While its main focus is on the earth, environmental science also focuses on many topics that are more social science related, such as how poverty affects the environment, social justice, access to clean water, women's education and global disease.

Topics such as these relate to my research question in that students are often more engaged with curriculum that they can connect to their lives. Waste reduction and management are both important and relevant to urban students and to environmental sciences courses. Due to this, students should find connections to their lives in the material, in turn, increasing their engagement in the material. In the following section, urban education and environmental education will be discussed in tandem to further support the research question.

Urban Environmental Education

Urban environmental education is a modern approach to teaching students about the world around them. Although not every student lives in a vast natural area, there is a bit of nature in all landscapes and locations. The world we live in today is becoming increasingly urban (Glaeser, as cited in the Journal of Environmental Education 2013, p. 1). This brings forward the need for students who are educated in the environmental workings of the earth around them, especially in an urban environment. This need became immediate in the mid-1960's when Schneider (1968) emphasized:

Education about environmental restoration might be more relevant for urban residents than nature study... {and} called for integrating into classes education issues that impact the everyday life of urban youth such as pollution, city planning, respiratory diseases due to air pollution and lack of recreation areas. (p. 67)

Students in urban learning centers are often more interested in topics that they can directly apply to their lives. If a topic is not relevant or is too far removed from their lives

it lacks importance and they may remain uninterested. In regards to urban environmental science, researchers found that there were certain topics that were more engaging to students than others. Verrett, Gaboriau, Roesing, and Small (1990) found that students in urban areas were more interested in anthropogenic issues in the environment such as “poverty, environmental justice, financial insecurity and violence” than more traditional environmental issues (p. 4). Because of this, educators and curriculum designers began to design courses that inspired urban students to learn about issues that are meaningful to them and connected to the larger community. However environmental science is taught in an urban area, most agree that the “ultimate goal of urban environmental education is to make the urban environment a livable and sustainable system” (Kudryavtsev & Krasny, 2012, p. 5). Environmental education strives to produce thoughtful and informed citizens that are prepared to tackle a multitude of issues in their immediate and global environment. Although there is no unique urban environmental framework for this course at this point, for the sake of this literature review, and capstone project, we will define urban environmental education as a course or class that teaches students about the environment and its systems and takes place in a city or urban setting.

Trends in Urban Environmental Education

As stated above, urban environmental education is not a concrete secondary course and therefore does not have any set standards or learning objectives. However, as the popularity of the course has expanded, certain trends and concepts covered have emerged. These five concepts are (Journal of Environmental Education, 2013): City as classroom, problem solving, environmental stewardship, youth and community

development and city as social-ecological system. Each of these concepts is defined and elaborated in the following sections.

City as Classroom

As noted, urban education is mainly taught in the city, where natural spaces exist, but may be too far for students to travel to during their school day. It is for these reasons that educators have adapted and found a new type of natural system, the city. A cityscape includes a multitude of buildings, gardens, water systems and infrastructure that can be used as a teaching tool for environmental science. Although these options are not traditionally seen as environmental, they allow for endless environmental case studies and field experiences. Teachers and educators can open the doors of their school buildings to a plethora of environmentally focused locations within walking distance of their classrooms. Utilizing the city as a classroom is a free and simple way to allow students to understand the environmental workings of a habitat they live in every day. Students can easily access multiple points for learning opportunities that are meaningful and impactful to their life as a young person living in a metropolitan area.

When using the city as a classroom it is important to see what students are most interested in. If students are interested in building or construction, it would be easy to study green buildings and LEED-certified structures. The US Green Building Council website (n.d.) defined LEED, or “Leadership in Energy and Environmental Design” as a certification rating system that recognizes buildings that are the gold standard for energy efficiency. In the Twin Cities metro area, a field trip could be organized to visit Target Field, a professional baseball field, that follows the LEED certification standards. The

U.S. Green Building council discusses the accreditations Target Field has received on their website.

After being named the “Greenest Ballpark in America” and earning LEED Silver certification for both New Construction (2010) and Existing Buildings:

Operations and Maintenance (2011), the home of the Minnesota Twins became the first professional sports franchise to also obtain recertification as LEED Gold. (USGBC, 2010, para.3)

Taking students to visit areas such as these that are a part of their community and daily life will hopefully allow them to see why environmental science is important. It could also give them a taste of certain career paths they could take in the future. Using the city as a classroom doesn't stop there either. Students could study transportation systems around these buildings, where certain public transport hubs are located (Spitzner, 1975, pp. 8-10), or analyze the effects of buildings and green spaces on the urban environment (Sandler, 1989).

Problem Solving

The trend of problem solving attempts to foster a group of environmentally focused young adults who can continue on to solve some of the environmental issues and problems that are arising in our world today. According to Pope et. al in the book *Urban Environmental Education*, this trend was originally born to address concerning, but not catastrophic, environmental concerns such as air pollution, distribution of land and public health (p. 15), but has since taken on a more urgent nature, as our planet grapples with impending environmental disasters on a much larger scale. It has been shown that

oftentimes urban citizens are not concerned with the environmental issues that may be taking place in their cities; such as water quality or invasive species. Science, in general, may be foreign to them in an environment that doesn't include exposure to typical "natural" aspects. "Many students perceive science to be a difficult subject and are minimally engaged in learning it" (Ateh & Charpentier, 2014, p. 259). Teaching problem solving through an environmental lens can help combat some of these disparities by arming students with knowledge and interest in their local environments. If students are knowledgeable about their local watersheds, waste treatment and native species, they may be more likely to participate in citizen science opportunities and policy making regarding these issues.

Environmental Stewardship

The third trend, environmental stewardship, is perhaps the most important of the trends, as it encourages a prolonged and active role of the students serving their community and spreading the word of environmentalism (Pope et al., 2015). Through environmental stewardship, students have the opportunity to be active participants in their communities; organizing farmer's markets, establishing community clean-up groups and beautifying parks and communal areas. Multiple researchers have found that residents of urban areas can gain a better understanding of the "dependence of cities on other habitats through nature trails and cultivated gardens" (Tanner, as cited in Kudryavtsev & Krasny, 2012, p. 3). When students are aware of the natural systems in their cities, they are more likely to get involved and be informed citizen scientists.

Youth and Community Development

Urban environmental education can be taught in a traditional setting such as a classroom, but can also be implemented in after-school programs, clubs, summer camps and faith-based organizations. Through these multiple avenues, students and youth can develop leadership skills, knowledge and confidence. They can gain comfort in exploring their cities and states as well as develop vital skills that will assist their future endeavors and careers. Youth and community development is listed as a trend because it has been linked to positive community change from empowered youth that are aware of their urban environment. Krasny, Lundholm, Shava, Lee and Kobori (2013) found that a sense of belonging in the community and a sense of place helped build youth social capital. This sense of place and ownership of one's local community improved not only the natural environment but assisted in access to fresh foods, lowered crime and influenced local policy and planning.

City as Social-Ecological System

As times change and more and more of our world becomes developed, the need for urban environmental education will continue to grow. A city is a constantly changing system that incorporates nature and natural systems seamlessly among its buildings and roadways. Having a local population that is educated in these workings will surely only serve to improve the efficiency and sustainability of these vital systems. Many of the urban systems that seem completely removed from science include functioning ecosystems that provide endless services that must be maintained. Just as natural systems evolve, so do cities and urban areas. Williams and Agyeman (1999) stated that “urban

environmental education builds an understanding of cities as complex systems that blend nature and culture, and ecology and society” (p. 28). Just as cities are constantly evolving and changing, urban environmental education courses are as well. These programs must continually adapt to the diverse needs of the communities they are rooted in to produce citizens that are invested in improving natural ecosystems.

It is through these five trends that environmental science is able to thrive as a useful and meaningful course in an urban setting. As the landscapes of urban environments continue to evolve, urban education must continue to adapt to fit the needs and challenges of the times (Pope et al., 2015). The importance and possible applications of this knowledge are endless, and the potential impact of having environmentally focused citizens in an urban area is immense. Using these five trends to shape an urban environmental course would likely improve student engagement and connection to one’s community.

Why is this important?

“It is predicted that 80 percent of the US population will live in cities by 2050 and that the population demographic will be more than 50 percent people of color” (Taylor, 2014, p. 4). However, the percent of people of color who work in environmental careers does not reflect this (Taylor, 2014). According to a study by Mathews and Riley (1995) students who participate in a local environmental education program are likely to reproduce what they learned in an urban school to their real lives. They found that students learn more applicable knowledge by venturing out into the surroundings they

live in every day to learn about science, more so than if they attend a sleep away, immersive environmental retreat for one weekend.

Youth who participate in nature based programs removed from their everyday environment often undergo profound personal transformations, but that the impacts are short lived and do not necessarily lead to pro-environmental behavior when students return to their normal lives. (Mathews & Riley, 1995, p. 26)

Therefore, it is of utmost importance that students of all backgrounds are exposed to natural science courses. No matter what the population of an area includes, environmental science can serve a purpose. It is especially important for underrepresented students to feel knowledgeable and confident about what is going on in their environments. Students who live in urban areas and are armed with environmental awareness will likely participate in community action groups dedicated to solving environmental problems. Or will transfer their learning into scientific careers.

Place-Based Education

Generating student interest in a topic, or series of lessons, can sometimes be a challenge. Often students may feel that they do not need to learn what is being presented, or simply lack interest in the subject. One way to encourage participation and engagement in the topic of study is by using place-based education.

What is Place-Based Education?

Place-based education is an approach to education that focuses on utilizing local communities to connect students to their local environment (Russell-Ciardi, 2006, p. 71). Traditionally, placed-based education is used more prevalently in rural or suburban areas

but according to Russell-Ciardi, this approach is being used more and more in urban settings. The author went on to describe how place-based education can serve as an introduction to the community for many students in an urban area. For example, students may not be aware of environmental problems that are affecting their own state or city. By using place-based education, they may be more likely to join an organization and engage in these issues. Place-based education has two main focuses. The first is to connect learners to their local environment, spark interest and encourage involvement. The second is to illustrate how local issues are connected to larger social, environmental, and economical issues. This takes the approach from a local to global reach (p. 76).

Placed-Based Environmental Education

Environmental education has been shown to be most effective at solving global issues when students are introduced to them at a local level (Ostrom, as cited in Flanagan, Gallay, Pykett & Smallwood, 2019, p. 2). Using the place-based model can assist students in connecting what they are learning in the classroom, to what they see happening in their local environment. “It combines the restorative benefits of being in nature with development of the capabilities to observe and improve the natural environment and to see how human behavior and choices (including the students’ own) affect the ecosystem” (Krasny & Tidball, as cited in Flanagan et al., 2019, p. 2). The authors emphasized that environmental education should not be taught through the lens of the environment being a separate entity to urban life. But rather, that the environment is wholly encompassed within the city and interacts with it seamlessly. They suggested that a student must be able to see their connections to the environment and view it as relevant

if the goal is to encourage them to act as an agent of change (Flanagan et al., 2019, p. 3). For example, the student must be able to reflect on how a certain issue affects their life and feel a pull to want to influence this issue. This is especially vital in urban communities that struggle to engage youth in community issues and projects.

There are many ways to approach place-based education. One way is through community service projects where students or learners are immersed in their local environment. They may be making observations, conducting surveys, collecting data or making ecological analysis. Flanagan et al. (2019) described a sample lesson in which students would study food production in their state and local community. They would take soil samples, interview farmers and learn about land sustainability. Students could then participate in a community garden project or start a school garden on the grounds (p. 3). Connecting students to their communities in this way would hopefully encourage them to continue to engage in their local food communities, even after leaving the school environment. Students who participated in place-based environmental education reported the following; an increased awareness of nature, greater well being, a deeper understanding of the interdependence of natural systems, and a new found environmental identity (Flanagan et al., 2019, p. 5). Perhaps the greatest aspect about place-based education is that it can take place as near as the school's own backyard. Place-based education often requires minimal to no equipment, and can include the immediate school environment. This makes it a vital tool in an urban environmental science classroom. Place-based education can also include a multitude of other relatable topics to student's lives. One of these topics is waste.

Waste

Waste is a major issue in our world today. Waste is produced at a shocking rate of 482,520 lbs in Minnesota schools every day (Minnesota Pollution Control Agency, 2010, p. 6). Most of this waste is food. In the United States, we throw out \$165 billion dollars worth of food each year (Natural Resources Defense Council, 2017). Globally, about $\frac{1}{3}$ of all food is thrown out or otherwise wasted (Simmons, 2016). Not only is this simply wasteful, but it comes at both a financial cost and an environmental danger. Rotting food waste releases methane gas, a greenhouse gas that contributes to global climate change (Environmental Protection Agency, 2019). Much of this waste is preventable. According to a study of Minnesota schools by the Pollution Control Agency, “78% of school waste materials could be moved from the trash to organic composting or recycling” (2010, p. 5). With an uptick of disposable, single-use materials, our world is getting more convenient, but at a steep environmental cost. Waste is all around us, in our homes, place of work and schools. Thanks to our many restaurants that simply dump unsold food items or leftovers, the United States takes the prize for most wasteful nation (Simmons, 2016). We throw items away daily, thus all contributing to this compounding issue. According to a study completed by the World Economic Forum, there will be more garbage than fish in the sea in 30 short years (2016). The immediacy of this issue, as well as its accessibility to all students and educators, makes it a relevant and engaging topic to discuss in an urban environmental science class.

Waste generation is not only an environmental issue, but a social, economical and societal issue as well. While so much food is being wasted by some, others are struggling

to find enough food to survive. In the U.S “more than 42 million people - including 13.1 million children -- live in homes that face food insecurity” (Klein, 2017, p. 20). By introducing students to the concept of waste generation in school, they may be more likely to engage in waste reduction initiatives in the larger community after their time in school is up.

Why Teach About it? A Rationale.

As described in the paragraphs above, urban schools often struggle with funding, and in many cases lack science equipment or field trip funds to immerse a student into their learning. What urban schools do have to their advantage, is the city itself. And cities, are often filled with trash. Every classroom has a garbage can, and every school produces waste. This allows for immediate observations and data collection. Students can track the trash output of their individual classrooms, or of the school as a whole, all without leaving the school property. Students can study trends in trash and recycling to see how their schools could adjust their waste disposal practices to decrease waste and protect the environment. A school in New Zealand found success with their waste amount after implementing a recycling curriculum in their public schools. In four years, the schools that implemented the program reduced their production of garbage by diverting 8,716 garbage trucks worth of waste from landfills. They also saw a decrease in water and energy use at the participating schools (“Why Recycling Programs” 2017). Students could reach out to school vendors to request more sustainable materials or contact farms to see if food scraps could be donated as pig food. Each of these skills provides immediately applicable learning while teaching the student a variety of scientific skills.

Student Engagement

What is it?

For many students, science is not the favorite or most engaging topic in school. Like other core classes, science can be abstract, challenging, and to some, seemingly useless. This is unfortunate because science is a vital course that covers applicable material. However, if a student is not excited about, or engaged with what is being taught, the learning will be minimal. “Research supports a strong correlation between factors such as interest, engagement, motivation, persistence, and self-identity and the ability to understand scientific concepts and develop skills in science and engineering” (Next Generation Science Standards Lead States, 2013). The challenge then lies in how educators design engaging curriculum that allows for substantial learning.

The first step in creating engaging lessons for students is to understand what it means for students to be engaged. According to research conducted by Schlecty (1994), students are engaged when they “are attracted to their work, are persisting in their work despite challenges and obstacles, and take visible delight in accomplishing their work” (p. 8). Teachers often see this level of engagement during projects and field trips, but it can be hard to come across during everyday lessons. To encourage everyday engagement, educators should focus on five essential goals: success, curiosity, originality, relationships and energy (Strong, Silver & Robinson, 1995, p. 10). By including lessons that help students reach each of the above goals, it is likely that the student will be motivated to complete their tasks and be engaged in their learning.

Beyond lesson design, teachers can utilize a multitude of other strategies to increase student engagement. These include ensuring a student is aware of all expectations and desired outcomes of their time in class, providing constructive and immediate feedback, and modeling desired results. It is also important for students to be stimulated by their learning and find a natural sense of curiosity (Strong, Silver & Robinson, 1995, p. 10). This can be achieved by allowing for inquiry and self-discovery. One such way to engage students in an inquiry-based unit is by teaching them something relevant and applicable, such as about waste reduction and management.

How does teaching about waste engage students in environmental science?

Does teaching environmental science through waste reduction and management in an urban classroom affect student engagement and connection? This can be answered by examining if the topic of waste is engaging to students. Using the signs of engagement discussed in the preceding sections, I would argue yes; the topic of waste reduction and management is engaging. According to Sinatra, Heddy and Lombardi (2015), students are most engaged in an activity when it is something that they enjoy (p.4). Although some may argue that working with trash isn't enjoyable, it does provide a stimulating and thought-provoking basis for learning. Waste reduction is a personal, yet global issue. Each and every person has the capacity to influence the waste crisis. Collectively, we have the power to end it. A waste reduction unit would allow for students to collect local data from their classrooms, homes and jobs. They could then generate a solution for the output of trash in these locations and work to implement these plans. Students could tour local recycling facilities and waste collection warehouses to interact with employees and

see the actual process of waste disposal or recycling in action. Each of these activities could easily stimulate inquiry, wonder, and curiosity. Participating in an immersive unit such as this has been shown to allow students to develop a deeper interest and a more positive attitude towards science (Tutler & Osborne, 2012). By seeing the many facets of the waste process, students may also be drawn to careers in these fields, or feel compelled to participate in a local waste reduction organization. This type of immersive learning would certainly lead to increased student engagement.

Summary

In chapter two, multiple topics were discussed including urban education, environmental education, urban environmental education, place-based education and waste. Each of these topics are necessary to explain the importance of using relevant topics to teach environmental science in an urban area. Together they work to explore the research question: *does teaching environmental science through waste reduction and management in an urban classroom affect student engagement and connection?*

Students in urban areas find success in science courses in which they are able to form connections between the content and their lives. In environmental science, there are multiple areas of focus that can help build these classroom-to-city connections. By providing students the opportunity to study waste management and reduction in the classroom, students will be better equipped to manage their private waste in their homes and jobs. Through waste education, students will gain insight into the greater workings of disposal and recycling processes, and perhaps spark an interest that results in them working in the waste management field, or participating in local waste reduction efforts.

The literature outlined in chapter two explored the concept of using place-based education to include students in their local, city environments and encouraged the use of students as positive agents of change. The importance of teaching students about waste in a high school environmental science course is paramount. This necessity increases when working with students who live in a highly populated area. With an increase in population comes an increase in waste. Having citizens that are educated and aware of where this waste goes after it leaves homes, schools or offices will only have a positive effect on the environmental footprint of the city. Waste, in itself, is the definition of consumption, but through relatable, applicable curriculum, waste production can be reduced to a fraction of what it is now. They say students are the future; with environmentally focused students living in large cities, the future is sure to be clean.

Introduction to Chapter 3

Chapter three includes continued examination of the research question: *does teaching environmental science through waste reduction and management in an urban classroom affect student engagement and connection?* This will be done by first discussing the setting in which the curriculum will be introduced. Next will be a discussion regarding the instructional strategies that will be implemented when designing and delivering the unit on waste reduction and management. Standards and assessments will be stated, and a lesson plan template introduced. Lastly, the methods and implementation will be summarized.

CHAPTER THREE

Project Description

Chapter Preview

Chapter three of my capstone project continues to explore the question of *does teaching environmental science through waste reduction and management in an urban classroom affect student engagement and connection?* Throughout this chapter, I review portions of the literature covered in chapter two and discuss my research question once again. Then I dive into the purpose behind this project, why it is important to me personally and why I feel it is important for other science teachers in urban areas. Next, my current setting and the participants that are a part of my study are described. I break down the demographics and statistics of my school. I describe the economic situation in which our school finds itself as well as our location in relation to relevant curriculum needs, such as bodies of water, waste treatment areas or current waste reality.

Next, I discuss the instructional strategies I use to develop my current curriculum. Then the current state standards are explored and student learning objectives are identified. This unit uses the Understanding by Design Framework, designed by Wiggins and McTighe (2011), and the backwards design approach as a base for the development of lessons. I then outline the lesson plan template I will be using. A timeline is presented of what a typical unit length would look like, as well as possible alterations to this timeline. The chapter concludes with a discussion of the assessment designed for this unit. A summary of the chapter follows along with an introduction to chapter four.

Rationale

As described in chapter two, the topic of waste is paramount to science education in the 21st century. We are living in a time of buy - use - discard - buy again. When instead we need to be at a stage that includes ample reusing of products, sustainable production and conscious discard. If we, as a society, desire our world to change, we need to look at the awareness of the people and be certain that our future leaders are aware of the mark they are leaving on this planet. Student exposure to the waste crisis will hopefully open their eyes to a problem they may not be completely aware of. Throughout this unit, students will be exposed to the reality and magnitude of the waste problem and be encouraged to explore possible solutions. This unit gives learners a voice and a platform while fostering a sense of ownership and change when it comes to the issue of waste. As my research question aims to prove, using a curriculum that is relevant often increases student engagement and fosters real-world connections. In the next section of this chapter, the setting and participants of this research are described.

Project Description

As stated above, the purpose of this research project is to determine how best to reach, engage and connect urban environmental science students to the topic of waste management and reduction. This will be accomplished by describing a unit of study for high school students in an urban setting. This unit would work well in the larger unit of study surrounding the topic of human impact. It would serve as a solid introductory unit to pollution and could even serve as a preparatory unit to climate change.

The unit will begin with an introduction to waste, and an engaging short video on waste production to introduce students to the topic. This will then be followed by a sequence of project-based, hands-on lessons aligned to Minnesota high school life science standards. The lessons in this unit are designed for a classroom with 15-40 students but could be adapted for use in smaller and larger classes if need be. The lessons in this unit could also be adapted for settings other than the classroom; such as an environmental learning center or park. Each of the lessons in the unit have worksheets or projects designed to connect and engage students in the topic of waste management and reduction. This unit includes two local field trips to a waste collection area (dump) and a recycling center. Each of these lessons will be appropriate for classrooms and learning centers with limited funding or field research supplies. The included lessons and projects could also be adapted to fit different age groups or a group of students of varying ages.

This project implementation will occur within a six-week term of Environmental Science. At the culmination of this project, a multi-lesson, unit length project on waste reduction and management will be created that for an urban, high school environmental science class. The unit project will not span the entire six weeks but can be placed in the sequence that makes the most sense to the educator. Ten, 50 minute to 150 minute lessons will be included that can be stretched or shrunk to fit the needs of the teacher and his or her unique learning environments. The estimated unit length of these lessons is approximately 15 standard class periods. Although this unit would be best taught in the fall or spring to allow for outdoor exploration, certain lessons could be adapted for indoor learning as well.

Setting and Participants

This project takes place in a Minnesota urban high school. The school includes 180 students mainly from the surrounding northeast metropolitan suburbs. The school make-up includes the following: 64% male students, 36% female, 64% minority students and 72% disadvantaged students with free or reduced lunch pricing. The school serves as an Alternative Learning Center that focuses on credit recovery opportunities for students who are falling behind in their studies. Many of these students performed poorly in a traditional learning establishment and thrive by working on hands-on projects and inquiry-based lessons. The participants in my class have a mix of abilities including a handful of students with an individualized education program (IEP), multiple English Language Learners (ELL), students who have been incarcerated, as well as students without housing. Students in this school are in grades 9-12+ and are between the ages of 14 and 21. The lessons and topics included in the project will be implemented into the Environmental Science course that is taught to mostly 9th grade students, but may also be taken as an elective course by students in any grade. This unit is important in that it demonstrates that engaging and relevant lessons can be taught in an urban school with limited resources and funding. The next section describes the framework used to design the unit and includes suggestions on how to make the curriculum as relevant and engaging as possible.

Instructional Strategies (Understanding by Design Framework)

The curriculum design framework that is being used for this project is Understanding by Design, or UbD. This framework, created by Wiggins and McTighe

(2011) focuses on using backwards design to break down curriculum construction into three main stages. These stages are: identify desired results, determine assessment evidence, and plan learning experiences and instruction. In simplistic terms, each of these stages is asking “What do we want students to know?”, “How do we instruct this learning?”, and “How are we going to know when they have learned?” (Wiggins & McTighe, 2011, pp. 2-6). In order to answer these questions, Wiggins and McTighe suggested using a backward design approach when designing curriculum. They suggested developing your assessment first and then building lessons that allow for student connections and authentic performance. They suggested that the teacher serve as a facilitator of learning and not a director of learning (p. 1). This framework fits well with this project’s unit of waste reduction and management as it allows for inquiry and student exploration in a topic that is familiar but contains ample opportunities for new learning.

Developing a relevant and engaging curriculum is essential when working with young learners. Especially high school students who are facing constant distractions from home life, social engagements, and work. In order to develop an engaging unit on waste reduction and management that connects students to the real-life problem reflected in this topic, educators will need to follow the Understanding by Design framework, as well as include a multitude of authentic and applicable lessons. Wiggins and McTighe (2011) recommended incorporating skills that allow the student to have ownership in their learning and increase confidence (p. 6). By following these two pathways, students should walk away from the course with the tools needed to foster change in their communities and personal lives. The following page presents the Minnesota State

Science Standards that are addressed within the curriculum. The lesson plan template that is being used for this unit is presented in appendix A (ASCD Publications, 2004).

Standards Addressed

The following standards are part of the Minnesota State Science Standards, 2009 Edition. These standards are in the process of being revised and may be updated in the near future.

MN 9.1.1.2.1 - Scientific inquiry uses multiple interrelated processes to pose and investigate questions about the natural world. *Benchmark: Formulate a testable hypothesis, design and conduct an experiment to test the hypotheses, analyze the data, consider alternative explanations and draw conclusions supported by evidence from the investigation.*

MN 9.4.4.1.2 - Human activity has consequences on living organisms and ecosystems. *Benchmark: Describe the social, economic and ecological risks and benefits of changing a natural ecosystem as a result of human activity. For example: Changing the temperature or composition of water, air or soil; altering the populations and communities, developing artificial species.*

MN 9.4.2.2.2 - Matter cycles and energy flows through different levels of organization of living systems and the physical environment, as chemical elements are combined in different ways. *Benchmark: Explain how matter and energy is transformed and transferred among organisms in an ecosystem, and how energy is dissipated as heat into the environment.*

Objectives

The following student objectives are included in the unit on waste reduction and management. The statements are written in student-friendly language. At the culmination of this unit of learning, students should be able to do the following:

- The student will be able to generate a possible hypothesis to solve a waste issue based on observations made.
- The student will be able to explain how waste reduction and management impacts the environment.
- The student will be able to identify waste problems in their schools and propose possible solutions for these problems.
- The student will be able to identify waste problems in their homes and propose possible solutions to these problems.
- The student will be able to describe possible steps we as a society can take to reduce our waste production.
- The student will be able to define and describe a landfill, waste treatment plant and recycling center.
- The student will participate in discussions and debates around the topic of waste generation and reduction.

Assessment

The culmination of this project is a student designed implementation of their learning towards a part of their lives that could use less waste. Students reflect on their day to day lives and choose an aspect that generates a surplus of waste. Each student

implements this plan and tracks their data. The project concludes with the student's reflection and results. This standard-aligned project allows the student to demonstrate their learning through a service minded, exploration activity that ties in a multitude of other scientific skills such as experimental design, implementation and research. Students collect data and create a poster project describing their plan and their results. At the end of the designated time period, students share their project and findings with their classmates via a gallery walk. The instructor grades the students' work via a rubric and discuss each student's project and their journey in waste reduction to ensure the student met the standard and is proficient in their understanding. Students are also assigned multiple formative assessments throughout the unit to gather data to give the instructor an idea of each students' progress. These formative assessments include worksheets, lab reports and exit tickets.

Special Considerations

There are a number of special considerations that must be taken into account when designing and carrying out a unit on waste reduction and management. The first is safety. This unit includes multiple experiences that work directly with exposure to waste. Students must have access to gloves and sanitary precautions must be taken. If a field trip to a waste treatment plant occurs students must have proper attire and be aware of the safety risks they are assuming, if applicable. Make sure all rooms have proper ventilation when working with waste, or conducting labs that use chemicals and fumes. If taking students on foot off of school grounds, be sure to have proper supervision and instruct students to be careful when crossing roads, and interacting with community members.

Timeline

This project research, design and implementation was conducted over the course of six months. Preliminary research began during the spring of 2019, with final design and implementation plans during the summer of 2019. Due to the project being completed during the summer, this curriculum will not be implemented with students until the fall of 2019 when classes resume.

Summary

Chapter three presented the methods used to design a curriculum project regarding waste with the purpose of addressing the research question of *does teaching environmental science through waste reduction and management in an urban classroom affect student engagement and connection?* In this chapter, the setting and participants were introduced as a rationale regarding the importance of teaching about waste management. Next, I introduced the MN state standards that are to be covered throughout the unit, along with a sample of student objectives for the unit. A timeline was established for the unit, as well as options for the instruction time. Lastly, both formative and summative assessments were discussed and a possible cumulative project was described.

In chapter four, the results of my curriculum implementation are discussed as well as a reflection on why this research is important to the field of science education. The successes and challenges are reviewed as well as a summary of further extensions of the research. I then present final conclusions of the project as a whole.

CHAPTER FOUR

Reflections and Conclusions

Introduction

The purpose behind this capstone project is to increase engagement, passion and connection with the environment through learning about waste. Through the unit lessons and projects, the research questions of: *does teaching environmental science through waste reduction and management in an urban classroom affect student engagement and connection?* is implemented. Throughout this unit of lessons students are exposed to the process of waste generation and the consequences of squandering our resources. Students gain ownership in their learning by participating in independent and collaborative projects and incorporate engineering concepts to design and implement their own waste reduction plans and track the progress of these plans over time. This project focuses on using materials that are easily sourced or readily available without major funding. Urban environmental education focuses on using the surrounding environment to educate students. By bringing students out into the community and exposing them to the environmental issues and concepts that are found in a metropolitan area, real world applicable learning can take place. As described in the above chapters, this authentic learning can be achieved through the use of place-based pedagogy in which the student's immediate environment is used to spark inquiry.

Overview of chapters

Chapter one served to introduce my research topic of waste reduction and management. I explained my personal connection to the topic and described the related

background information. I described my current teaching placement as a high school science educator in an urban alternative learning center and the challenges that come with this position that ultimately inspired me to choose this topic of research. Chapter two took a look at the research that is currently in place surrounding my research question. I discussed the importance of environmental education, the uniqueness of urban environmental education, and the challenges that come with it. Place-based education and its necessity in applicable learning was described, as well as the urgency of studying the waste problem. Chapter two also provided data from successful waste management school programs and examines how these lessons not only impacted the students who participated in them, but influenced the larger community as well. Chapter three described the project's beginning stages, the plan of implementation and some challenges that could possibly arise throughout the process. A timeline and description of the project setting, the participants, and possible challenges were each presented. Throughout chapter four I will reflect on the capstone writing process as a whole as well as look back on the capstone project specifically, citing its strengths and value.

Looking back on the process

When beginning this capstone process I knew I wanted to focus on writing a unit for environmental science, but I wasn't sure what area I wanted to focus on. Would I choose to study food webs and chains, water quality, climate change or population? Would I choose to focus on pedagogy or content? Would I create a brand new unit or use lessons I already teach in my own classroom? I knew I wanted to create a unit that was current and cutting edge, hands on and project driven. It needed to coincide with current

events and be able to be taught on a tight budget. I began to scour the internet for an idea. What am I most passionate about that I could write multiple pages on and still have that passion?

It was around this time that I saw a news story about trash and about how China was no longer going to be purchasing recycling from the West. With China being one of our largest buyers of recyclables, what does this mean for the U.S? According to an article in NPR, “by 2030, an estimated 111 million metric tons of plastic waste will be displaced because of China's new law” (Watson, 2018, para. 8). Where are we going to put all of this new waste that is sure to be piling up? There has to be a solution. I began to think about how this could be pared down to a smaller scale question to ask my students. What do we do about the rather large pile of waste we generate each day in our classrooms? How could we alter our behavior, or create a better system, in order to reduce this waste. Could we possibly go from having two trash cans per classroom to just having one? What about compost? Are we recycling as much as we could? The questions kept piling up. In the end I settled on creating a three week, 10 lesson unit on trash. Luckily, it didn't turn out like total garbage!

The topic of trash seemed perfect. It would be somewhat interesting to them albeit a little bit gross, and I would have unlimited materials (trash) for us to study. I focused on finding and creating lessons that would work well in an urban classroom; one with little funding and a metropolitan population. The finished lessons are a result of many hours spent searching for valuable content, and when it was lacking, creating it myself. Eventually a solid, student-driven, inquiry based, real-world unit began to take shape.

The lessons themselves range from introductory presentations to field trips to project implementation. Students are encouraged to apply what they learn in the early lessons to a hands on, student-designed project to serve as their assessment. This unit can be taught to a class of 40 students or to a small group of 5-10. This unit could span two weeks or be extended for an entire semester. The world of trash is only growing, and thus so do the possibilities to teach about it.

Review of Guiding Literature

The literature review portion of this capstone was very informative and gave a new lens with which to see my project; the lens of research. When conducting research for this paper I started with the basics. How exactly does the scientific community classify urban environmental education and how does that look in an ideal setting. Urban education is defined by Milner (2012) as learning that takes place in a densely populated area. I then dove into best practices when it comes to teaching urban students about science. I turned to a book from a previous course written by Pope et al. (2015). In this book, *Urban Environmental Education*, the authors describe the importance of using the urban environment to drive instruction and unit design. They outline several trends in environmental science that support student learning; city as classroom, problem solving, environmental stewardship, youth and community development and city as social-ecological systems. When constructing the curriculum unit for this capstone, I referred back to each of these trends and designed the lessons to reflect these core environmental values.

Another aspect that frequently arose in my research was place-based education. The research shows that place-based education assists students in forming connections to their city of residence and helps encourage engagement in their communities (Russell-Ciardi, 2006). By designing lessons that bring the students out into their community, connections were hopefully formed that foster student-community involvement and action in the future. Armed with this knowledge, the capstone curriculum project began to take shape.

Implementations

At this point in time, this unit of lessons has not been implemented with students. However, with a plethora of hands on lessons, interaction, reflection and travel, I am certain student learning will be achieved. The first step to implementation for me will be to share this unit of lessons with my fellow science teachers. Currently, we teach in tandem and share our lessons and calendars with one another. This allows us to track student data and ensure that all students are learning at the same pace and covering the same content. After sharing this lesson with my peers I hope to implement it with my students. This unit will be implemented into an environmental science class, most likely in the greater learning segment on human impact. This unit includes outdoor activities so it will be taught in either the fall or the late spring so that students are able to participate fully without the hindrance of the weather. I am eager to implement this unit and receive feedback from students as well as suggestions on how I could improve the learning experience. I am also looking forward to collecting data with my team to see the impact of these lessons on student test scores and comprehension levels. As research shows,

students learn best by being directly involved with the material and working hands on. This unit of study allows for students to be fully immersed in their learning and get “down and dirty” within the world of trash.

Adaptations

Although this lesson assumes the students are in a school or large learning facility that produces ample trash, this unit could be adapted to a smaller program or even to an independent classroom. This unit of study is best taught in an urban area where students and staff can walk or travel a short distance by bus to reach recycling and waste treatment plants. However, if traveling to these facilities would be too time consuming or would simply not be feasible for a classroom, they can be omitted from the curriculum.

Limitations

Working in an urban classroom I understand that there are often limitations to implementing lessons. One of these is space. Although my goal for this unit was to be able to conduct all lessons in a small amount of space, I did include activities that need to be completed outside. Realistically, a downtown school without green space will be unable to make a class compost pile. City ordinances and permits may also restrict this lesson in some locations. My hope is that schools or learning areas that are located in areas without green space are able to travel a short distance to a park or community garden where they can explore some of these aspects and processes.

Another limitation that could arise is that many of these lessons do require parent/guardian permission (if the student is under 18). Although working with trash and field trips are very safe, some parents/guardians will wish for their students to not

participate in these activities. If this is the case, the instructor will need to find alternative assignments for the student that still incorporate the exploration and immersion of the hands on lessons. Often this can be achieved with an online simulation.

Due to this project being completed in the summer, I was unable to implement it with students. These lessons are still only hypothetical and have yet to be tested with a group of students. Working through a new unit of lessons with students allows the teacher to uncover errors, challenges and areas of adaptations and revisions. This unit of work has not yet been put through this test and therefore may need to be tweaked and molded to better fit the needs of actual students. It is my hope that this project will continue to be a living unit that evolves and adapts to fit the needs of diverse learners and their learning environments.

Future use of the capstone

It is my hope that this capstone remains as a living document that can be adapted and changed over time to fit the needs and issues of the modern world when it comes to trash and recycling. As the waste crisis grows, this lesson will only become more meaningful. It could be extended and built upon to reflect the current state of affairs and be stretched to go more in depth into the topic of waste. This capstone project may spark the minds of teachers who wish to design their own unit on waste and implement it with their students or community members to further engage people in the topic.

Unfortunately, the issue of waste is here to stay and it is vital that our students are aware of the problem and are conscious in their role in either exacerbating or solving the problem.

Conclusions

Throughout the process of writing my capstone paper and project, I focused on answering the research question of: *does teaching environmental science through waste reduction and management in an urban classroom affects student engagement and connection?* This research question not only guided me through the literature, but allowed me to construct and create a unit of lessons that I feel is relevant, engaging and important. By completing the literature review, I learned that students are better able to learn when they are engaging in material that they can apply to their lives. Through study and design I learned that the classroom may not be the best place for learning to happen, and that the community holds a trove of opportunity for student exploration. This capstone project has allowed me to explore my passion for curriculum design and combine this passion with my love for science. It is my hope that this unit of lessons serves as a valuable tool for educators and students alike and that through learning about waste, the world can be changed for the better. As the Dalai Lama once said, “it is our collective, and individual responsibility to preserve and tend to the world in which we all live”. Preserve it, we must, for our generation and beyond. And it all begins with reduce, reuse, recycle.

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APPENDIX

Understanding By Design - Lesson Plan Template: The Logic of Backward Design

Stage 1 - Desired Results	
Established Goals:	
Understandings: <i>Students will understand that...</i>	Essential Questions:
Students will know...	Students will be able to...
Stage 2 - Assessment Evidence	
Performance Tasks:	Other Evidence:
Stage 3 - Learning Plan	
Learning Activities:	

