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Long-Term Effects When Educating Elementary Students on Waste Reduction in

Minnesota

by

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A capstone submitted in partial fulfillment of the requirements for the degree of
Master of Arts in Education, Natural Science and Environmental Education.

Hamline University

Saint Paul, Minnesota

August 2021

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ABSTRACT

Hoensheid, M. Long-Term Effects When Educating Elementary Students on Waste Reduction in Minnesota (2021)

Recycling is a part of many people's everyday lives but it is often an action that many did not receive formal education regarding. Recycling provides a simple way to reduce waste and reduce dependence on virgin resources. However, this lack of education leads to much confusion about the items that can be recycled. The literature review revealed the many benefits of recycling and education about reducing waste at an elementary age. The literature review informed the educational guide about waste and waste reduction for elementary students. The purpose of the guide is to answer the question, *How can curriculum support students' understanding of recycling and waste reduction?*

CHAPTER ONE

Introduction

In this first chapter, I dive into how my personal and professional backgrounds have come together to create my capstone focus; *How can curriculum support students' understanding of recycling and waste reduction?* Trash is something that everyone creates and yet, people are not educated about how to properly handle it.

From growing up in a very low waste household to later in life finding myself teaching students about plastic in the Great Lakes waterways, it became very apparent to me that I was interested in waste reduction, but I did not actually know that much about it. I often thought to myself, “I care about this topic and have invested a bit of time into figuring out what is recyclable. Imagine what people are doing who are not as interested.” It never seemed like I could find a great source of information or a perfect, one size fits all solution.

This interest began with my sister who would pick things out of the garbage or recycling and say, “I can craft with that”. Because of this, I grew up assisting in reuse art projects and seeing the true beauty of a clementine box transform into a planter to sprout seeds. As a child, it was a great feeling to know that this item was given another life. Our parents supported our creative upcycling, and they were influencing us in other ways, as well. There was no such thing as wasting food in our home and my parents always thought of single-use items as unnecessary and frankly too expensive. They unknowingly instilled this additional thought process to the items I use today.

As I grew older, this idea of low waste stayed with me and helped drive my passion and career interests. With an interest in waste reduction, but few resources, I

became very grateful for the training I received through my job. My work gives me the opportunity to assist businesses in waste reduction efforts and educate them on better recycling practices. I do often wonder why I did not learn this information sooner as it is a part of many people's everyday lives. The conclusion that I have settled on is that recycling is confusing because it depends on where you live and there are a plethora of caveats.

Background Information

Growing up, I was always the first and only child in the car when it came time to make the weekly trip to the dump. I still get excited just thinking about it. I would watch as people would unload items from their cars to go into large dumpsters: Old TVs, windows, exercise equipment, and other items that once had a life but were being hurled into a dumpster. Little did I know at the time, those items were about to be buried in a landfill and no longer have a life. The good dump days were those when I actually took an item out of the dumpster and brought it home for reuse.

My sister would be the brains behind what an item from the dump might become. She was always able to take things out of recycling and trash proclaiming that she could craft with it. I can remember a chair turned into a shelf, an old bike tire that had a new life as a clock, and the golf bag that served a better life holding hockey and lacrosse sticks. This helped me to have a different perspective when looking at the items many people thought had little use. However, I did not grow up preaching low waste lifestyles or proper recycling habits. It was one of those things that I did not realize until I was a bit older.

During college, I had my first internship. It is, to this day, the coolest job I have had. I learned of this internship just by googling words about education and marine life. From this, I found a non-profit called Inland Seas and was hired for the summer through their internship program. I packed up my red Saturn Aura, who was lovingly named Chip because of the chipped paint peeling off of the hood, and drove North to Suttons Bay, MI, where I would live for the summer.

My first day on the job, I had no idea what I was doing but I was hooked. I observed as students would board the 61 foot schoolship (sailboat), learned to sail, caught fish and plankton to study, took water samples and performed tests, and learned about the health of the Great Lakes. This all made complete sense to me, of course students would get a better idea of the health of the Great Lakes when learning about it in such an immersed way. No one was going to forget what a plankton was, or how small it was because they used a net to catch it, then studied the little creature under a microscope.

As the summer progressed, so did my skills and the classes I was able to teach aboard the schoolship. The sail that set me onto the trajectory I am passionate about was all about trash. It was called the *Microplastics Sail*. It began by setting sail and skimming the top of the lake for about a half mile with a device that looked like a manta stingray. The arms were aluminum, keeping the device afloat. Where the mouth of the ray would be, was a giant net, catching very small microplastics and debris that lay on top of the water. Much of what we would collect were small pieces of plastic. These small pieces of plastic are called microplastics, which found themselves in a waterway and made it to the Great Lakes. They had broken down into plastic that was about the size of a sesame seed. The students and I would gaze in awe and slight disgust, as we would look through vials

of lake water and microplastics. This was the water we swam in, this was the water that the fish we would catch and eat came from, and this was our trash.

These discoveries and revelations during my internship at Inland Seas led me to focus my undergraduate thesis on microplastics moving up the food chain. It was a relatively new topic at the time, but it was gaining attention quickly. What I found was that my research only made me more interested in the topic and I wanted to know more about how we all could reduce our trash. Trash was a thing that did not exist in most homes about 100 years ago, and it was now working its way up the food chain because plastic was in our oceans, rivers, and lakes.

After graduating college, I accepted a fellowship position at Eagle Bluff Environmental Learning Center in Southeastern Minnesota. This is where I was able to try my hand at helping students understand how each and every one of us could play a role in waste reduction. The specific topics I taught about were not as complicated as recycling and helped my confidence grow. I helped students learn how they could reduce their food waste. I enjoyed identifying all of the resources that it took to grow an apple. In this lesson, the students listed the required resources like gas for transportation, electricity for refrigeration, water, sun, and soil. Then we talked about when we threw an apple away, we were also throwing away all the resources that had just been listed.

Upon learning this, the students were then given the opportunity to put their new knowledge to the test by putting all the food waste in one bin after a meal and then weigh the bin. As the students' time at the Environmental Learning Center progressed, it became much easier for students to know how much food to take in the cafeteria line in order to have little to no food waste. If they succeeded in this waste reduction challenge, they

would get a prize at the end of their stay and be awarded their school name on a gold plate.

Teaching about food waste became simple to me. It was rather black and white, but it empowered me to look for jobs more specifically in waste reduction. Through this search, I accepted another internship as the recycling intern for the City of Lino Lakes. When I began my internship, I quickly found myself as the person everyone in the office would ask about an item they were unsure was recyclable or not. I did not always know the answer to these questions, but it made me want to put together a training that people could attend to learn more about what should be recycled or not. This turned into a very daunting task to embark on my own. I was unsure where to begin and what exactly should be covered. There was not a great guide out there nor many places I was able to find consistent information to aid me in creating a guide of my own. After a lot of time and research, I decided I was not the best person for the job and I could continue to help assist the city in different ways.

Rationale

I have been fortunate enough to make a full-time career out of my passion. I currently work for a foundation that works directly with businesses to help them reduce their waste, and it is very rewarding when I help them do so. On my first day on the job, I was able to attend a training on recycling that my supervisor was giving for a church. This was the information I needed to conduct a training at my Lino Lakes internship. I was impressed with the content and clarity of information that was presented. My supervisor, Erin, made it look so easy and seamless. Erin took the time to explain what items were recyclable and specifically what made those materials recyclable. This

information helped me understand the full picture of waste reduction and assisted me in making better decisions with my own items.

I now lead my own training sessions with businesses, and I still get excited seeing how the attendees react to this topic and the new information that is presented. It is neat to see people understand the life of the materials they have and use daily. This often leads to them wanting to do a better job reducing their waste. When I am not training, it makes my heart sing when I am able to help a business get rid of single-use items and reduce their waste. Getting feedback like, “Our dumpster pick-ups were cut in half!”, or “We have virtually no waste at our business” makes me feel like a real impact is being made. That being said, there is still so much work to be done! And another audience that is being missed.

Nonetheless, some businesses we work with are geared towards children. When my colleagues and myself are at these businesses, we are often asked what resources we have that can assist children in learning about recycling. Unfortunately, we do not have educational materials or training programs that can assist children in learning about waste reduction. This is a problem because it is easier to teach a child a new habit than it is to teach an adult (Zelenzny, 1999). Also, when a child knows about a topic, it is often shared with the adults that will listen. More often than not, the opposite does not happen.

For many people, waste is a part of their daily lives and the option to recycle is present as well. It is an easy task to do because of how integrated waste is in our lives and how widespread recycling programs have become. Many materials are made with non-renewable resources that exist in a finite amount on our planet. When these items are recycled we are able to extend the life of that resource, reduce waste, and reduce energy.

This can all be done by selecting the correct bin when disposing of plastic, metal, paper, and glass.

Summary

Though my suggestions to businesses do not include elaborate art projects regarding how they should craft with the yards of plastic film they have, they do include creative ways to not have the plastic film altogether. It was about six years ago since I first learned about microplastics and I am forever grateful for two things. The first being environmental education and hands-on learning, because learning by doing is a very effective tool. And, the second being the first internship giving me a glimpse of what I wanted to do in the future. My work does not directly correlate with keeping waterways clean, but what I do helps to greatly reduce the waste that can end up there.

Recycling can help reduce waste in a large way and it allows for products to be made from recycled - not virgin - materials. However, it is a confusing topic and there is a lot of misinformation about what is recyclable and what is not. It is different in almost every state and sometimes even county to county. Many communities have the option to recycle, but unfortunately, many people do not know what is recyclable and what is not. This can lead to high levels of recycling contamination.

With my interest in waste reduction, recycling, and a hands-on approach to education, I want to create a guide that helps educate people on what should go in the recycling bin. This guide will help address my capstone question; *How can curriculum support students' understanding of recycling and waste reduction?* To create this guide, there are many topics that need to be explored. The literature review walks through the benefits of recycling, its history, then moves into habit forming behavior and attitudes,

including the importance of teaching students about recycling from a young age. Lastly, the educational recycling curriculum is reviewed. The third chapter provides more in depth information about the curriculum that I created. Chapter four addresses the process of creating this capstone and also the limitations in the curriculum.

CHAPTER TWO

Literature Review

The focus of chapter one was on personal experiences and rationale for wanting to come to a concise conclusion to the question: *How can curriculum support students' understanding of recycling and waste reduction?* The main objective of this capstone was to present information regarding the effects of educating students on recycling and waste reduction. When students learn the difference between recyclable and non-recyclable items, along with the effects this can have on the environment, it helps them better understand how to properly dispose of items used on a daily basis. These goals were achieved by honing in on three main topics: recycling and waste reduction, long-term habits, and elementary education.

In this chapter, the appropriate literature and studies that assisted in distilling the curriculum are reviewed. The first area reviewed is recycling and waste management in the United States and in Minnesota. To inform students on the importance of recycling, the students were taught the environmental impacts of waste and enlightened regarding the unsustainability of generating waste.

Next, the importance of recycling education is covered, student attitude, and long-term effects recycling education has on students recycling behavior. Such as with knowledge gained by environmental education, this education can play a significant role in responsible environmental behaviors and habits (Oskamp et al., 1991). This section provides information regarding the results obtained from teaching students about waste management and starting the practice of recycling and recycling education early in life. Additionally, the difference in attitudes for recyclers and non-recyclers is explored.

Lastly, curricula are compared that have been developed in multiple states to help teach students about recycling. Student engagement is examined and the explanation of waste management through environmental science and environmental education. This section also introduces the ease of implementation of these lessons and provides information on the activities to supplement the lessons.

Waste Reduction and Recycling

The following section provides further insight on recycling and the history of it, current trends, benefit of recycling, and recycling food waste, known as composting.

History of Recycling

The practice of recycling takes items that might be considered garbage, such as cans, cardboard, some plastic containers, glass, paper and collects them for processing at a materials recovery facility (MRF). Once the items are sorted, they are sold to be reprocessed and made into materials that can be used again (The Recycling Zone, n.d.). An example of the types of products made from these recycled materials in the Twin Cities can be seen in Figure 1. One reason that recycling is a beneficial environmental practice is because, in general, using materials extracted from their raw state and reprocessing them into a new item requires less energy as opposed to processing virgin material ("Climate change and municipal solid waste fact sheet | pay-as-You-Throw | US EPA," 2016; Healey, 2016; Rappaport & Creighton, 2007). Additionally, by reducing the need to collect new, raw materials, it prevents significant amounts of pollution associated with these energy inputs ("Climate change and municipal solid waste fact sheet | pay-as-You-Throw | US EPA," 2016; Healey, 2016; Rappaport & Creighton, 2007).

Figure 1

Educational Poster: Where does my Twin Cities recycling go?



Note: Used with permission by Eureka Recycling. Copyright by Eureka Recycling, 2020.

Reusing unwanted items and materials for a secondary or even tertiary purpose is not a new technique. Since before the industrial age, the concept of recycling and repurposing items and materials has been prevalent. Many European cities' scavengers were employed by municipal authorities. These scavengers would roam the streets collecting waste, gathering rags, shells, metals, and ashes to refashion into new items (Werrett, 2012, p. 630). Ashes from fires were often collected to use as a material when creating bricks ("Brief Timeline of the History of Recycling," 2016). The process of

reusing, repairing, and repurposing materials allowed people to obtain materials easier and at a cheaper cost, which is a concept still alive today.

Often, there were very few choices for many people other than recycling. Recycling items became an economic necessity, especially during war times, when civilians found they did not have many items allocated to them because they were being reserved for the war and military efforts ("Brief Timeline of the History of Recycling," 2016).

The Solid Waste Disposal Act (SWDA) was passed in 1965 by the United States government (Golueke, 1972, p. 29). The overarching goal of the SWDA was to assist and provide resources for local and state governments to refine solid waste systems ("Environmental policy and law," n.d.). While the underlying focus was to lessen the negative effects of poor waste management on the environment ("Environmental policy and law," n.d.), About eleven years later, in 1976, the SWDA was altered to the Resource Conservation and Recovery Act (RCRA). According to the United States Environmental Protection Agency (EPA), the RCRA's principal objectives were to:

- Protect human health and the environment from potential adverse effects of improper/poor solid and hazardous waste management
- Conserve material and energy resources through waste recycling and recovery efforts
- Reduce or eliminate the hazardous waste accrued over past generations as expeditiously as possible.

To achieve these objectives, the RCRA authorized the EPA to regulate the generation, transportation, treatment, storage, and disposal of hazardous waste

(also referred to as “cradle-to-grave management”) and the management of solid waste. ("Resource conservation and recovery act (RCRA) and federal facilities," 2019, p. 1)

This piece of legislation persists today with its primary focus to minimize the effects of waste on our environment, but the enforcement of this legislation has been primarily identified as the responsibility of each state ("Resource Conservation and Recovery Act [RCRA]," 2020).

Also in the mid 1970's, private companies started to explore replacement materials. One very common replacement was plastic for glass. With six plastic bottles weighing less than six glass bottles, the economics of this replacement seemed like an obvious avenue to explore at the time. With the rise of plastics in the 1970s and plastic being a very cheap material to recycle, recycling increased roughly 50% from the 1960s through the 1970s ("Recycling through the ages: 1970s," 2020). Plastic is a rapidly growing segment of municipal solid waste, making up about 12.2% of waste generated today ("Plastics: Material-specific data," 2020).

Be it European street scavengers in the early 19th century or private companies in the 1970s, recycling has always had a strong economic link. People currently recycle to get some money back on goods that have no use to them. An example of this would be in states that have container deposit laws ("State beverage container deposit laws," 2020). However, recycling markets fluctuate based on the cost of materials and disposal expenses. In the 1980s, landfill space was very inexpensive and therefore throwing things away seemed like the most economical solution. However, there is a very significant downside to this out-of-sight, out-of-mind approach. Things took a turn toward the end of

the decade when landfill problems became apparent. Some of these problems are quite obvious such as negative impacts on air and groundwater quality. Since 1988, landfill requirements have done a better job of protecting groundwater and air quality by installing and maintaining plastic pit liners, so chemicals are significantly less likely to leach through to the ground and nearby water tables (Taylor, 1999). In recent years, with the fluctuating cost of oil, the economic benefits of recycling plastic is not as easily apparent. If it is cheaper to retrieve virgin material to manufacture a plastic bottle, rather than recycle, that is unfortunately where the market will go. This obviously leads to less economic incentive to recycle.

Current Recycling Trends

The average recycling and composting rate in the United States is 32.1% and Americans are generating 4.9 pounds of waste going into the trash daily. Additionally, Americans are recycling and composting 1.88 pounds per day ("National overview: Facts and figures on materials, wastes and recycling," 2020). Fortunately, in Minnesota, the recycling rate is higher than the national average with Minnesota recycling 46% of its waste as of 2018 ("Report on 2018 SCORE programs," 2020). Many Minnesotans living in metro areas have single-stream recycling available to them, meaning all materials are placed into one container and separated at the materials recovery facility. This method makes it less time consuming to recycle but can lead to contamination when the public does not know what items can be placed into the recycling bin. Minnesota and the greater Midwest are fortunate to have very strong recycling programs and markets. The states with the lowest amount of waste being recycled are Kentucky, Texas, and Louisiana ("10 best and worst states for waste diversion, reduction," 2015).

Before 2018, 70% of the world's plastic was going to China to be recycled and manufactured into new products (Joyce, 2019). In 2018, China enacted a policy to scale back the amount of recycling they would accept from foreign nations. When these new limitations were put into place, many curbside recycling programs either stopped collection entirely or started scaling back which items could be recycled. Some items were, and still are, stockpiled until markets rebound, and the recycler can sell off the built up inventory (Joyce, 2019). However, there are rumors of recyclables being thrown in the trash. There are certain protections put into place so that this does not happen in Minnesota. In Minnesota, recyclable materials that are brought to a recycling center cannot be dropped off at landfills or incinerators without approval from the state. According to Moylan (2020), that permission to take recyclable material to a landfill has not been granted or even requested.

Recycling Benefits

Besides economic benefits, recycling has other upsides that - to some - might seem even more apparent. Recycling drastically decreases greenhouse gas emissions. This is an advantage that experts can agree upon across the board ("Climate change and municipal solid waste fact sheet | pay-as-You-Throw | US EPA," 2016; Healey, 2016; Rappaport & Creighton, 2007). Accompanied with greenhouse gas reduction, energy savings can also be achieved by recycling. As previously discussed, when taking an existing material and making it into a new product, it requires less energy than sourcing virgin material for a product. For example, an aluminum can is 100% recyclable and manufacturing cans from recycled aluminum requires about 90% less energy than virgin aluminum ("Aluminum recycling," n.d.). While not all recyclable products can be fully

recovered and transformed into new materials, recycling is almost always the preferred waste management option from an emissions and energy savings standpoint.

A life cycle assessment completed by Morris (2004) evaluated environmental concerns affiliated with the management and collection of municipal solid waste from both curbside collection programs for recycling and mixed solid waste. The study found;

Recycling of newspaper, cardboard, mixed paper, glass bottles and jars, aluminum cans, tin-plated steel cans, plastic bottles, and other conventionally recoverable materials found in household and business municipal solid wastes consumes less energy and imposes lower environmental burdens than disposal of solid waste materials via landfilling or incineration, even after accounting for energy that may be recovered from waste materials at either type disposal facility. (Morris, 2004, p. 273)

The study went on to say that the reason it is better to recycle is because it conserves more energy and pollutes less than using virgin materials as the primary feedstock for manufactured goods (Morris, 2004). This conclusion accounts for the pollution resulting from processing and shipping recyclables.

Recycled goods will always be contending with the cost of virgin materials and this not only depends on the cost but also the availability and quality of the material (Alwaeli, 2011). Additionally, if material cannot be collected, sorted, and repurposed in an efficient manner, then it becomes less valuable ("Five most dangerous myths about recycling," 2017). However, the idea around waste is a very inefficient concept. It is not a closed loop system and puts materials into a landfill, only for us to have to make more items. In Minnesota, there is a state tax on trash disposal and many counties impose an

additional tax or solid waste management fee on trash that can be avoided through recycling and/or composting which are not taxed by the state or counties. Large companies also benefit from recycling. In a case study done by New Jersey WasteWise Business Network 2015, Campbell Soup Company headquarters and pilot plant, created a vigorous recycling and reuse program in 2014. From this program, they were able to recycle 92% of the items they were disposing of and saved \$219,000 in disposal costs ("Economic benefits of recycling and waste reduction – WasteWise case studies from the private and public sectors," 2015). Furthermore, the benefits of recycling do not just include financial and environmental aspects. They also create jobs.

In California, for every job in recycling collection, there are eight jobs generated through manufacturing the material that was recovered into a new product ("Frequently asked questions: Benefits of recycling," n.d.). One of the prominent areas for recycling jobs is the computer refurbishing and repair industry; creating 68 times more jobs than landfills ("Five most dangerous myths about recycling," 2017). Recycling not only can be better for the environment, but it creates significantly more jobs when compared to landfilling and incineration of waste and helps people and businesses save money. In Minnesota, the recycling sector employed 63,500 people in 2015 with \$6.28 billion in wages paid (Hotz & Walsh, 2019).

The many benefits of recycling were reviewed for both environmental and economic impacts. The act of recycling takes items and turns them into the same product or a different one using a component of the same material. When food is recycled, it turns food scraps and other organic materials into a useful product as well, called compost.

Composting

Composting is the process of mixing organic materials together, such as food waste and yard waste, then allowing this mixture to decompose through natural processes. Organic materials possess high natural amounts of nitrogen and carbon. The combination of organic materials creates a productive environment for bacteria and fungi to grow which expedites the decomposition process. The nutrient rich soil amendment this process creates is called compost. Composting is an environmentally friendly way to get rid of organic waste because it does not release methane, a byproduct of organic waste in a landfill, and the resulting product of compost has several benefits (Composting At Home, n.d.).

Compost retains moisture very well which helps prevent erosion when used in construction projects compared to sand or rocks. Compost is also a chemical-free fertilizer that can be used in gardens and farms (Pokorny, 2015). Moreover, alternative ammonia-based fertilizers are rich in nitrogen, and this excess nitrogen gets carried away through surface runoff and into groundwater (Buelin-Biesecker, 2014). This nitrogen-rich runoff has been known to create massive algae blooms in lakes, rivers, and oceans. When these algae blooms inevitably die, they use up almost all the available oxygen to decompose. Areas where this phenomenon occurs are known as dead-zones since there is little oxygen remaining for any other aquatic life to thrive. The mouth of the Mississippi River is an example of a dead-zone; a low oxygen area. Taking advantage of compost's natural properties is beneficial to the environment, and the act of composting is environmentally preferable to the alternative; organic waste in landfills or waste to

energy facilities ("Sustainable materials management: Non-hazardous materials and waste management hierarchy," 2020).

The reason organic waste should be left out of landfills is that a landfill is an anaerobic environment meaning that it is starved of oxygen. Therefore, when organic materials are put into a landfill, they do not receive enough oxygen and instead of decomposing, they release methane gas (Buelin-Biesecker, 2014). Methane gas is a greenhouse gas that is 84 times more potent when compared to carbon dioxide because of its incredible ability to absorb the sun's heat (Methane: The other important greenhouse gas, n.d.). Limiting the emission of methane gas from landfills is a big factor in reducing the effects of climate change. In recent years, emissions of methane from landfills have substantially decreased. A study conducted by the EPA from 1990 to 2012 observed that the quantity of solid waste being put in landfills annually dropped significantly over the course of the study (Municipal solid waste landfills economic impact analysis for the proposed new subpart to the new source performance standards, 2014). Decreasing from about 145.3 million tons to 135.5 million tons, this drop is due to strong recycling and composting efforts, as well as waste to energy efforts in the United States (Municipal solid waste landfills economic impact analysis for the proposed new subpart to the new source performance standards, 2014).

Similar to recycling, there can often be contamination within the compost such as plastic, metal, and glass, or non-organic materials. Contamination happens when trash or non-compostable items are included in the compost or organic waste bin and not properly removed when at the composting facility. This indicates a need for continued education when it comes to composting as well.

This section discussed the advantages and disadvantages of recycling and composting. Recycling and composting are great ways to easily lower a person's carbon footprint, and gives items the opportunity for new and useful life. The literature summarizes the benefits of recycling, though observes that practices or benefits are not universally embraced. In this project, the goal was to provide a better understanding of recycling to youth so they can have the tools to make their own decision on the topic. The curriculum will help address the question; *how can curriculum support students' understanding of recycling and waste reduction?* In this next section, behaviors and attitudes around recycling will be discussed.

Long-Term Habits

A habit is an action that a person does regularly, occasionally without knowing that they are doing it ("HABIT | definition in the Cambridge English dictionary," n.d.). Habits can be formed with adequate knowledge of an issue. Such as with knowledge gained by environmental education, it can play a significant role in responsible environmental behaviors (Oskamp et al., 1991). This section provides information regarding the effects on habits of teaching students about waste management and starting the practice early in life. Additionally, the difference of attitudes for recyclers and non-recyclers is explored.

In a study conducted by Knussen and Yule (2008), they stated "...behavior is predicted by intentions to behave or act in a certain way. Intentions, in turn, are predicted by three factors: the attitude toward the behavior, the subjective norm, and perceived behavioral control" (p. 684). The attitude mirrors the interpretation of the behavior and its conclusion or outcome. The subjective norm or normative behavior reflects the scope of

which people important to the individual support the behavior (and how motivated the individual is to satisfy). Perceived behavioral control demonstrates the extent to which the person thinks they are able to perform the behavior (Knussen & Yule, 2008).

To expand on each of these three points, first, attitude is addressed. One of the fastest and effective ways to change one's behavior is by changing their attitude (Hook & Lucier, 1995). Chen and Tung (2009) defined a behavior as a physical emotion and the positive or negative ideas made as an individual does a specific behavior. They go on to say that if a person has a positive attitude toward the environment, then that person's behavior will be consistent with their attitude. However, studies have found that there are many external variables related to a person's recycling behavior, not just their attitude about the concept.

Second, normative behavior is further explained. Some contributing factors that increase recycling behavior include environmental concerns and issues, societal norms, or observing one's neighbors and friends recycling. A person can make a commitment to recycle and make it public, and set goals to help increase their recycling efforts (Oskamp et al., 1991). An example of this would be a study completed by Schwab et al. (2012) on a college campus. Four different residence halls were studied in the research. At the beginning of the school year, attitudes were found to be the main indicator of recycling behaviors. However, over the course of the semester living together, the college students became more identical to those in their living areas in many attitudes. By week ten, the recycling behaviors of the students became more similar to those around them. The study demonstrated that attitude affects behavior, but behaviors can also be predicted by those around us. This is called normative behavior (Schwab et al., 2012).

Lastly, a study completed by Boyes and Stanisstreet (2012) showed the extent to which people are willing to perform multiple behaviors and how much they believe it will help reduce emissions. Boyes and Stanisstreet found the more students thought the action would help the environment, the more they were willing to perform that action to a certain extent (2012). Since the group of people in the study were younger students, they did not have a lot of influence on action for something such as which mode of transportation to take. Middle schoolers may not be old enough to take public transportation and they cannot drive a car. However, many said that an increased usage of public transportation and smaller vehicles would be good for the environment and were willing to do these actions, but they were too young (Boyes & Stanisstreet, 2012).

The research went on to illustrate that there was an eager willingness to act when an action was thought to be effective at reducing global warming. Some of the actions were installing better installation in the home, using energy efficient appliances, reducing synthetic fertilizer use, planting trees, and recycling. Some of these are actions that are in the area of control for middle schoolers and young people. Of course, they are not always responsible for putting the action in motion (Boyes & Stanisstreet, 2012). However, it is shown in several studies that young people impact behaviors and decisions of their family (Croucher et al., 1985; Wilcox et al., 1981).

Some of the areas that found the students unwilling to act were when there was inconvenience due to the decision. An example of this would be the students' struggles to reduce purchasing of new clothing items. It is believed that this resistance came from it being thought of as a normal component of their lifestyle. The same was true when it came to long-distance travel. Many students were unwilling to make lifestyle changes

because they were thought to be an inconvenience (Boyes & Stanisstreet, 2012). This inconvenience then served as a disincentive to alter one's actions (Flanagan, 2017).

Boyes and Stanisstreet (2012) studied these behaviors to see how effective environmental education would be. The behaviors that were proven to be most effective through environmental education were actions that would generate participation by many. This is similar to normative behaviors. Examples of these behaviors include reducing meat consumption, purchasing organic produce, decreasing car use, and using energy from renewable sources (Boyes & Stanisstreet, 2012). These are examples of items for which people are more willing to change their behavior because there is environmental education available on these topics. This helps people better understand the rationale of why an action reduces the effects of climate change.

It was shown that those around us affect our actions. Our attitude towards a topic or behavior can dictate what a person might do and improve their understanding of the topic. This is important to know because driving forces to get someone to recycle needs to be understood. The next section examines the importance of learning these behaviors and if there is a better age to learn them.

Recycling Knowledge and Recycling Behavior

In a small study conducted on a college campus, Wright (2011) found that individuals who could not correctly identify, sort, and dispose of recyclable items properly had lower recycling rates than those who had stronger recycling proficiency. The need for education on proper disposal methods and sorting was highlighted with the number of respondents that answered the survey questions incorrectly, especially when

dealing with what materials are recyclable and the proper way to recycle them (Wright, 2011).

In the same study organized by Wright (2011), it was found that there was a strong correlation between recycling behavior and recycling knowledge. This shows that knowledge has the strongest effect on recycling behavior. Vining and Ebreo (1990) identified one distinction between non-recyclers and those who do recycle is their knowledge and familiarity with items that can be recycled, and that recyclers possessed higher amounts of knowledge about recycling than those who did not recycle. To facilitate actions of sustainability, and protect the environment through waste reduction, it seems that substantial knowledge is a necessary condition (Wright, 2011). This led to the conclusion that with the proper knowledge of recycling, more people would participate (Wright, 2011). Education around recycling can be impactful knowledge for someone to help them make better decisions for the environment.

Environmental awareness education has been implied to be most powerful on younger children who are pre-adolescent because they do not have well-ingrained environmental habits (Asch & Shore, 1975). It is conceivable that a more firsthand experiential approach could be more effective in changing the behaviors and attitudes than a mainly knowledge-based presentation (Smith et al., 1997). In a study completed by Smith et al. (1997), they found that even a brief educational recycling program with elementary school-aged students had a significant impact on behavior, habits, and attitude toward recycling. The study also found that a field trip to a landfill and a presentation regarding what happens when items are not recycled, are effective tools to increase

recycling behavior. Additionally, a classroom discussion helps increase students' knowledge of waste management (Smith et al., 1997).

When completing a similar study looking at both adults and students, the results found that classroom interventions such as composting, planting a vegetable garden, and recycling improved environmental behavior for the students (Zelenzny, 1999).

Additionally, the behaviors persisted for a longer duration in younger participants. In the same study completed by Zelenzny (1999), it was found the effects on adults were much smaller than they were for children.

Education is often associated with environmental behavior, as it is thought to direct a person to greater environmental awareness and changes in attitudes (Williams, 2011). This shift in attitudes and knowledge is thought to improve environmental behavior (Zelenzny, 1999). Furthermore, it has been found that the particular positive attitudes towards the environment are frequently retained after a two-year period (Jaus, 1984). Attitudinal shifts can be thought of as more impactful than cognitive ones, because attitudes can still persist even if education learned is lost (Jaus, 1984).

In the section above, recycling behaviors, attitudes, and habits are examined. The next section focuses on the curriculum created that helps to shape those behaviors and inform habits. It examines several recycling curriculums. Some of these curriculums were used as a guide to create the capstone project and assist in answering the question; *how can curriculum support students' understanding of recycling and waste reduction?*

Examples of Recycling Curriculum

As previously mentioned, human behaviors are shaped by attitude, and education can impact those attitudes. An individual can gain knowledge about a topic through

experiences, from those around them, and through their education. It was demonstrated that teaching students about something like recycling at a young age, stays with them longer than an adult (Zelenzny, 1999). To identify topics that recycling curriculums cover exhaustively, numerous educational materials and lesson plans were reviewed and analysed.

A-Way with Waste

A-Way with Waste (1990) was written and developed by Washington State Department of Ecology with a special focus on making it very classroom friendly. The curriculum has activities for K-12, however, this project focuses on K-5. Each lesson gives students the opportunity to problem solve and work through decision-making tasks.

The curriculum has many sections with an overarching goal to educate students on air quality. However, the solid waste section contains subsections focused on reduction, recycling, and disposal.

The section titled "Reduce" focuses on consumerism and how individuals can work to reduce their waste through the decisions they make (A-Way with Waste, 1990). In the K-5 section, there are four subsections: consumer awareness, reuse, advertising, and litter. The consumer awareness section challenges students to keep track of their waste, by making a chart and marking an "x" in that box when an item is thrown away. Then after a week of tracking their trash, the students reduce the size of their trash bins and track the trash that is thrown away to see if they have less waste than the week before. In a different lesson, the students are asked to think about all the possibilities that items can be used for and discourages the use of products that only have one purpose. It often brings up the idea of how Indigenous Peoples lived with little waste and why

people have more trash today. This section encourages students to remember they have the power to choose the items that they dispose of. The reuse section ties in with the previous section, this section helps students think about the necessity of certain items such as a grocery bag or take-out container (A-Way with Waste, 1990).

Next, advertising is covered, giving students the task to create a short commercial discussion of the environmental consequences of the product. It poses a question about why people should consider the disposal characteristics of a product before purchasing it. Lastly, in the litter section, students hunt for litter outside and see first hand how prevalent and problematic it can be. They then sort out items that are recyclable (A-Way with Waste, 1990).

These sections of *A-Way With Waste* (Washington State Department of Ecology, 1990) get students thinking about how their decisions impact the planet and reaffirm that they have the power to not bring certain items into their home. It should be noted this is very difficult since younger students may not have as much purchasing power.

In the recycling section, the lessons focus on what items get made into as a result of being recycled. For example, the students make paper from recycled paper, seeing the process of taking one item and having it become another item. There is a portion of the lesson that focuses on composting as well and teaches using a box of food scraps with worms. The students learn that the worms are also recyclers, turning one product (food waste) into a nutrient rich dirt. Disposal is the last section of the lesson where the students make a landfill in a jar. They are given four solid waste materials consisting of organic waste (orange peels), recyclable/renewable items (newspaper), non-renewable/recyclable (glass), and trash (styrofoam). The jars are observed for three

weeks while the students discuss the problems with landfills, such as methane gas, loss of natural resources, and contamination of groundwater. At the end of the three weeks, the students are asked what products they believe they should buy (*A-Way with Waste*, 1990).

In this section, put together by the Washington State Department of Ecology (1990), learners get to have a firsthand experience of their waste and what it is made into or how it breaks down. This can help paint a better picture for students of what happens after an item is thrown in the bin. This can help reduce the out-of-sight, out-of-mind thinking that many of us have when it pertains to waste.

A-Way With Waste presents itself as a good curriculum for a younger audience, as it touches on a lot of the basics but does not go into too much detail. The following lesson plan would do a good job of building on the basics that were learned with *A-Way With Waste* (1990).

The Quest for Less

This curriculum is a resource for teachers of elementary to middle school students and is designed to be a more accelerated week-long unit or enhance existing classroom activities (EPA, 2005). The Environmental Protection Agency (EPA) developed this lesson plan to teach students how natural resources are used to make new materials, the types and quantity of waste that are created from these products, and goes into detail about the methods used to manage waste.

The first unit of *The Quest for Less* curriculum consists of three chapters on source reduction, waste, and products. It teaches students about natural resources and the difference between virgin resources and recovered resources. Additionally, it explains the

difference between renewable and non-renewable resources. An example that is used is the damage that can happen to an ecosystem when many trees are cut down and brings up the displacement of animals (EPA, 2005).

The first unit helps students understand where the products they use daily come from and the kinds of waste these products create. The learners are challenged to think about the waste that is created by human activities such as mining for virgin materials and manufacturing goods in factories. This helps set the learner up for success for the coming lesson where they learn about waste prevention, recycling, compost, and reuse (EPA, 2005).

The second unit of *The Quest for Less* outlines the waste hierarchy. The unit begins with the most environmentally friendly option, reducing waste, and moves to the least environmentally friendly option, landfilling waste. It teaches students about the benefits of reducing waste, reusing items, recycling materials, and composting. This unit ends on waste incineration and landfilling (EPA, 2005).

In the section on reducing waste, the issue with convenience is covered and how single-use items can cause more waste. The associated activity includes a source reduction picnic, showing the benefits of reusable plates and silverware, and how using these items can help reduce waste. The lesson then moves onto the recycling section and covers the benefits of recycling and buying recycled products. The lifecycle of a plastic bottle is covered and how it can be used in a variety of products when recycled. Next, composting is introduced, teaching students how to make and use compost while focusing on the importance of decomposers. Students observe the benefit of growing plants with compost and compare it to a plant that is grown without compost. Lastly,

incineration and landfills are discussed. When an item is incinerated, it is burned, whereas in a landfill the bottom of a hole is lined so chemicals cannot leak out, and an item is buried in that hole without the presence of oxygen. Students make a landfill by lining a colander with clay then adding garbage and dirt. They pour water over the colander to act like rain, then they make observations (EPA, 2005).

The last unit in *The Quest for Less* (EPA, 2005) allows students to apply the knowledge they have learned throughout the units and show analytical and decision-making skills. The activities help learners review the types of materials that are trash, recyclable, and compostable. The students do a relay race to sort out items into the proper bins. There is then a call to action for the school, to have students create posters and announcements to hang throughout the school and help others learn of proper disposal of materials (EPA, 2005).

This lesson plan answers more of the ‘why’ questions and gives students more background knowledge on the process. Much like *A-Way With Waste*, this curriculum developed by the EPA gives young people the opportunity to learn about the products they interact with in their everyday lives, but it has a call to action component to help others learn more about proper recycling. The following and final lesson plan offers a very hands on and discussion-based curriculum for students to learn about waste management.

Doing the 4Rs

The 4R's Curriculum was developed by Alameda County in California and is used in the Bay Area as a guide for teaching students in fourth and fifth grades (2005). This curriculum examines many of the other topics focused on by the other curricula. It should

be noted, 4R's Curriculum does not contain a trash component and does not go into detail about landfilling or incinerating trash.

This curriculum begins with a renewable and non-renewable lesson. It walks students through examples of items that are renewable like plants and animals and showing how fossil fuels and minerals are not renewable. It gives examples of everyday items that are made from natural resources such as a wool hat, a leather shoe, and canned food and asks students to decipher if the items are from renewable or nonrenewable resources (4R's Curriculum, 2005). This is another example of giving students the knowledge to know where their items come from and what resources the materials are using.

The first “R” of 4R's Curriculum is “Reduce”. The lesson starts with an activity exploring how students can reduce packaging waste by finding alternatives to the packaging they brought in from home. Then learners move onto a different lesson about using less as they brainstorm with their peers how they can minimize their paper use. This leads into a lesson about how saving natural resources, such as paper, can have positive effects on the environment by conserving wildlife habitat. The last lesson of this section focuses on a discussion with classmates about where they stand on waste reduction, giving them a scale of strongly disagreeing and strongly agreeing, then supporting why they feel that way (4R's Curriculum, 2005).

The second “R” that *Doing the 4Rs* covers is “Reuse”. The students are given the task to compare the energy required to recycle a bottle, reuse a bottle, and create a bottle from virgin materials. They explore which takes the most amount of energy through steps given by the teacher. This helps lead into the following sections where the students find

four useful alternatives to the trash or recycling they brought in from home. This helps the students come to the realization that not every item needs to be disposed of when it is done being used for its initial, intended purpose (4R's Curriculum, 2005).

“Recycling” is covered in the third section of 4R's Curriculum. This section begins by guiding students through the steps of seeing how plastics are made, starting from drilling for oil. This is followed by diving deeper into plastic to learn about the seven different types (plastic resins) and doing research regarding which plastics are recyclable in their community. Students are then tasked with a research assignment to find where some household items can be recycled in their community such as electronics, appliances, and yard trimmings (4R's Curriculum, 2005).

The last of the four “Rs” is “Rot” or composting. This topic is introduced through a video, then students practice their skills by finding items around the school to classify as biodegradable or non-biodegradable. This section is concluded by students observing organic materials breaking down in a cup of dirt and performing an experiment to see if compost helps plants grow faster.

The three lessons listed above all focus on waste management and teaching students about it through a variety of educational lessons. *A-Way with Waste* (1990) offers material on waste reduction and also air pollution, which two other curriculums listed do not cover. *The Quest for Less* (EPA, 2005) and *4R's Curriculum* (2005) are similar in the topics that are reviewed except *The Quest for Less* (EPA, 2005) contains lessons about more environmentally friendly productions and the benefits of source reduction.

Summary

All of the curriculums covered cater to those who learn best by doing and have more of a kinesthetic learning approach. This is likely best because recycling is a very hands-on activity. Many of the curriculums touched on similar topics with each going into different amounts of detail. For a younger audience *A Way With Waste* (Washington State Department of Ecology, 1990) would likely be best because of the lack of details that are covered. *A Quest for Less* (EPA, 2005) was the curriculum that the project has pieced pulled from, as well as *Doing the 4Rs* (4R's Curriculum, 2005). These seem most appropriate for the audience addressed in the project.

From the findings of others, it can be concluded that education on recycling can help young people better understand waste management and have a deeper understanding of the products they use. This education helped students make better connections with the natural world and assisted them in leading more sustainable lifestyles. The act of recycling can be implemented immediately upon learning more about it, and can be part of many people's daily lives. With that being said, students can benefit from education on the topic of waste reduction (Boyes & Stanisstreet, 2012).

Chapter three provides an overview of the project and the audience it is intended for. The chapter touches on the rationale of the project, as well as the state standards that are met, and the timeline it would take to complete the curriculum. The third chapter helps aid in answering the capstone question; *how can curriculum support students' understanding of recycling and waste reduction?*

CHAPTER THREE

Project Description

Chapter Preview

Chapter three of my capstone project continues to examine the capstone question of *how can curriculum support students' understanding of recycling and waste reduction?* Throughout this chapter, I review sections of literature from chapter two and again, examine my research question. Then, I discuss the purpose of this project, the importance of it to me personally, and the reason I feel it is an important topic for students to learn about. Next, I describe the setting and participants are a part of the project. I discuss the instructional strategies used to develop my current curriculum. This leads into the current state standards that are used in the curriculum and I identify student learning objectives. This curriculum uses the Understanding by Design Framework, designed by Wiggins and McTighe (2011), and the reverse design approach for the development of each lesson. An outline of the lesson plan template is provided, as well as a timeline of what a typical unit length looks like with possible alterations to the timeline. A discussion of the assessment created for the unit concludes the chapter. Lastly, a summary of the chapter continues with a brief introduction to chapter four.

Rationale

Waste is something that is a fixture in many people's lives and, as described in chapter two, there are many ways to avoid waste and properly dispose of it. With the proper education around waste management, a person can better understand the impacts that certain products are having on the environment. Additionally, by learning about proper disposal, it works to eliminate a barrier to recycling because the person is better

informed about the topic. My hope is that by exposing students to the impact their waste has on the environment, will open their eyes to a problem. With this knowledge, students can use this understanding of waste and how their purchasing habits can have an impact on the environment.

This curriculum aims to expose students to the life of waste beyond throwing an item in the bin. Additionally, it focuses on proper recycling practices for those living in Minnesota. Each lesson offers a hands-on approach for students to learn about waste and gives them the opportunity to implement those findings into their lives. The next section offers more detailed information regarding what content is in the lesson.

Project Description

Similar to what is stated above, the purpose of this project is to educate students on waste management so they can make more informed decisions when disposing of an item with the hope that will carry through to make better choices as consumers when old enough to make those decisions. The way this is to be achieved is by explaining a unit of study for elementary students in a formal or informal educational setting. This unit works well when studying human impact. It also serves as a unit to accompany environmental science.

The curriculum guides students through the topics of natural resources, recycling, composting, the purpose of landfills, and waste reduction overall (Appendix A, B, C, D, E). At the end of each lesson, there is an evaluation or assessment to gauge students' understanding. This is done through discussion, answering questions, and taking a pledge to reduce waste. Each section follows a similar pattern; the students would learn about a topic through a video or through discussion/activity that is educator-led, then the students

are instructed on how to do a project pertaining to the discussion, activity, or video promoting a better understanding of what they learned about. The assessment at the end is through discussion, answering a few questions to measure understanding of the topic, or recording weekly observations (Appendix A, B, C, D, E).

With five lessons in total, each lesson will take about 45 minutes to complete and has suggestions for alterations due to time, setting, and budget. For example, if resources allow, two local field trips are suggested to the Ramsey/Washington Recycling & Energy Center or to a waste collection area (dump) and also Eureka Recycling or a materials recovery facility (recycling center). The lessons are appropriate for a classroom setting and projects can be changed to accommodate educational settings outside of the classroom. The lessons were prepared with alterations to adapt different skill levels, age groups, and groups of students with varying ages.

The implementation of this project will occur over a five-week period. The unit project will not span the entire five weeks but the sequence can be completed in a way that makes the most sense to the educator. The estimated curriculum length of the lessons is about 10 standard class periods. The season this unit is best suited for is fall, spring, or summer given there is some outdoor exploration. However, with the right clothing, winter would be fine to conduct this curriculum as well. The audience and seeing of this research is described in the next section.

Setting and Audience

This project takes place in Minnesota with a variety of educational settings, including but not limited to schools, environmental centers, churches, after-school programs, and camps. The intended audience is elementary school-aged children and the

size of the group can vary from 15 to 30 learners. In some of the lessons, there are modifications for different settings. An educator is needed to facilitate each lesson. There is a section in the unit that is specific to Minnesota recycling acceptable items. The lessons and topics included in the project will be implemented into the educational handouts and resources for Minnesota Waste Wise Foundation. This curriculum is significant because it exhibits that captivating and applicable lessons can be taught in a variety of educational settings. In the following section, instructional strategies are explored.

Research Framework

This curriculum uses the Understanding by Design Framework, designed by Wiggins and McTighe (2011), and the backwards design approach as a base for the development of each lesson. When creating the curriculum, the assessment was created first, followed by the project, and lastly the background information. The construction of the curriculum is broken down into three stages. The stages can be defined as: identify results, elect assessment evidence, and create instruction and learning experiences. Each of the three stages asks the question “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). By having a backwards design approach, each of these questions were answered by creating an assessment first, then curating a lesson allowing students to make connections with their world. Wiggins and McTighe (2011) made the suggestion that the lessons are student-driven with the teaching acting as more of a facilitator. Since waste is a part of almost all students' everyday lives, it is likely a familiar topic with each lesson allowing for new learning opportunities. Minnesota State

Science Standards that are addressed within the curriculum can be found in the preceding section.

State Standards Addressed

The standards that are addressed in the following section are part of Minnesota State Science Standards for grade three, 2019 Edition. These standards are currently available in the form of a draft and could be revised in the future.

1.1.1 Students will be able to ask questions about aspects of the phenomena they observe, the conclusions they draw from their models or scientific investigations, each other's ideas, and the information they read.

1.2.1 Students will be able to design and conduct investigations in the classroom, laboratory, and/or field to test students' ideas and questions, and will organize and collect data to provide evidence to support claims the students make about phenomena.

2.1.1 Students will be able to represent observations and data in order to recognize patterns in the data, the meaning of those patterns, and possible relationships between variables.

3.1.1 Students will be able to develop, revise, and use models to represent the students' understanding of phenomena or systems as they develop questions, predictions and/or explanations, and communicate ideas to others.

4.1.1 Students will be able to engage in argument from evidence for the explanations the students construct, defend and revise their interpretations when presented with new evidence, critically evaluate the scientific arguments of others, and present counter arguments.

These standards are addressed throughout the curriculum. The assessment at the end of each section identifies whether the standards have been met.

Assessment

To confirm the effectiveness of each lesson, there will be an assessment at the end of each section. This assessment will be in the form of discussion, recreating a landfill, recording observations, and answering questions. The assessment will show the educator what topics were understood by the students and the areas that need further explanation. Additionally, the project's effectiveness is measured by the amount of waste diversion or reduction in the setting that the project takes place.

Timeline

The project literature review, design, and implementation was conducted over the course of 9 months. The preparatory research began at the end of January 2021 and the final design completed in August 2021. Since the project was completed in August, implementation began in September of 2021.

Summary

The purpose of chapter three is to present a curriculum project educating students on proper waste reduction practices. It addresses the research question; *how can curriculum support students' understanding of recycling and waste reduction?* In the chapter, it began with a rationale for the need for more education regarding waste at an elementary age. This led to an explanation of the setting and audience that the curriculum was geared towards and the curriculum was briefly explained in this chapter. Then, the research framework was examined, in addition to the Minnesota State Standards that are

covered throughout the curriculum. There was an explanation of instruction time given and also the timeline for establishing the curriculum was presented.

Chapter four contains the results of my project implementation and a reflection regarding the importance of the field of science education. The chapter also reviews the success and challenges of the project as well as a brief summary of the further extension of the research. To complete the chapter, there is a final conclusion of the entire project.

CHAPTER FOUR

Conclusion

Introduction

With waste impacting almost every person in Minnesota, this capstone project serves as a guide to reduce waste and better understand recycling while increasing the engagement and understanding of our natural world through learning about waste. The unit lesson and project address the question of: *how can curriculum support students' understanding of recycling and waste reduction?* The theme that is carried through each lesson is the mindful use of natural resources and the impact people's goods have on the planet. Both group and individual work involves students to problem solve and think critically about the items they use in their daily lives. The lessons ask them to reflect about how their actions might impact waste and ultimately the amount of natural resources they are using. Additionally, students make observations regarding how organic waste such as food scraps are broken down into a useful material called compost. Throughout the project, the focus is on easy implementation with alternative activities to better fit any educational setting. Students are encouraged to use their environment, community, and resources they use daily to reflect on how they might impact the waste stream. Chapters one through three demonstrate how this hands-on learning can be performed through the use of place-based learning to encourage reflection on natural resource use.

Overview of Chapters

The first chapter introduces my capstone project of the importance of waste reduction education. My personal connection to the topic is explained and the related

background information is described in this chapter as well. The chapter describes how I use this education in my work when working with businesses to reduce waste and my rationale for needing this type of education at a younger age.

In the second chapter, I examine the research and resources that have been conducted regarding my capstone project. Including the major topics of waste reduction and recycling, long-term habits, and current recycling curriculum. In the section on waste reduction and recycling, I cover an array of topics starting with the history of recycling, which leads to the items that can be recycled in the Twin Cities metropolitan area because it has a strong market. The benefits of recycling are researched as well as the act of composting and the benefits of the final product. In this chapter, I also cover how knowledge, habits, and the actions of those around a person can affect their recycling behaviors. Lastly, there are three curriculums that are reviewed covering many different waste management topics.

The project is described in chapter three, as well as the timeline the project can be completed within, the implementation of the lessons, and the setting and audience that the project is curated towards. The research framework, assessment details, and state standards that are addressed can be found in this chapter as well.

Chapter four reflects on the writing process of the capstone project. It presents the strengths and value of the project. It reviews the literature that guided the project.

Reflection on Capstone Process

It was always clear to me that I wanted to focus my capstone project on creating an artifact that I was passionate about, but that others could use as well. Environmental education has always been something that excites me and my current job requires a lot of

education around recycling practices. Much of the education I do in my job is geared towards adults who have been recycling most of their lives but did not learn how to do it properly. This shows me that there is a gap between the act of recycling and educating those who are participating. Training and tools are developed for adults at my work but not necessarily towards students in the churches, camps, daycares, etc. that we are working with at Minnesota Waste Wise Foundation.

Throughout the process of creating my capstone, I learned a lot about my preferred writing style, the importance of time management, and the need for proper APA formatting. My classmates and I were encouraged to write just 15 minutes a day. This would allow us to not forget the spot we were at and where our writing was going. The 15 minutes a day writing technique worked very well for me and my work style because it often led to more time than 15 minutes spent on writing and researching my capstone.

While writing my second chapter the research that I enjoyed writing about the most was habit forming behaviors. I believe this is because prior to writing the chapter, I knew very little about it. I found that it can have profound effects on a person's willingness and ability to recycle properly or reduce waste. It was also very reassuring to learn that there is correlation between the amount of knowledge a person has on a topic and their interest in it. This is reassuring because it causes me to assume that the more a person knows about recycling, its benefits, and positive impacts on the environment, the more they could become interested in the topic.

Review of Guiding Literature

Looking through the lens of research, the literature review portion on my project was very informational. As noted above, when conducting my research, I broke the

research down into three categories: waste reduction and recycling, long-term habits, and recycling curriculums. This helped organize and prioritize the topics I wanted to bring my focus towards.

In the first section, I found that covering a history of recycling would create a good foundation as an introduction to the topic. For this information I cited works from *Brief Timeline of the History of Recycling* (Busch Systems Resource Center, 2016), as well as *Resource conservation and recovery act (RCRA) and federal facilities* (US EPA, 2019). These sources explain how people and legislation helped build recycling over time. In the section regarding current recycling trends, I worked to debunk the myth that in Minnesota, our recyclables were not getting recycled. An MPR news article was used for this research, stating that permission has never been granted to take recyclable materials to a landfill (Moylan, 2020). Recycling benefits and composting were the last two topics covered in this section. I used many sources to show both the energy savings and cost savings that recycling has compared to virgin material (Morris, 2004; Rappaport & Creighton, 2007). The source *Urban composting in the technology and engineering classroom* was a beneficial resource to demonstrate the lack of emissions that composting creates rather than landfilling food waste (Buelin-Biesecker, 2014).

The second section includes information on long-term habits and the correlation between recycling knowledge and recycling behavior. The sources that I found to be most uplifting and beneficial was conducted by Zelenzny (1999). This researcher found that when students learned about recycling the habit stayed with them for longer than it did with adults (Zelenzny, 1999). This led to more research supporting the final section and project.

Three recycling curriculums are reviewed in the final section of the literature review. *A Way With Waste* (Washington State Department of Ecology, 1990) was a good curriculum for younger audiences and builds on the basics of recycling and waste reduction. *A Quest for Less* (EPA, 2005) and *Doing the 4Rs* (4R's Curriculum, 2005) were mainly referenced when completing the project.

The research conducted and highlighted in my literature review helped my capstone project of creating a curriculum take shape. This review works to support the question: *how can curriculum support students' understanding of recycling and waste reduction?* The limitations, adaptations, and shortcomings of the project are explained in the following section.

Limitations and Adaptations

The biggest challenge to the project is creating the time to complete it with many other competing standards that need to be met. The curriculum offers many different adaptation exercises and stand alone activities that can be completed in the interest of time. This lesson was mainly created for informal educational environments where there is often more time and freedom regarding how to fill that time.

The capstone project is intended for an elementary school aged group with more of a focus on third grade. Again, the additional exercises can assist an educator in better tailoring the curriculum to the group they are working beside. Unfortunately, much of the lessons could not be adapted for high school students, as they would likely not be challenged enough.

With recycling practices varying by county, and even by waste hauler, some of the lessons of the project may not pertain to students outside of the metro area such as the

lesson titled *Recycling*. This would be an excellent opportunity for future adaptations and future uses, as educators could utilize the base of this lesson and change it to contain the recycling details of what is accepted in that specific area. The next section of this chapter includes information on communicating results and a final conclusion.

Communicating Results

In completing this project, all of the relevant information and documents are linked with this capstone. My intention is to share my work with my friends and family, but mainly my results will be communicated and used with those in my professional community. I hope to update the capstone project, as information changes.

Conclusion

During the process of creating, researching, and writing my capstone paper and project, the focus was on the question: *how can curriculum support students' understanding of recycling and waste reduction?* This question assisted to guide me through the process of reviewing and building upon research to reach the goal of creating a curriculum project that is important, engaging, and relevant to our society. The literature review taught me how far we have come but also, how much improvement is needed. As I tried to portray in the lessons and the paper that recycling is important, but is even more important is reducing waste. The literature review explained that learning about the environment does have positive habit forming effects on students that can be carried with them and even influence others. In the curriculum that was created, I strived to make it as hands-on as I could, because of how hands-on a topic recycling is. I am excited to share my capstone project with my co-workers and the different groups that could find it beneficial. I plan to make changes and adaptations as I see fit to continue

having a relevant project. It is my hope that this project is a valuable tool for students and educators, and that this can help teach others how to leave the world a bit better than how we found it.

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