The Role of Environmental Education in the Ontario Elementary Math Curriculum

By

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ABSTRACT

In 2007, the Ontario Ministry of Education (OME) mandated environmental education (EE) be integrated into all subject areas. However, in the Ontario math curriculum, there is not a single specific expectation that makes reference to EE. An initial literature review revealed there is a significant research gap when connecting math and the environment at the elementary level. Very few techniques, strategies and specific activities are proposed to help teachers integrate EE within the math curriculum. The primary research question that guides the study is: What role does environmental education play in the Ontario math curriculum at the elementary level? A qualitative case study approach is used as data is collected through individual, semi-structured interviews. Codes are created to identify two overarching themes. There are many challenges that restrict teachers from easily integrating EE and math. However, opportunities do exist for schools to overcome these challenges and successfully integrate EE and math. The OME must take a more active role in providing practical solutions that link EE and math. Teachers must be reflective and motivated to make their own connections between EE and math. Finally, administrators must encourage widespread integration of EE within all subjects, including math.

Key Words: Environmental Education, Math, Elementary, Ontario
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Chapter 1: INTRODUCTION

1.1 Introduction to the Research Study

Humans are entering a critical moment in time, and the choices we make moving forward could have a catastrophic impact on our future existence and success. Rachel Carson’s *Silent Spring* (1962), was the catalyst for the public realization of widespread environmental degradation. Davis (2010) concludes that since that point, it has become clear that humanity is not living within Earth’s capacity to provide food, water, clean air and other natural necessities required for human survival.

That is why it is so critical that all of society – seniors, adults and children alike – recognize the importance of promoting ecological awareness and implementing solutions to support sustainability. Sustainability is defined as “the ability to meet the needs of the present, without compromising the ability of future generations to meet their own needs” (United Nations World Commission on Environment and Development, 1987). The next generation will be the recipients of the choices we make in the present. It is clear that education must play a significant role in promoting sustainability:

Schools have a vital role to play in preparing our young people to take their place as informed, engaged and empowered citizens who will be pivotal in shaping the future of our communities, our province, our country and our global environment (Ministry of Education, 2009).

In 2007, the Ontario Ministry of Education (OME) published ‘Shaping Our Schools, Shaping Our Future.’ This document mandated that Environmental Education (EE) be integrated into all subject areas (Ministry of Education, 2007). However, this document does not provide
specific recommendations on how teachers can actually integrate EE within school subjects. In 2011, the OME published the document ‘Environmental Education: Scope and Sequence of Expectations,” which was aimed at assisting teachers in integrating EE into each subject. This document clearly shows that in the grade one to six Ontario math curricula, there is not a single specific expectation that makes reference to EE. In contrast, subjects such as science had 98 specific expectations referenced to EE (Ontario Ministry of Education, 2011).

1.2 Purpose of the Study

An initial literature review revealed that there is a significant research gap in the techniques, strategies and specific activities proposed to help teachers integrate EE with the math curriculum. Gadotti (2010), Wakefield (2001), and Renert (2011) demonstrate that integrating EE and math enhances student learning and develops skills such as the ability to think critically; however, all three authors fail to propose actual strategies or activities demonstrating how to integrate EE and math. Although many authors demonstrate that the environment and math are interrelated, they do not make any connection between EE and math at the elementary level. Ernst and Monroe (2006), as well as Pfaff (2011), only justify the importance of connecting EE and math at the high school and university level, making no reference to the importance of linking EE and math at the elementary level.

Due to the importance of integrating EE into all curriculum subjects, and the fundamental gap that exists in the current Ontario math curriculum, the purpose of this study is to examine the role of EE specifically within the math curriculum. The scope of the study is confined to the primary and junior levels of education in Ontario, grades one to six, with a focus on schools within the Toronto area. This is supported by primary research gathered from interviewing two
elementary teachers who have a working knowledge of EE and have integrated it within specific subjects. The paper ends with a discussion and analysis of the participants responses followed by recommendations and conclusions.

This study is important to the education community because there has been very little research analyzing the relationship between EE and math at the elementary level. Many teachers do not possess the knowledge or skills on how to integrate EE into the classroom and therefore struggle with educating their students on aspects of sustainability.

1.3 Research Questions

The primary research question that guides the present study is: What role does environmental education play in the Ontario math curriculum at the elementary level?

The secondary sub questions for this research are: 1. What are the challenges teachers face when attempting to incorporate environmental education into the math curriculum? 2. What activities and strategies are teachers currently implementing to integrate environmental education with math? 3. Which strands of the math curriculum are best suited to integrating environmental education?

1.4 Methodology

In this research study, a qualitative case study approach is used as the methodology. Eisenhardt (1989) defines a case study methodology as a research strategy that focuses on understanding the relationship and dynamics within a confined, real world setting. The methodology used in this proposal draws on the work of existing experts in the field of qualitative research. Specifically, it draws in part draw from the work of Creswell (2013), who
describes a case as a bounded system and includes a detailed, in-depth data collection process. Creswell highlights that key components of a case study approach include identifying the case, stating intent, using multiple sources of data, and analyzing the data.

In addition to Creswell, the methodology guiding this research proposal draws from Robert Yin (2014) who argues that a case study research strategy answers how and why questions, accommodates situations when the researcher has minimal control over the events, and occurs in a real-life context. In this research study, I use Yin’s recommendations on how to construct validity and follow the case study protocol for developing effective questions and conducting successful data collection techniques.

The scope of this research is confined to schools within the Toronto region, which sets the boundary for the research. Data is collected through individual, semi-structured interviews as well as observations. The interview is recorded on a recording device. The results of the data collection from two specific cases of teachers who currently integrate environmental education and math are analyzed. This analysis consists of the identification of codes, which can easily be organized into groups of themes or categories. The case study approach is utilized to provide a description teachers perspectives on integrating EE and math, as well as make conclusions and recommendations for best practices moving forward.

1.5 Background of the Researcher

I am currently completing a Masters of Teaching degree from the University of Toronto. I have completed an Honours Bachelor of Environmental Studies degree from the University of Waterloo. The specific program I studied was Environment and Business. The core of my program was centered around interdisciplinary courses, focused on the concept of sustainable
development. My undergraduate degree has given me the opportunity to work full time in five different four-month co-op placements, holding varying positions within businesses, such as a Project Manager for New Gold Inc. It is through these co-op experiences that I have experienced first-hand the importance that all businesses and all of society work to preserve the natural environment. I am very passionate about, and well versed in, the concept of sustainability and environmental education.

Unfortunately, it was not until I got to the university level that I started to learn about environmental stewardship and sustainability issues, such as climate change. I believe that it is extremely important we educate children on the concepts of sustainability from a very young age.

By conducting this study, I hope to help identify solutions that teachers can readily implement into their classrooms that connect environmental education and math. My previous research experience combined with my passion for promoting environmental education will ensure that I succeed in addressing an obvious gap in academic literature and the existing OME curriculum. More importantly, my work supports student engagement of environmental awareness in elementary education and empower students to become agents of change.

1.6 Overview

This research proposal consists of five chapters. Chapter one provides an overview of the study, the purpose of the study, the research questions and the background of the researcher. Chapter two consists of a literature review, which analyzes previous research exploring the relationship between environmental education and math. Chapter three described the methodology and procedure used in the study, as well as information about the participants, data
collection methods, and ethical considerations. Chapter four provides an analysis of the data collected. Chapter five discusses and provides conclusive statements on the data analysis, limitations of the study, and highlights recommendations for future teaching practices and future research studies. References and the appendix are at the end of this study.
Chapter 2: LITERATURE REVIEW

2.1 Introduction to Literature Review

Children, tomorrow’s leaders, must be knowledgeable and prepared to tackle the future challenges that they will inherit. It is our responsibility as a society to provide environmental education to children. Children must possess the knowledge, skills, attitudes, and values necessary to support a sustainable future (Davis, 1998).

In 2007, an expert panel was formed and undertook the task of analyzing and presenting recommendations to address the needs of teaching and learning about the environment in elementary and secondary schools in Ontario. The panel published 32 recommendations in the document “Shaping Our Schools, Shaping Our Future,” effectively mandating environmental education (EE) be a part of every child’s learning (Ministry of Education, 2007). This document defined EE as:

Environmental education is education about the environment, for the environment, and in the environment that promotes an understanding of rich and active experience in, and an appreciation for, the dynamic interactions of the Earth’s physical and biological systems, the dependency of our social and economic systems on these natural systems, the scientific and human dimensions of environmental issues, and the positive and negative consequences, both intended and unintended, of the interactions between human-created and natural systems. (Ministry of Education, 2007, p.6)

In 2009, the Ontario Ministry of Education published the document ‘Acting Today, Shaping Tomorrow,’ which is a policy framework that provides guidance on how to promote environmental education (Ministry of Education, 2009). The framework provides board
strategies and recommendations for the OME, School Boards, and Schools, but does not provide specific strategies for teachers on how to integrate EE in the classroom setting.

The ‘Environmental Education Scope and Sequence of Expectations’ was published by the Ministry in 2011 and aims at identifying where in the curriculum teachers can refer to EE links. However, the document admits that in elementary education (grades one to six), most curriculum connections to EE are in the science and social studies categories. From grades one to six, there are zero expectations in the Math curriculum that make in reference to EE (Ontario Ministry of Education, 2011).

It is also important to recognize that although the OME cite on numerous occasions that the government will move forward with addressing the 32 recommendations made in the 2007 policy document, there has been little to no work done since the 2011 policy document to support the implementation of EE.

Teachers are instructed to teach based on the OME standards and expectations. It is clear the OME expects teachers to include EE in their practice, but the Ministry offers little guidance on how teachers should actually teach EE, which is especially true when integrating EE with math.

Therefore, the objective of this literature review is to examine the relationship between EE and math, and to help identify gaps and opportunities in current literature for improving the assimilation of EE and math at the elementary level.
2.2 Benefits of Environmental Education

In a report issued in 2000, by the National Environmental Education and Training Foundation, EE was infused into lessons in a range of grades at the elementary level within schools in the southern states. The results showed that students scored higher grades on standardized tests after a year of EE (Wakefield, 2001).

Other research suggests that assessing the effectiveness of EE is not measured by observing if students have increased their knowledge or get higher grades, but is measured in the student’s ability to think critically (Bright & Tarrant, 2002). The ability to solve problems and make informed decisions is an important skill that will help children to become tomorrow’s leaders.

Archie (2003) concluded that environment based education stresses critical thinking skills such as questioning, investigating, interpreting data, analyzing and solving problems. These findings are supported by Ernst and Monroes (2006) study of 400 students in grades 9 and 12, in 11 Florida based schools. The purpose of the study was to determine the effect of environmental based learnings on students motivation for school and critical thinking skills. The results demonstrated student improvement in critical thinking skills, attributed to using environmental themes and topics connected to the community and empowerment. They also concluded students were more motivated to learn, which was attributed to applying real life examples in the classroom. Ernst and Monroes work supports similar findings to Wakfields (2001) analysis that green lessons boost grades, however, their work differs because Ernst and Monroe further demonstrate that EE helps students develop critical thinking skills, a crucial skill of responsible citizens.
Therefore, the trend amongst research that effective environmental education translates to not only improved academic achievement, but also improved critical thinking skills, only strengthens and supports a call to include environment education within the Ontario math curriculum.

2.3 The Relationship between Environmental Education and Math

A second key theme evident within existing literature was that the two disciplines, the environment and mathematics, are connected.

Mathematics is traditionally seen as its own discipline, separate from natural phenomena such as the environment. That is why, historically, school mathematic programs do not focus on sustainability related issues (Renert, 2011). In a separate article, Renert and Davis (2012) employ an integral analysis to argue that mathematics and sustainability are intertwined. The article demonstrates that the mathematics being taught in schools today focuses mostly on manipulation of numbers and mathematical problem solving, instead of educating about the obvious connection between math and the real world, such as the environment. It is time we move away from “simple math,” math that does not deal with solving environmental issues, to “green math,” which does. Green math is not just about including environmental examples in math lessons. It’s about educating students on models and statistics detailing the concepts of sustainability, such as resource depletion, and how we can make a change (Newman, 2011) (Pfaff, 2011).

It is important to note that previous research has determined that four major barriers exist that constrain incorporating environmental education into classrooms: Conceptual, Logistical, Educational, and Attitudinal barriers (Ham & Sewing, 1988). These barriers must be considered when integrating EE and math at the elementary level.
The ultimate goal of green math is to inform the general public on environmental issues and help make people more socially charged, which aligns directly with the OME’s goal established in the ‘Shaping Our Schools, Shaping Our Future’ policy document.

**2.4 Integrating Environmental Education and Math**

A third theme identified within existing literature was that author’s proposals for how to integrate EE and math varied significantly.

Gadotti (2010) contents that major changes to the entire education system are needed to successfully implement EE in schools and within specific subjects such as math. He presents a compelling argument that the current education system in all countries is founded on unsustainable practices. He highlights the importance of educating for sustainability and recommends that the education system shift towards an eco-pedagogy, where education practices and sustainability are connected.

Other authors call for the importance of teachers to be more educated on concepts related to EE. This can be accomplished through professional communities, university pre-service programs and professional collaboration (Gayford, 2003) (Stevenson, 2007).

The argument that major changes are required in education is contrasted by other authors who argue that small changes within the classroom setting can contribute to the successful integration of EE and math. Renert (2011) calls for a transdisciplinary approach to connecting math and the environment. Integrating EE and math can be as easy as moving your math lesson outdoors, which provides a foundation for conceptual application, where students can use problem solving skills to make real world connections (Bezanson and Killion, 2001) (Wells,
2000). Teachers can simply introduce and explore environmental topics in their math lessons, such as food consumptions and energy (Kenschaft & Fusaro, 2003).

Major changes to the entire education system are unlikely to occur any time soon. Therefore, small changes that teachers can make inside their classroom provide a more appropriate foundation to integrate EE and math, further strengthening students critical thinking skills and improve students motivation to learn.

2.5 Limitations and Research Gaps

There is very little existing literature directly related to the topic of EE and math. Math and the environment have historically been viewed as completely separate disciplines (Renert 2011). An initial literature review revealed that there is a significant research gap in the techniques, strategies and specific activities proposed to help teachers integrate EE with the math curriculum. Multiple authors demonstrate that integrating EE and math enhances student learning and develops skills such as the ability to think critically (Gadotti, 2010) (Wakefield, 2001); however, both authors fail to propose actual strategies or activities specifically demonstrating how to integrate EE and math. It is very difficult for teachers to integrate EE within curriculum subjects such as math, when the OME offers very little guidance and academic literature offers very little practical solutions on how to combine these two subjects.

Although many authors demonstrate that the environment and math are interrelated, very few make any connection between EE and math at the elementary level. Ernst and Monroe (2006), as well as Pfaff (2011), only justify the importance of connecting EE and math at the high school and university level, making no reference to the importance of linking EE and math at the elementary level. Similarly, Pfaff and Newman (2011) present the conclusion that
statistical modelling, a very advanced form of mathematics, should be used to help understand environmental concerns and incorporate math and environmental education. Renert and Davis (2012) call for a new type of education, sustainable mathematics, but claim that math and the environment are only connected at very high levels, such as assessing global warming through mathematics. Many elementary students are extremely eager to learn and are absolutely capable of understanding the obvious relationship between EE and math, a relationship that does not only exist at high level of mathematics (Bezanson and Killion, 2001) (Wells, 2000).

The fact that very little research has been done to assess how EE can be integrated within the subject area of math at the elementary level is problematic and an obvious gap that must be addressed.

### 2.6 Conclusion

Schools must play an important role in educating children on issues of sustainability in order to provide them with the knowledge and capacity required to deal with complex future environment related issues.

The implementation of EE in schools has many benefits for children, which include improved critical thinking skills and an increased self-motivation to learn (Wakefield, 2001) (Archie, 2003) (Ernst & Monroe, 2006). Mathematics itself is integrally embedded in and open to exchanges with its environment, thus EE and math are clearly interrelated (Renert & Davis, 2012). Many literary authors’ proposals on how to integrate EE and math vary significantly. Some argue that a major shift in education is required to effectively integrate EE (Gadotti, 2010), while other argue small changes within the classroom are all that’s necessary to effectively infuse EE and math (Bezanson & Killion, 2001) (Wells, 2000).
One major gap in academic literature was the lack of information related to EE and math, specifically at the elementary level. The data gathered during this research proposal is from teachers at the elementary level, which contribute to addressing that gap.

The second significant gap identified was the lack of concrete activities and strategies classroom teachers can refer to and implement to help them better integrate EE and math. As this research proposal interviews elementary teachers who already integrate EE and math, the findings contribute to helping current and future teachers implement EE within their math classes.

Ultimately, this proposal contributes to assisting the OME policy on EE. This research proposal acts as a supplemental document to the most recent policy document, ‘Environmental Education Scope and Sequence of Expectations,’ published in 2011 by the OME. It contributes to addressing the clear gap in the 2011 OME publication, where the Ministry provides no guidance for teachers on how to integrate EE and math, as zero specific math curriculum expectations are related to EE.

This study explores the question of: What role does environmental education play in the Ontario math curriculum at the elementary level? Elementary teachers, who have been mandated by the OME to integrate EE in all subject areas, can refer to the findings of this study for directions and recommendations on how to integrate EE and math.
Chapter 3: METHODOLOGY

3.0 Introduction

The primary goal of this research paper is to identify the role of environmental education, specifically within the Ontario math curriculum at the elementary level. A primary and secondary data collection process was performed. The work of many academic literary authors is analyzed to develop a foundation of knowledge. This is followed by the generation of data through two one-on-one semi structured interviews with exemplary elementary school teachers. Within this chapter, my methodology is discussed highlighting the study procedure, the participants, how the data is collected and analyzed, the ethical review procedure and the study limitations.

3.1 Research Approach & Procedure

A qualitative case study approach is used as the methodology here. Eisenhardt (1989) defines a case study methodology as a research strategy that focuses on understanding the relationship and dynamics within a confined, real world setting.

The methodology draws from existing experts in the field of qualitative case study research. Creswell (2013) argues that key components of a case study approach include identifying the case, stating intent, using multiple sources of data, and analyzing the data. Additionally, Robert Yin (2014) recommends the researcher construct validity to follow the case study protocol for developing effective questions and conducting successful data collection techniques.
A qualitative case study approach is appropriate for this specific study because this study is very limited in nature. The study is confined to interviewing only two individuals, resulting in two specific cases being compared and contrasted.

A review of relevant literature was conducted to initiate the data collection process. The main purpose of the literature review is to examine existing literature in relation to the topic of this study; environmental education and mathematics (EE and math). Key themes are identified amongst the work of various authors to develop a foundation of information that is expanded upon and added to via this study. Important limitations and gaps are identified amongst the academic literature, which help establish exactly what this study addresses. In addition to analyzing academic journal articles for research gaps, published documents from the Ontario Ministry of Education are assessed to help support and guide the purpose of this study. The fact that the Ministry has mandated that environmental education be incorporated into all subject areas but offers no guidance for how teachers can actually integrate EE and math in these documents, demonstrates a clear need for this research study. Despite there being very few academic publications connecting EE and math at the elementary level, the academic literature is constantly revisited throughout this entire study process to incorporate any additional contributions.

3.2 Instruments of Data Collection

A series of semi-structured interview questions have been developed based on the knowledge gap highlighted above. Two interviews (Appendix B, page 45) constitute the primary means of data collection. The interview questions are aimed at identifying information about
how EE can be incorporated into the elementary math curriculum. Special attention is placed on what barriers hinder teachers incorporating EE and math.

Predetermined interview questions are asked in the semi-structured interview. However, a semi-structured interview allows for non-predetermined follow-up questions based on the conversation (Crestwell, 2013). Thus, a semi-structured interview is the appropriate type of data collection process for this specific study, as it allows the interviewees to expand upon the interview questions, to further contribute their lived experiences.

The interview is broken into four sections loosely following the structure of the main research questions and sub questions. Firstly, the interviewee’s background and experience are explored. Secondly, the teacher’s current practices are explored, the ‘what and how’. Thirdly, the interviewee’s beliefs and values are explored, the ‘why’. The final section explores the next steps and challenges of integrating EE and math, the ‘what’s next’. A digital voice recorder is used to record and transcribe the interview.

3.3 Participants

A brief overview of the participant recruitment process and the sampling criteria which enable exceptional participants to be selected is presented in the following section.

3.3.1 Sampling Criteria

The participants are exemplary teachers who have a working knowledge of environmental education, thereby ensuring credibility. Two elementary teachers are selected. This allows for varying perspectives to be compared and contrasted.
Participants must meet each of the following criteria:

- A grade 3-5 teacher at the elementary level in a public school in the GTA
- Have at least 3 years of full time teaching experience
- Are willing to reflect upon and share their own experiences
- Have a working knowledge of EE and incorporate EE into some of their daily lessons
  (does not have to include math)

Two elementary educators teaching similar grades and having a comparable amount of full time teaching experience are selected to maintain study consistency. A pseudonym is assigned to each participant and their school to support their privacy. Further, daily schedules and other identifying factors are kept private.

### 3.3.2 Sampling Procedures

Two participants will be recruited through word of mouth within the Toronto teaching community. I will be asking friends and colleagues to recommend individuals who fit the key criteria listed above.

### 3.3.3 Participant Bios

Participant #1, “Jen,” is a grade 3 primary teacher in the Toronto District School Board. She has been teaching for 6 years. She graduated with a teaching degree from Medaille Collage in Buffalo, New York.
Participant #2, “Mike,” is a grade 4/5 teacher with the Toronto District School Board. He has been teaching for 16 years and graduated with a teaching degree from the University of Toronto. Michael has taught all grades except for kindergarten.

3.4 Data Analysis

The data is collected through two face-to-face, one-on-one semi-structured interviews. The main research question and sub questions were used as a foundation for developing the interview layout. The interview was broken into four sections. Firstly, the interviewee’s background and experience are explored. Secondly, the teacher’s current practices are explored, the ‘what and how’. Thirdly, the interviewee’s beliefs and values are explored, the ‘why’. The final section explores the next steps and challenges of integrating EE and math, the ‘what’s next’.

Saldana (2008) highlights six key attributes that are necessary for the interviewer to possess, which in turn would help the interviewer conduct an effective interview; perseverance, the ability to deal with ambiguity, flexibility, creativity, rigorous ethicality, extensive vocabulary. During the entire interview process, I would refer back to these six key attributes and ensure that I was doing my best to embody these attributes.

After the interview was conducted, I started the data analysis process. Creswell (2013) states: "[minimize] the data into meaningful segments and [apply] names for the segments" (p.148). The segments generated are turned into codes which can easily be organized into groups of themes or categories.

Saldana (2008) defines a code as: “assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data.” In order to identify
themes justified through codes from the data, I implemented a data analysis process that combined Smith et al (2009) 6 steps for analyzing transcripts with the final two stages of data analysis proposed by Biggerstaff and Thompson (2008).

Smith et al (2009) 6 steps are as follows: 1. reading and re-reading, 2. initial noting, 3. developing emergent themes, 4. searching for connections across themes, 5. moving to the next interview and repeating steps 1-4, and 6. looking for patterns across participants.

Smith et al’s six steps were combined with the final two stages of data analysis proposed by Biggerstaff and Thompson (2008):

*Stage 3.* Grouping themes together as cluster

*Stage 4.* Tabulating themes in a summary table

After transcribing the interviews, I put them into a table and identified codes and categories that emerged from the interview. I grouped these codes together to form a cluster, or ‘category’ which made up the left hand column of the table.

Interview results are highlighted in the Findings section (see page 23). The Implications section (see page 34) concludes the study. The section discusses how the literature review, the interviews and the data coding analysis contribute to answering the main research and sub research questions. Recommendations are proposed to address the main research and sub research questions, as well as contribute to existing teaching practices. Finally, limitations to the study are identified and areas for additional research and highlighted.

### 3.5 Ethical Review Procedure

Every effort was made to conduct this study in accordance with the Research Ethics Board (REB) policy. The participants of this study were given letters of consent, which
contained information about the interviewer, the nature of the study, content, consent, and confidentiality. The letter also contained information about participants’ right to withdraw from the study at any point and about their right to refuse to answer a question. The participants read and signed the letter of consent, which is stored in electronic and hard copy format, as a record of this study. At the start of the interview, the interviewer confirmed the interviewee’s willingness to participate in the study and confirmed their awareness of all of the overarching ethical procedures, rights and policy. All data generated from the interview was stored on a password-protected computer and will be destroyed after five years.

3.6 Methodological Limitations and Strengths

As this study is small in nature, there are some obvious limitations. Firstly, the scope of the research is confined to public elementary schools in Toronto. The main research question guiding this study aims to draw conclusions that can be applied to elementary education at a provincial level. Thus, due to the small number of participants, and the limited scope of the study, conclusions should not generalize the experience of teachers more broadly speaking.

Secondly, although a significant effort is made to find teachers of similar grades and similar experiences that fit a certain criteria, the differences in teachers’ backgrounds contribute to varying results. To overcome this limitation, this study analyzes and synthesizes the data through a lens of transferability, not generalizability. This means that the conclusions made can be applied to teachers who operate in similar environments, but cannot be applied to all teachers.

Thirdly, the literature review is selective. The time constraints of this study limit the amount of academic research that can be accomplished. Although the gaps in current academic
literature listed above in the Literature Review Section (see page 5) are clear, these gaps cannot be considered all encompassing.

Regardless of the limitations, every effort has been made to craft an appropriate methodological framework that limits weaknesses. As noted above, it is clear that interviews are the preferred method of data collection and that conducting interviews has many strengths. For example, unlike surveys, interviews allow participants to provide in-depth answers and expand upon their thoughts. Interviews validate a teacher’s voice and experience, and are a way for them to make meaning from their lived experiences. Finally, interviews allow teachers to reflect upon their practice, helping them as well as the readers of this study to better connect theory and practice.
Chapter 4: RESEARCH FINDINGS

4.0 Introductory Overview

The OME has mandated that environmental education be integrated into all subject areas. However, there are no direct expectations in the math curriculum that link EE and math (Ontario Ministry of Education, 2011). In addition, the OME has done little to provide teachers with resources to integrate these two subject areas. The findings for this chapter were derived from the opinions and experiences of two participants. The transcriptions of the interviews were put in a table, coded and grouped into categories. Based on the data, two major themes emerged from the data: (1) challenges, and (2) opportunities.

Within each theme, there are related categories and codes that are discussed and summarized in the following sections.

4.1 Challenges

The table below (Table 4-A) is a graphic organizer that displays categories and codes that make up the theme of challenges. The superscript numbers beside the codes demonstrate whether the first participant 1 (Jen), second participant 2 (Mike), or both participants made statements that provided data for the code.

A study by Ham and Sewing (1988) determined four major barriers exist that restricted the integration of EE within the classroom setting: Conceptual, Logistical, Educational, and Attitudinal barriers. Based on the data analysis for this study, three out of the four barriers were very apparent and aspects of the other barrier existed. Educational and attitudinal barriers (the background of the researcher), as well as logistical barriers (lack of resources and Ministry
restrictions), impacted the participant’s willingness to incorporate EE. This is not encouraging as
many of the same issues identified in 1988 are still evident in today’s classrooms.

Table 4-A

<table>
<thead>
<tr>
<th>Theme</th>
<th>Category</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Challenges</td>
<td>Background of the Participant</td>
<td>• Lack of environmental background (1 and 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Educational Background impacts classroom priorities (1 and 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Does not id correlation b/w the environment and student engagement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cannot define environmental education (1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Does not look to improve awareness of environmental education (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Small amount of classroom preparation (1 and 2)</td>
</tr>
<tr>
<td></td>
<td>Lack Resources</td>
<td>• Does not consult any environmentally themed resources (1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Does not know how to integrate EE and math (1)</td>
</tr>
<tr>
<td></td>
<td>Ministry Restrictions</td>
<td>• Unaware of Ministry requirements/mandate to Integrate EE into all subject areas (1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• EQAO pressure restricts math creativity (1 and 2)</td>
</tr>
</tbody>
</table>

4.1.1 Background of the Researcher

Educational barriers stem from teachers’ perceptions of their own competence to include environmental programs. If a teacher has a poor background in EE, they may lack the personal interest to include environmentally themed lessons (Ham and Sewing, 1988). After analyzing the data, it became clear that the background of the researcher had a major impact on the integration of EE within their classroom. Every teacher has their own preference and confidence with regards to subject area’s. Both Jen and Mike do not have a background in EE, and thus do not teach many environmentally themed lessons.
When asked to define EE, Jen struggled greatly. She paused often, attempted to start a sentence, and then stopped. Finally, she admitted, “I don’t know if I would know how to define it in a sentence.”

Certain authors identify the importance of all teachers being more educated on concepts related to the environment. This can be accomplished through professional communities, university pre-service programs and professional collaboration (Gayford, 2003; Stevenson, 2007). It is clear that Jen and Mike’s background are not in EE, and this is a major challenge that must be addressed. This is important because teachers often base their classroom programs around what they value and deem important, math, literacy, etc. If teachers do not see EE as a priority, they will be less likely to integrate EE within their classrooms.

Attitudinal barriers stem from teachers’ negative perceptions towards environmental education, lead to very little EE instruction taking place (Ham and Sewing, 1988). When discussing student responses to environmentally themed lessons, Mike did not identify a correlation between student engagement and environmental education, mentioning “As far as a direct correlation between math and environment, no I can’t say that I have any evidence of that really getting them (students) going.” In Mike’s eyes, although he believes students should be education on the environment, environmentally themed lessons have not generated an overly positive response from students, which has contributed to less environmental education being taught in his classroom.

Historically, math and the environment have been viewed as two completely separate disciplines (Renert, 2011). Consistent with Renert’s observations, Jen and Mike both admitted that most teachers see math and the environment as two completely separate entities. Mike went on to say, “I can’t say I have done anything in terms of improving my awareness of
environmental ed. I can’t think of any instances where I have tried to learn more about integrating math and EE.” The attitudinal barriers many teachers inherently possess with regards to EE are a major challenge that has restricted the integration of environmentally-themed math lessons.

4.1.2 Lack Resources

Logistical barriers include a perceived lack of time, funding, resources, etc. (Ham and Sewing, 1988). One of the gaps I identified in the academic literature was that very few authors offer concrete solutions or resources to help teachers integrate environmental education and math (Gadotti, 2010; Wakefield, 2001). This gap in the literature is further supported from the data within the two interviews.

A major category that emerged from the interviews was the lack of resources available for teachers to consult. In the literature review, the OME was criticized for not providing resources to help guide teachers in implementing environmental education (Ontario Ministry of Education, 2011). When asked if she consults any environmentally-themed resources, Jen’s answer was “no.” She mentioned that she is not comfortable integrating EE and math because she “doesn’t really know how.” In addition, Mike pointed to the challenges that arise when trying to identify and access resources and ideas. It is evident that logistical barriers pose a major challenge to the successful integration of EE and math.

4.1.3 Ministry Restrictions

A third challenge to integrating environmental education with math that emerged from the interviews was the restrictions imposed as a result of the actions from the Ministry of
Education. It is clear that the OME has mandated EE be implemented into all subject area’s (Ministry of Education, 2007). A significant finding from the interview was that Jen had no idea about this ministry requirement. As a classroom teacher, you are expected to support a large number of ministry requirements within your classroom. However, teachers seem to support certain requirements over others. Jen and Mike each taught a grade that writes the EQAO standardized tests at the end of the year. Because of this, in those classes, both teachers teach math directly out of a textbook, thus restricting the creativity and cross curricular connections they infuse within their math program. The results of a study published by Wakefield (2001) demonstrated that students scored higher grades on standardized tests after a year of environmental education. It must be communicated to teachers that including EE within math does have a positive correlation with higher scores on standardized tests such as the EQAO.

4.2 Opportunity

The table below (Table 4-B) is a graphic organizer that displays categories and codes that make up the theme of opportunity. Four sub categories were identified and are analyzed below.

4.2.1 EE and Math can be Integrated

The first category that emerged within the ‘opportunity’ theme was that environmental education and math can absolutely be integrated. In academic research, many authors come to this same conclusion. For example, Renert and Davis (2012) employ an integral analysis to argue that mathematics and sustainability are intertwined. Based on the results of the interviews, both Jen and Mike agree that math and EE are connected.
Table 4-B

<table>
<thead>
<tr>
<th>Theme</th>
<th>Category</th>
<th>Code</th>
</tr>
</thead>
</table>
| Opportunity            | EE can be integrated into Math | • Have done lessons that integrate EE and math (1)  
• EE and math absolutely can be integrated (1 and 2)  
• Identifies a correlation between environment and student engagement (1)  
• Society benefits long term by integrating EE in math (1 and 2) |
| Willingness to Change  |                        | • Aim to develop environmentally conscious students who act as agents of change (1 and 2)  
• Acknowledged they would look to integrate EE and math based on this interview (1 and 2)  
• Reflective (1 and 2) |
| Practical Solutions    |                        | • Need for clear easy solutions (1 and 2)  
• Does not want to re-invent the wheel (1 and 2)  
• Online Resources (1 and 2) |
| OME Responsibility     |                        | • Change curriculum expectations (2)  
• Provide resources for teachers (1 and 2)  
• Value in a workshop (1) |

One of the gaps identified within the academic research was that although many authors demonstrate a link between environmental education and math exists, very few make the connection at the elementary level. Ernst and Monroe (2006), as well as Pfaff (2011), only justify the importance of connecting EE and math at the high school and university level. This gap was addressed through the findings in this study as both Jen and Mike see major value in environmental education being taught to elementary students. In addition, each teacher has taught environmentally themed math lessons in the past. When asked if he has taught environmentally themed math lessons, Mike replied “On occasion yes. If we are doing something that is related to the environment as far as science goes. I have done graphing with the kids as far as environmental initiatives.” It is very significant that the gap in academic research
(very little connections between math and the environment at the elementary level) is addressed. This is because it proves that EE and math are connected at every level of education, not just higher learning.

Gadotti (2010) argues that major changes to the entire education system are needed to successfully implement EE in schools and within specific subjects such as math. However, this argument is contrasted by Renert (2011) who highlights that small changes within the classroom setting can contribute to the successful integration of EE and math. The findings in this study support Renert’s (2011) argument; Jen recalled one math lesson where she had her students collect empty plastic water bottles from around the school, and graph the results. The class then discussed the importance of drinking out of reusable bottles. Jen stated:

I think students being able to visualize how they are effecting the environment would definitely be good. I feel like those things stay in them. I feel like those memories, if you can try and find a way to really engage a student, like a meaningful memory, or a cool lesson. I find kids really remember cool lessons. Like teaching math with water bottles, I still have kids come up to me about that and they say, I don’t use water bottles anymore.

Bright & Tarrant (2002) and Archie (2003) demonstrate that thinking critically and making informed decisions help children assess their impact on the environment and become agents of change. Jen’s water bottle lesson provides such an important insight into the impact environmentally themed math lessons can have on students. This insight proves that little changes can have a monumental difference with regards to educating students on environmental education to become educated citizens and leaders of tomorrow.

Bezanson and Killion (2001), and Wells (2000) demonstrate that students can develop problem solving skills that help them make real world connections when they participate in
environmentally themed lessons. This insight is supported through Mike’s opinions. When asked if there would be any long term benefits for society as a whole if EE was integrated into the math curriculum, Mike replied:

Yes definitely. Having the kids learn more about the environment in general is always a positive thing, because the more connection they have to the environment, the more likely it is that they will make positive change to take care of the environment, as well as thinking proactively as they get older about protecting and improving our environment.

Both Mike and Jen want to help children become environmentally conscious students who act as agents of change as they grow older.

4.2.2 Willingness to Change

A common category that emerged from the interviews was that both participants were very reflective. Both interviewees admitted that they could be doing more to incorporate environmental education within their classroom. In addition, both participants acknowledged they would look to integrate math and the environment more often based on the interview they participated in. Mike said that he would look for cross curricular ties between social studies, EE and math when he teaches his upcoming grade 4 unit of Habitat and the Environment. This is a significant insight that is expanded upon within chapter 5, as the quality of being a reflective teacher is so important if EE is to become incorporated into math lessons.

4.3.3 Practical Solutions

One gap in literature, highlighted within the OME Responsibility section, was the lack of resources available to teachers that assist with integrating environmental education and math
(Gadotti, 2010) (Wakefield, 2001). The data from the interviews with Jen and Mike provide a lot of insight into what resources are needed.

When asked what can be done to encourage more teachers to learn about EE and infuse EE into their math lessons, it is important to note that Jen and Mike both mention that online resources would be the easiest to access. Jen highlights lessons being posted on commonly used teacher education sites, such as teachers pay teachers. Mike says:

It’s a question of access to resources and ideas. For example, if there was a website that had curricular links to science and math. Even just websites you could go to gather information and then you could use your math lessons to break down that information.

The education system is becoming very technology based. In order to address the clear gap in literature caused from the poor integration of environmental education and math, we need practical solutions. Jen and Mike both agree they do not have the time to “reinvent the wheel.” They require easy lessons that can be directly implemented. In addition to online resources, Jen and Mike reference the need for lessons sent from the TDSB, such as a pamphlet teachers could reference or teacher workshops.

When asked what strands of math offer the best opportunity to integrate environmental education into Mike responded:

“Probably number sense and numeration has a lot of opportunity to talk about pollution, waste management, energy, kilowatts of energy consumption. Well it would be applicable to most anything.” Jen adds:

I would say graphing because you could take surveys in the community or class, about how long of a shower do you take, or who brings a litter less lunch or what does that mean. So I would say graphing is a big one. Umm, I would say numeracy, I think like
how many water bottles did you use in your household, or how many plastic bags did you see people leaving the grocery store with. So I think graphing and numeracy would be the big two.

Therefore, EE can be integrated into essentially all 5 math curriculum strands. The key is that resources must provide practical, easy solutions to implement.

4.4.4 OME Responsibility

Many academic journal articles mention the benefits to integrating math and the environment (student engagement, critical thinking skills, etc), but fail to propose actual strategies or activities that specifically demonstrate how to integrate EE and math (Gadotti, 2010) (Wakefield, 2001). This gap in literature is further supported by the OME, who mandate environmental education be integrated into all subject areas, but offer very few resources to guide teachers in the implementation process. The results of the two interviews demonstrate that in order to address this gap, the OME must take a larger role in helping teachers integrate environmental education and math.

When asked if the OME has a responsibility to take a lead on guiding teachers towards integrating EE and math, Mike replied “Yes! I would say the Ministry of Education and Ministry of the Environment could.” Similarly, Jen highlights that resources such as actual lessons, should come from the OME, mentioning “It would be amazing if the board could do it.”

4.3 Conclusion

In conclusion, although Jen and Mike are completely unique individuals who teach separate grades, they both had very similar views with regards to integrating environmental
education and math. The coding process applied to their interview transcripts resulted in two major themes being identified.

Firstly, there are many challenges that make integrating EE and math difficult. Teacher backgrounds influence how they prioritize curriculum within their classrooms. If teachers do not see environmental education as a priority, they are less likely to integrate EE within the classroom. In addition, it is clear there are a lack of resources to help guide teachers to facilitate the integration of EE and math. Finally, standardized testing requirements restricts teachers creativity to integrate EE and math, as it forces many teachers to cover as much material as possible directly from textbooks.

Although these challenges are difficult to address, the interview data provided a feeling of hope. The opportunity absolutely exists to integrate EE and math, as it is clear the two disciplines can be connected. Both participants had successfully completed a math lesson that incorporated EE. The data also demonstrated that teachers are willing to change, but require practical solutions and resources. The OME must take a more active role in facilitating the successful integration of EE and math.

The final chapter, chapter 5, identifies and discusses the implications of this study.
Chapter 5: IMPLICATIONS

5.0 Introduction to the Chapter

Environmental education in schools today generally consists of sustainability practices – reduce, re-use, recycle, Earth day, ECO teams, etc. The OME has mandated environmental education be integrated into every subject area (Ontario Ministry of Education, 2011). Schools must go beyond general sustainability practices, and take a multidisciplinary approach to integrating environmental education within the curriculum. This study aimed to identify what role EE plays within the math curriculum at the elementary level.

There is very little existing academic research in the multidisciplinary field of EE and math. Thus, these findings serve to support and add to existing gaps in literature by providing information on challenges to integrating EE and math, and opportunities to improve this integration within Ontario elementary classrooms.

The following chapter highlights the key findings and significance of the research. Broad and narrow implications are discussed. Finally, recommendations and areas for further research with be presented.

5.1 Overview of Key Findings and Their Significance

The participants of the study provided similar evidence with regards to environmental education and math integration. Two major themes were identified. There are many challenges that restrict teachers from easily integrating EE and math. However, opportunities do exist for schools to overcome these challenges and successfully integrate EE and math.

The first theme, challenges, serves to remind us that there are many barriers that must be overcome in order to achieve widespread assimilation of EE and math. The data analysis results
demonstrate that teachers backgrounds have a major influence on what they focus on within their classroom. If teachers are not educated in EE, or do not see value in EE, it is unlikely they will incorporate EE in their classroom. In addition, the lack of environmentally themed resources, specifically resources that connect EE and math, significantly limit teachers likelihood to teach these types of lessons. Finally, many policies and requirements mandated by the OME, for example EQAO requirements, contribute to restricting cross curricular subject integration within math, because there is a lot of pressure on teachers to cover a huge range of material in order to prepare students for EQAO.

The second theme, opportunities, serves to to remind us that although there are many challenges that must be overcome, the opportunity certainly exists to improve the integration of EE and math within Ontario elementary schools. The data demonstrates that EE can, and has been successfully integrated within the two participant’s math lessons. Both participants were clearly reflective, motivate to change and see value in integrating EE and math. Teachers need practical solutions that are readily accessible and easy to integrate. The OME must play a major role in providing these solutions to teachers as well as changing the math curriculum expectations to better reflect EE.

5.2 Implications

There is little evidence in academic research that demonstrates connections between environmental education and math, specifically at the elementary level. Thus, the present study has important implications for educational reform. The following section is broken into two categories; broad implications for the entire educational community, and narrow implications for educators.
5.2.1 Broad

In broad strokes, the findings from this study prove math and the environment can be integrated at the elementary level. Existing academic literature demonstrates that environmentally themed lesson boost grades and improve children’s problem solving skills Bezanson and Killion (2001), Wakefield (2001), and Wells (2000). The fact that green lessons boost grades and improve certain skills, combined with the conclusion that math and the environment can be integrated at the elementary level, should inform policy makers that we must continued to make widespread changes to the education system to more effectively combine EE with all subjects. The research data demonstrates that there is a lot of work that must be done to successfully integrate EE and math.

5.2.2 Narrow

The present study also had three specific implications for Ontario elementary teachers, the OME and myself as an educator.

Firstly, there is a huge knowledge gap between policy and practice, recommendations and guidelines, and preparation and execution. The participants in this study did not see EE as a priority, and lack the resources and knowledge to easily and consistently implement EE within their program. The OME must re-examine how they can support teachers to better ensure policy mandates are put into practice.

Secondly, this study has proven that there is always work to be done to improve how EE is implemented within our schools. Teachers must be reflective of their own practice and always look for ways to improve their program. As teachers, we are all life long researchers.

Thirdly, as a teacher, I will make a commitment to ensure EE is a priority within my
classroom. I will take an active role in my school community as an ambassador for promoting EE. I will help other teachers and students recognize the importance of EE and understand how they can make meaningful changes in their lives to help preserve our environment for future generations to grow up and thrive within.

5.3 Recommendations

The implications of the present study point specifically to several recommendations for ministries of education, school administrators, and teachers. Three recommendations are outlined below:

1) The OME must take a lead and more active role in providing concrete, practical solutions for integrating environmental education and math. The 2005 Ontario elementary math curriculum has zero references to any type of EE requirement even through the OME has mandated environmental education be integrated into all subjects (Ministry of Education, 2007). The OME must update existing math curriculum with specific expectations connecting math and the environment. In addition, the OME must recognize that teachers are not readily or easily integrating environmental education and math. The OME has a responsibility to offer resources and learning opportunities to educate teachers on implementing environment education within their classroom setting.

2) The data from the study suggest that teachers must be self motivated to learn about environmental related policies. Teachers must be reflective and motivated to find creative ways to implement cross curricular connections between subjects that include the environment and math. Teachers must provide students with learning opportunities about environmental education to facilitate increased awareness and promote passionate agents
of social change.

3) Administrators play an important role in improving widespread integration of environmental education with all subjects, including math. Administrators must ensure teachers are aware of all curriculum requirements and put an emphasis on the importance of EE within their school community. They must also help facilitate collaboration amongst various school community stakeholders, including professional associations, teachers, parents, etc, to improve the integration of EE.

5.4 Areas for Further Research

In as much as the present study has served to expand upon the extant literature, it has also highlighted the need for further study. In future research endeavors, it is recommended that a greater emphasis be placed upon identifying specifically ‘how’ teachers are integrating environmental education and math. Current academic research has demonstrated the value in teaching students about EE, but a clear gap in academic literature, further supported from the data in this study, demonstrate that few readily available solutions exist to increase the integration of EE and math at the elementary level.

Additionally, it would be valuable to re-visit this study in a few years to see if the OME has made changes to the curriculum and if those changes reflect improved student awareness and knowledge about EE. This is important because it would prove that the OME is the primary stakeholder responsible for ensuring widespread school support of environmental education.

Furthermore, valuable information can be generated by investigating other educational stakeholder’s perspectives on the integration of environmental education and math. Students, administrators and OME representatives can all provide very valuable insight into answering this
studies research questions. These various perspectives are important because they look at the research question from different lenses, which in turn provide more data to make conclusions and recommendations that support the widespread implementation of EE within elementary classrooms.

5.5 Concluding Comments

Schools play a significant role in preparing children to become informed, engaged and empowered citizens who are vital in shaping the future of our communities, our province, our country and our global environment (Ministry of Education, 2009). Existing academic research suggests the implementation of environmental education in schools has many benefits for children, which include improved critical thinking skills and an increased self-motivation to learn (Wakefield, 2001) (Archie, 2003) (Ernst & Monroe, 2006). However, this research does not provide insight as to if and how EE can be implemented within the math curriculum at the elementary level. This study investigated the role EE plays in the Ontario math curriculum at the elementary level.

The findings of this study suggest that there are still major barriers that must be overcome if we are to achieve increased integration of environmental education and math at the elementary level. The data suggests that the background of teachers as well as their passions contribute to an increased or decreased likelihood of implementing EE within their classrooms. In addition, teachers lack practical solutions on how to integrate EE and math and are restricted by Ministry policy and programs, such as EQAO. All of which cause significant challenges to widespread integration. In contrast, the data also demonstrates that there are opportunities to overcome these challenges. The study proves EE and math are connected as cross curricular integration of these
two disciplines has been accomplished in both participants’ classrooms. Teachers are excited and willing to include more environmentally themed math lessons within their program, but require additional guidance and support from the OME on how to easily and successfully integrate EE and math.

It is recommended that the OME take a lead and active role in changing policy and providing practical solutions to improve the integration of EE and math. Teachers must recognize the importance of educating students on EE and work to include environmental themed lessons in their classroom program. Finally, administrators, must work to establish a school community that values EE, thus improving the likelihood students are taught about EE.

The findings of this study are important for all stakeholders in the education community: students, teachers, administrators, staff, community groups, OME, etc, because the data demonstrates that challenges to integrating EE and math exist, but can be overcome. Ultimately, if we are to successfully prepare and motive students to become agents of social change, we need collaboration amongst all of these stakeholders.
REFERENCES


Date: X/X/201X

Dear ______________________________,

My Name is Matthew Litner and I am a student in the Master of Teaching program at the Ontario Institute for Studies in Education at the University of Toronto (OISE/UT). A component of this degree program involves conducting a small-scale qualitative research study. My research will focus on identifying what role does environmental education play in the Ontario math curriculum at the elementary level?

I am interested in interviewing teachers who currently teach grades 3-5 at a public school located in the GTA, who have at least 3 years of full time teaching experience, have a working knowledge of EE and incorporate EE into some of their daily lessons (does not have to include math). I think that your knowledge and experience will provide insights into this topic.

Your participation in this research will involve one 45-60 minute interview, which will be transcribed and audio-recorded. I would be grateful if you would allow me to interview you at a place and time convenient for you, outside of school time. The contents of this interview will be used for my research project, which will include a final paper, as well as informal presentations to my classmates and/or potentially at a research conference or publication. You will be assigned a pseudonym to maintain your anonymity and I will not use your name or any other content that might identify you in my written work, oral presentations, or publications. This information will remain confidential. This data will be stored on my password-protected computer and the only people who will have access to the research data will be my course instructor Arlo Kempf.

You are free to change your mind about your participation at any time, and to withdraw even after you have consented to participate. You may also choose to decline to answer any specific question. I will destroy the audio recording after the paper has been presented and/or published, which may take up to a maximum of five years after the data has been collected. There are no known risks or benefits to participation, and I will share with you a copy of the transcript to ensure accuracy.

Please sign this consent form, if you agree to be interviewed. The second copy is for your records. I am very grateful for your participation.
Sincerely,
Matthew Litner
416-XXX-XXXX
matthew.litner@mail.utoronto.ca

Course Instructor’s Name: Arlo Kempf
Contact Info: Arlo.Kempf@mail.utoronto.ca

Consent Form

I acknowledge that the topic of this interview has been explained to me and that any questions that I have asked have been answered to my satisfaction. I understand that I can withdraw from this research study at any time without penalty.
I have read the letter provided to me by _____________ and agree to participate in an interview for the purposes described. I agree to have the interview audio-recorded.

Signature: ________________________________________

Name: (printed) ______________________________________

Date: ______________________________________
Appendix B: Interview Protocol/Questions

I want to first thank you for accepting to participate in this study. I would also like to highlight confirm that you are aware of the Research Ethics Board Policy governing this interview, as highlighted in the consent letter. You may choose to withdraw from this study at any point. You have the right to stop the interview at any point, as well as refuse to answer any question. Please let me know if you have any questions or concerns.

Section 1: Background Information

1. a) What is your name?
   b) How long have you been teaching in Ontario?
   c) What did you study in university?
   d) What grade level do you currently teach?

Section 2: Teacher Practices (What and How)

2. How do you structure your classroom lessons over the course of a week?

3. On average, how many minutes do you spend preparing for in class lessons every week?

4. Do you ever consult environmentally themed sources when lesson planning? For example…

   If Yes >
   a) What types of sources do you use?
   b) Have you ever included environmentally themed math lessons? If so, how? Please give some examples.
   c) Have any students responded differently – either through participation or assessment – to these lessons?

   If No >
   a) Why not?
   b) What would you need as a teacher to start infusing environmentally education into your lesson plans?

Section 3: Beliefs/Values (WHY?)

5. In your own words, how do you define “environmental education”? 

6. What are your goals for your students regarding learning about environmental education?

7. What strands of the math curriculum do you think offer the best opportunity to integrate EE and why?
8. Would there be any long term benefits to society as a whole if EE were integrated more often into the math curriculum?

**Section 4: Next Steps/Challenges (WHAT NEXT?)**

9. Are you doing anything to maintain or improve your own knowledge of environmental education? If so, what? Does this affect your math program?

10. What do you think could be done to encourage more teachers to learn more about environmental education and infuse EE within their math lessons?