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Using Technology and Phenology to Increase Students' Observation Skills

Sondra Tokarczyk
Hamline University, stokarczyk01@hamline.edu

USING TECHNOLOGY AND PHENOLOGY TO INCREASE STUDENTS' OBSERVATION SKILLS

by

Sondra A.Tokarczyk

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Primary Advisor: Susan Manikowski
Secondary Advisor: Susan Wilder Akre
Peer Reviewer: Bridget Stalboerger

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CHAPTER ONE

Introduction

"Will the use of iPad technology and phenology increase students' observation skills?" That is the question this study is focused on. Getting students to interact with nature is not always an easy task. Slow down, stop, listen, watch, and learn are not ideas children are used to. Teaching students the importance of slowing down to observe and investigate in a technology-dominated world that values speed, connectivity, movement, and multitasking can be a real challenge. They have been observing their entire lives, but these skills are not always in the forefront when making decisions. For this reason, it is still important for educators to find the time to teach and model these skills.

In my role as an educator, I started to think about how I could get students outdoors and engaged in their learning, while fostering the importance of using their five senses to build observation skills. The first step is getting students outside and showing them the wonders of the natural world. The second step is building interest by making it relevant to their daily lives. Thinking about the third graders I teach everyday, I was able to make a connection between the two that led me to my research topic. Will the use of iPad technology and a knowledge of phenology increase third graders' abilities to use their five senses to observe the natural environment in their school forest?

In Chapter One, I will share the experiences that have brought me to this research topic. The journey will start with my childhood years and continue through my first ten years as a teacher. Each experience within that timeline has played an important role in the development of my beliefs and philosophy of environmental education in my classroom, and has played a vital role in the vision and purpose of this study.

Learning from Following the Path of Others

Growing up in northern Minnesota, I have always known the quiet, calming forest and the ability to find an area of peaceful lakeshore to listen to the lap of the water against the rocks. My parents were great mentors when it came to getting outdoors and enjoying nature. Our summer days were spent making forts in the trees, helping baby turtles make their way from our driveway to the lake after hatching, spending weekends at family cabins, traveling west to national parks, and using our imaginations outside from the moment we finished breakfast until the sun started to set. Winter days were spent ice skating and cross-country skiing. My family was also very involved in scouting, so camping trips and outdoor badge activities were a common part of our life.

My interest in nature started to become clear when I became a camp counselor and was encouraged by the camp's director to lead teenagers on canoe trips into the Superior National Forest near Ely, Minnesota. In the article, "What is our role in creating change?" (Wheatley, 2008, p. 2) it says, "We notice something that needs to be changed. We keep noticing it. The problem keeps getting our attention, even though most people don't notice that there's even a problem." Wheatley's statement connects to an experience I had during one summer of canoe trips. While portaging from one lake to the next, I would often see trash on the sides of the trails or in the water near the portages. My campers and I would pick up the trash and put it in our packs knowing it was the right thing to do. This continued throughout the summer and when a camper returned for a second trip, she was shocked to see there was more trash in those same areas. She couldn't understand why others would drop their trash instead of taking it with them. This led to a wonderful discussion about how special the land we were on was, how people take it for granted, and why it is important to educate others about proper use of the land. This trip experience allowed me to see the environment around me through the eyes of children and got me thinking about what I could do to start having a positive impact on the environment.

Creating My Own Path

I had always known I wanted to be a teacher, but my camp counselor experiences made me start to wonder if being a camp director was a better fit. My heart told me to continue with my dream of becoming a teacher and led me to an elementary education degree with a middle school science specialty, which I knew would come in handy if I decided to work in the environmental education field later on. That specialty also allowed me to continue my studies in the area of science and gave me more opportunities to learn about using inquiry in outdoor experiences with children to build their interest in the sciences.

After graduating from college I was hired for my first teaching position at the Bug-O-Nay-Ge-Shig School on the Leech Lake Indian Reservation where I worked for five years. While in this position, I gained a tremendous amount of knowledge about the Ojibwe culture and experienced my first maple sugar camp, wild ricing, pow wows, and a trip to the local fishery. The elders in the building were knowledgeable mentors who were willing to share many of the cultural traditions and the Ojibwe values which became an everyday part of my teaching. Through their teachings I learned many things about the different ways they respect the environment. Even after moving on to a new school district, the cultural knowledge I gained through this experience is always in the back of my mind.

I started teaching at my current elementary school in 2010. During my five years in the district I have taught 5th grade, 4th grade, and am currently teaching 3rd grade. Each grade level has built on my experiences as a teacher in a different way and has given me the background information to know what my students need in order to be successful. I have also become very familiar with Minnesota's academic standards at all three grade levels and have been able to see the gaps which appear in the science standards, as well as the importance of focusing on the Nature of Science and Engineering standards. Being part of the Science Curriculum Committee gave me the opportunity to help our school create a scope and sequence to make sure the necessary standards are being taught in-depth. This allowed me to take a close look at what I needed to address in all science areas, the gaps and misconceptions that my students may have, and the topics the standards miss completely at the elementary level. One of those missing areas is environmental education, which is not acceptable to me.

One of the most interesting changes that has happened within the district during my time there has been technology integration. It was brought to my attention in 2012 the district was looking for grade levels to participate in a 1:1 iPad pilot program. The grade levels selected would have an iPad for each student which would be used for academics with the hope of increasing creativity, collaboration, communication, and critical thinking skills. I jumped on the chance, and the next fall my students each had an iPad in their hands. The iPads have changed the way I teach, increased student engagement and motivation in the classroom, and have opened up the world to my classroom. I am constantly looking for new ways to integrate the iPads into my curriculum and enjoy seeing the students experience the many opportunities the devices bring to their learning. The pilot was successful in allowing every child in the district to now have an iPad.

During the summer of 2013, I decided to start the process of completing my Master's degree. After looking at a variety of programs at many different schools, I chose the Masters of Arts in Education: Natural Sciences and Environmental Education program through Hamline University. This choice was mostly based on my love of the outdoors and the interest I had in bringing environmental experiences into my classroom.

One of the courses I took as an elective in the program was a phenology course. Phenology is the science of studying the seasonal changes of plants and animals. Learning about phenology completely changed the way I view the world around me. I started to see seasonal changes and the beauty of nature everywhere I went, which made me want to share the science with my students. We started working with a local phenology expert who has a weekly radio show. He came into my classroom and started teaching my students what phenology is and the best things to look for during specific seasons.

During his visits, he would take the class out into the school forest to observe and investigate the nature around us. We also called in our weekly observations to the radio station and they were read during his show. My students couldn't wait until his next visit and were constantly sharing what they were observing. Phenology had sparked an interest in nature with my students and I knew it was something I needed to continue in the future.

As I started looking closely at the opportunities my students have and the resources we have available to us, I realized there is a natural connection between phenology and observing with technology. Bringing students into the school forest and allowing them to take notes, photographs, and videos within iPad applications could create an excitement and an interest in nature which students may have never experienced before. It seems like the perfect combination.

Sharing My Path With Others

Larry Weber shares in *Minnesota Phenology* (2013, p. xi) that he has seen students notice, "nature is alive and active here and now, not always somewhere else at another time." The older I get, the more I see this as being true and I find myself connecting with my environment and truly paying attention to my effects on the land. I want the students I teach to know how important it is to take care of our environment and how choices people have made in the past have affected the world we live in, but I also want to show them the many ways they can enjoy the environment around them. I can do this by giving them opportunities to explore their environment, helping them learn the skills they need to observe the natural changes we are blessed to see each year, and teaching them how important it is to ask questions and be curious about their world.

<u>Purpose</u>

In *Last Child in the Woods* (2005, p. 4), Richard Louv says, "One relationship with nature can evolve into another." As you have seen in Chapter One, that quote is definitely relevant to my life. I was introduced to the enjoyment of nature as a young child and continued to learn with each new experience I had growing up. The path I have taken from the early years to where I am now has molded me into an educator who wants to make a difference in the lives of not only those I teach, but also the lives of those my former students interact with. Through environmental education and teaching students the skills they need to interact with the environment around them, that goal is possible. I became a teacher to make a difference, and teaching students to love their environment not only makes a difference in their lives, but also the lives of the future students to whom we are passing this wonderful world.

Through the use of iPads and the science of phenology, I hope to see an increase in observation skills in my third grade students. By bringing students into the natural environment, incorporating lessons focusing on using our five senses, utilizing the expertise of a local phenology expert and using the technology students are highly motivated by as an observation tool, I aim to help students see the world around them in a different way and become more aware of the environment they live in. My ultimate goal is to show the students what a beautiful, amazing world we live in and the opportunity to be part of these natural changes.

Looking Ahead

Chapter One has been a glimpse into my experiences with nature, how they have helped me develop my philosophy of environmental education, and what I feel I can do as an educator to give students the skills they need to become observers. It has also shared the purpose of this study which is to help students develop necessary observation skills by connecting the environment to their real lives through the use of technology and phenology. Helping students make relevant connections to their environment will lead to students who are more aware of the world around them.

The review of literature in Chapter Two will provide more information about the importance of observation and how phenology and technology can help aid in increasing those skills. Research within the chapter will be split into four main areas, taking a closer look at the topics of observation, the five senses, phenology, and iPad technology. We will then be able to see how all of those areas can be connected to increase observation skills in children.

CHAPTER TWO

Review of Literature

"Will the use of iPad technology and phenology increase students' observation skills?" Chapter One looked closely at the researcher's environmental background and the path that led to this study. The overall purpose of this study is to help children develop observation skills that will allow them to better connect with their environment. This study will use technology and phenology to teach and enhance those skills.

Chapter Two will synthesize the literature surrounding the areas of focus in this study. First examined is the skill of observation, the difference between scientific and everyday observation, and how teachers can teach children to observe. The literature then discusses the five senses and their importance when observing. Next, the literature discusses the science of phenology and its connection to observation. Finally, the technology used in this study will be defined and its effectiveness in education will be addressed. To close the chapter, a connection will be made between all of these main research areas. The following background knowledge will provide a platform for the question being investigated in this study.

Observation

Observation is defined as the act of careful watching and listening, the activity of paying close attention to someone or something in order to get information, and a statement about something you have noticed (Merriam-Webster, 2015). It is a disciplined form of attention and a rigorous activity integrating what scientists are seeing with what they already know and what they think might be true (Paul, 2012). Observation is a dialogue between the mind and the five senses (Alden, n.d).

Observing is being able to treat something as not just a perception, but also a clue. It involves making mental or written notes of what is being observed and allowing others to consult those records, as well as, assess the person who took those records (Alden, n.d). Observation is a way of communicating with people in other places and other times and is a "language that requires a community of fluent speakers" (Alden, n.d.).

On the surface, it looks simple. A scientist sees some phenomena and records it. How difficult can it be? Children make observations all the time to learn about their everyday world. However, observation is more complex than it seems (Eberbach & Crowley, 2009). It must be learned and practiced because it includes inference. This logical reasoning allows scientists to use their observations to understand a phenomenon, even when it can't be directly observed (Hanuscin & Park Rogers, 2008). The ability to make observations is a core skill of scientists, yet not far removed from the skills we all use to get through life (Eberbach & Crowley, 2009).

<u>Importance of observation.</u> Observation is a skill fundamental to all scientific disciplines (Eberbach & Crowley, 2009). It is recognized as an important initial skill in the early years and in primary science because it assists in the recall of details and aids students in problem solving. Students learn to reflect, synthesize, and interpret material they find (Johnston, 2009).

Observing helps students focus their curiosity and builds a solid foundation for their future scientific learning (Anderson, Martin, & Faszewski, 2006). Attempts to develop scientific ideas without employing observation processing skills leads to rote learning and situationally confined knowledge (Farland, 2008). Quality observations are detailed, accurate, and often help create an image for those who are hearing them for the first time. The skill of observation is the cornerstone of inquiry in which students are learning to gather evidence, organize their ideas, and propose explanations based on their findings (Anderson, Martin, & Faszewski, 2006).

How scientists observe. As stated earlier, the skill of observation is often seen as a general everyday skill requiring little more than noticing and describing surface features, however, scientists and children observe in very different ways (Eberbach & Crowley, 2009). Many different aspects are involved in how scientists make observations and hypotheses to learn about their world. This is what distinguishes scientific observers from everyday observers (Paul, 2012).

Scientific observation requires expert skills in noticing and reasoning. To observe scientifically requires much more than sensory perceptions and using one's senses. Perception and sensing are foundational to observation, but true observation requires coordination of disciplinary knowledge, theory, practice, and scientists' habits of attention. When observation is disconnected from disciplinary context, we begin to simply see instead of observe (Eberbach & Crowley, 2009).

Asking the right questions is also an essential part of scientific observation. Scientists consistently ask what, how, and why when making observations and analyzing collected data. Questions starting with “what” help scientists focus on the specific data. “How” questions allow scientists to look at the current conditions and any immediate causations. Finally, “why” questions help scientists think about evolutionary factors involved in the study (Eberbach & Crowley, 2009).

Scientific observers are able to train their attention by learning to focus on the relevant features, while disregarding those not important to the study. This involves the ability to be problem solvers and make critical decisions. They draw information from many different resources to gather what they need to make informed decisions about what is happening, what is important, and to start developing explanations (Hanuscin & Park Rogers, 2008). Documentation of this information and their collected data is essential to the observation process.

Observation documentation allows scientists to ask different questions and create alternative interpretations to the data they are analyzing (Eberbach & Crowley, 2009). This documentation is usually taken in the form of field notes. The field notes include detailed written descriptions, as well as, labeled drawings or sketches and photographs of what was seen (Paul, 2012). Mental notes and memories are fragile, so scientists rely on written records which will last longer and can be analyzed by others.

The last important aspect of scientific observations is the inclusion of the habits of the scientists doing the observing. These habits are the way the scientists interact with their observations. Learning to observe scientifically necessitates creating a strong connection between their specific disciplinary knowledge, theory, and their practice (Eberbach & Crowley, 2009). This can be very challenging, yet is often underestimated by educators and researchers. Consequently, students often look at phenomena without developing new knowledge or associating their observations with scientific reasoning and explanations (Eberbach & Crowley, 2009). This puts them in the category of everyday observers.

How children observe. As was just stated, children are considered everyday observers. Observation is an important component of all other scientific skills, but there is little common understanding of how observation skills develop in children (Johnston, 2009). Children have been observing their entire lives. They observe the practical and intuitive things they feel drive and inform their everyday lives. They make everyday observations with little or no knowledge of the constraints and practices of scientific disciplines (Eberbach & Crowley, 2009).

Children's observations are the key to learning their cultural norms and practices, including their language, behavior, and the manipulation of tools. They are influenced by cultural contexts such as skills, values, and mannerisms. These observations are necessary for development, but scientifically are considered unsystematic, unfocused, and unsustained (Eberbach & Crowley, 2009).

As children develop, they begin to focus their observations and filter out ideas unimportant to what they are engaged in. These observations are influenced by their previous ideas and interests, causing the children to observe only what interests them (Johnston, 2012). Everyday expectations also influence how children structure a problem and decide what is important to observe. Expectations influence what observers do and do not notice. They are referred to as "conceptual spectacles" because the observer is actively seeking what meets their expectations and is ignoring the contradictory. These everyday expectations may or may not conform to scientific expectations and can often be considered misconceptions (Eberbach & Crowley, 2009). The ability to separate the children's expectations and what they are actually observing is extremely important.

Scientists notice multiple dimensions of phenomena when making observations. Children, however, typically notice things such as physical features. Everyday observers are more likely to notice isolated instances of evidence rather than all available evidence. This is due to a lack of domain knowledge and the fact that many scientific phenomena are too complex to understand without the needed knowledge. Even everyday environments are considered complex. It can be difficult for everyday observers to meaningfully decipher them without background knowledge (Eberbach & Crowley, 2009). This all complicates a child's ability to critically evaluate his or her observational findings.

The use of observational records also separates scientific observers from everyday observers. Scientists have very specific ways of recording and analyzing their data while completing a study. Children, on the other hand, tend to give the job of recording observational data to others. They do not productively generate or use their records and often will not refer to or track the data. Instead, they focus their observations on inferences, mental recall, or guidance given by adults (Eberbach & Crowley, 2009).

The method that children use to record data also affects their ability to use the information. The information they record often does little to support the development of knowledge and reasoning. Children's observational evidence is typically incomplete or irrelevant information. This is due to both developmental constraints and a lack of understanding of the importance of keeping detailed observational notes (Eberbach & Crowley, 2009).

The literature can give the impression of children being intent observers whose everyday expectations form their observations to help them understand and negotiate the world. However, their observations do share some similarities with scientific observers (Eberbach & Crowley, 2009). Children's observations can be influenced and become more sophisticated by educating them and helping them separate their expectations from their observations. The next section will look at ways to foster those skills.

Teaching children to observe. There is little evidence showing children can learn to observe and reason like scientific observers. They may observe things of interest to scientists, but the way they use their observations to make inferences is not necessary scientific. However, children can observe more scientifically when they learn in contexts which reflect disciplinary practice and connect their everyday observations with disciplinary knowledge (Eberbach & Crowley, 2009).

Observational skills are best developed through structured experiences including exploration, experimental maneuvers, generative learning, and the constructivist approach. Children observe using their senses to notice details, sort, group, and classify or sequence (Johnston, 2009). When children can use these senses to observe natural phenomena, it is found to produce positive effects on their development of language, social skills, and attitudes. However, fewer formal and informal opportunities to observe and explore natural scientific phenomena are being offered to children due to child safety concerns (Johnston, 2009).

There has been agreement the development of good observational skills needs to be supported by focused and structured teaching in order to develop thinking and linguistic skills, as well as, creative thinking (Johnston, 2009). Kelley and Psillos identified only 5% of student activities involved observation. Those activities mainly involved observations being taken by teachers while students watched (Johnson, 2009). Children should be active participants in their own scientific understanding, as it helps to scaffold both their own, and each others learning in a complex social process. This takes place with the child learning alongside the teacher (Johnston, 2009).

As children move through the process of becoming better observers, they begin to notice categories and are more likely to correspond those with a scientific discipline. The more frequent their observations, the more likely observers are to attach labels that are scientifically significant. Young children can start to make very sophisticated and detailed observations, and are also more likely to document those observations with a variety of representations (Eberbach & Crowley, 2009). They begin to use observational aids, yet can get distracted easily and continue to need support and quality interventions and interactions in order to refocus on the important information in front of them (Johnston, 2009).

Children engaged in scientific activities learn through “dynamically changing” social interactions with peers and adults, which allows them to begin to raise new lines of scientific inquiry. Without this social interaction and scaffolding, students are likely to move from unsophisticated creative and imaginative general observations to unsophisticated particular observations rather than improving their skills (Johnston, 2009). Multiple opportunities to participate in these types of activities help students transition from observations based on personal expectations to scientific observations (Hanuscin & Park Rogers, 2008).

Social interaction during this transition period also helps students begin to learn how to coordinate their expectations and evidence as they think, talk, and publicly organize their evidence in ways consistent with a disciplinary learning community (Eberbach & Crowley, 2009). Talk is especially useful in creating shared organizational labels, shaping shared questions stemming from the content, making expectations explicit, or changing and critiquing theories. Students begin to expect objects and phenomena to behave in ways that conform to the direct observations they have previously made (Eberbach & Crowley, 2009). Students also learn about differences between observation and inference, and to analyze their roles in developing scientific explanations (Hanuscin & Park Rogers, 2008).

Questioning techniques play an essential role in the transition from observations based on expectations to scientifically-based observations. Question-asking is important for engaging children in noticing the world (Ashbrook, 2010). By challenging children with questions throughout the process, they are forced to remain focused on the observational situation, even if it is not possible to gather information (Hanuscin & Park Rogers, 2008). In order to answer the questions, students need wait time to formulate answers based on the patterns they see (Ashbrook, 2010). They will also begin to take more detailed notes on their observations.

There are three factors that affect the detail of the field notes that students take. The first is the extent to which the records explicitly solve the problem the child is interested in. The problem must be authentic, interest based, and engaging to the student (Eberbach & Crowley, 2009). The second factor is whether or not the child uses their own note taking system. Students need multiple opportunities to create, critique, and revise notes. This allows them to build bases of domain knowledge (Eberbach & Crowley, 2009). The last factor is the amount of mediation by those with more experience. Students need scaffolding to help them understand what is important to include in their notes and what is not. They need a guide and facilitator to encourage them and help them assess the data they have collected (Anderson, Martin, & Faszewski, 2006).

Drawing from the research provided so far, there are ways for teachers to foster children's abilities to observe, infer, and understand phenomena like scientific observers. Instructional strategies such as giving students multiple opportunities to observe in natural environments, asking students challenging questions throughout the process, encouraging them to create their own system of note taking, and allowing them to share and discuss their findings in a safe learning environment have been found to be effective ways to foster development of the skill. The review of literature in the following section will focus on the role the five senses play in fostering observation skills.

The Five Senses

Aristotle is credited with the traditional classification of the five senses. Each of the senses consists of organs with specialized cellular structures that have receptors for specific stimuli. These cellular structures are linked to the nervous system and the brain. The senses gather information about objects the body encounters and sends that information to the brain for processing (Zamora, 2015). Each of the five senses serves an important function in information being gathered and processed smoothly (Cook, n.d.).

Sight is the most developed of the five senses. Humans are able to see in three dimensions and have depth perception. Each eye sees individually, but messages are sent to the brain and are combined to form the image. The sense of sight is crucial for learning (Pitts, 2012).

Hearing also plays a critical role in the observation process. The cellular structures in the ear pick up vibrations from objects around the body and turns them into sensations. Those sensations are sent to the brain for processing and allow humans to hear loud or soft sounds, as well as recognize particular sounds (Cook, n.d.). The sense of hearing adds a layer of comprehension sight alone can't offer, especially in nature (Pitts, 2012).

The sense of touch is activated by intentional touch or the skin coming in contact with an object, most noticeably in the fingertips (Cook, n.d.). Nerve endings distributed throughout the body transmit sensations to the brain, allowing humans to sense heat, cold, pain, and pressure (Zamora, 2015). Studies have shown that students learn better with an object and textures to physically touch or manipulate (Pitts, 2012).

Smell is also a powerful observation tool. Within the nose is a cavity lined with mucus membranes. The membranes contain smell receptors which are connected to the olfactory nerve. Vapors are collected by the smell receptors, chemical reactions are sensed, and information is sent to the brain. The brain processes the information to smell camphor, musk, flower, mint, ether, acrid, or putrid smells. Those vapors are also subconsciously associated with the smells of different things to which the brain has already made connections (Zamora, 2015).

The tongue controls the sense of taste. Tastebuds on the tongue create a chemical reaction and send the information to the brain for processing. The brain processes the information into the categories of salty, sweet, sour, or bitter (Zamora, 2015). Taste is often combined with the sense of smell to create a more powerful observation (Cook, n.d).

As far back as the 1760's, Immanuel Kant proposed that humans' knowledge of the outside world depends on their modes of perception (Zamora, 2015). Studies have shown humans rely heavily on their senses when learning, and multi-sensory experiences help learners remember and retain information more effectively. Engaging more than one sense at a time helps process information (Pitts, 2012). To become scientific observers, students must use a combination of senses to fully connect to their environment.

Phenology

Phenology is a growing body of science seen as important to helping us better understand our environment. In 1853, Charles Francois Antoine Morren first defined phenology as "the art of observing the life cycle phases or activities of plants and animals in their temporal occurrence throughout the year" (Puppi, 2007, p. 24). Other definitions have been given since then, but the United States National Committee for the International Biological Program's Phenology Committee has come up with what is possibly the most complete and appropriate. They define phenology as, "the study of the timing of recurring biological events, the causes of their timing with regard to biotic and abiotic forces, and the interrelation among phases of the same or different species" (Puppi, 2007).

In more common language, the science of phenology studies the environment and provides evidence of how the natural cycle of climate impacts the world. The repeated life cycle events in all biotic organisms seem to occur like clockwork. These cycles take their cue from local climate. Changes in sunlight, temperature, and precipitation work together to trigger the biotic changes (National Wildlife Federation, n.d.). Some of these phenological events capture the attention of observers and cause excitement throughout the year. Plant flowering, animal migration, and changes in the appearance of leaves are only a few well known phenological changes. Phenology is increasingly relevant to the various environmental, ecological, and land management issues being addressed today. It also helps scientists understand the health of species and the different ecosystems (Morisette & Schwartz, 2010). Phenology is a prominent bio-indicator of how biological systems are affected by climate change (Magney et al, 2013).

In 1936, Aldo Leopold first began recording phenological changes in Wisconsin. He kept observational records about the land around his family's farm and shack from 1935 - 1948. During this time, Leopold increasingly focused sharing his observations and conservation message with the public. He began writing essays about how the natural world worked based on his observations. Those essays led to Leopold's most well-known work, *A Sand County Almanac*, which inspired many people to begin taking action toward a healthy environment. His work has led to many phenology tracking organizations and databases and has had a significant impact on environmental education (The Aldo Leopold Foundation, n.d.).

As Leopold demonstrated through his records, observation of phenomena represents the fundamental first steps in collecting knowledge. This is important to take into consideration when teaching environmental education. Children are naturally curious about their world and enjoy exploring it through concrete hands-on experiences.

They are eager to know why things are the way they are, and have questions about their immediate environment (Bullock, 1994). Using phenology and the seasons in the science classroom increases students' observation skills as they begin to focus on, and note, subtle differences in color, shape, and patterns they are seeing in nature. Students are encouraged to make observations and record data to enhance and extend their learning (Sterling, 2006). They also begin asking questions and making predictions based on their observations. Incorporating nature education into children's everyday lives helps introduce them to living things, helping them find answers to their questions and develop inquiry (Bullock, 1994). With the correct tools, this can help students create a strong connection between themselves and the natural world.

Technology

As discussed earlier, Aldo Leopold kept written field notes of observations of the landscape near his home. The art of written field notes was natural to Leopold, but what was natural a generation ago is different from what is natural today. Technology is now used in a variety of ways by natural resources scientists and managers to ensure healthy environments are available for all life (Baker, Dvornich, Eschenbach, Trygg, & Tudor, 2011). It is common practice for these scientific observers to use multifunctional tools to collect and organize their data (Universities and Colleges Information Systems Association, 2014).

Technology is also natural for children. A majority of their time is spent in front of digital media, and less time is spent outdoors. Opportunities need to be created for children to be outdoors and engaged in their learning. Mobile technology devices can be used as a tool to provide or enhance children's connection with nature by creating outdoor experiences that are engaging and relevant to their lives (Holloway & Mahan, 2012).

iPads. In 2010, Apple introduced a major revolution in technology. It was called the iPad and created a lot of excitement within the technology community (Eichenlaub, Gabel, Jakubek, McCarthy, & Wang, 2011). Several versions of the iPad have been released since 2010, but many of the features that made it successful from the start have stayed the same. The iPad is a tablet which is a wireless, portable personal computer. It has an intuitive touchscreen interface, quick start-up, a lightweight design, and approximately ten hours of battery life (Eichenlaub, Gabel, Jakubek, McCarthy, & Wang, 2011).

Apple marketed the iPad as a tool to bridge smartphones and laptop computers (Eichenlaub, Gabel, Jakubek, McCarthy, & Wang, 2011). The iPad gives users easy access to digital media and can store large collections of videos, photos, and music, as well as serve a number of purposes (Barett, 2015). As ownership of these mobile devices increases, there is great interest in how they can be used to support and enhance learning experiences in instructional settings and beyond (Universities and Colleges Information Systems Association, 2014).

Effectiveness in education. A major scientific breakthrough during the twentieth century was the advancement in understanding cognition and its affect on learning.

Research showed learning to be most effective when four major fundamental characteristics were present in education. Active engagement, collaborative group work, frequent interaction and feedback, and real-world connections all play a large role in learning. That same research led to exploring how technology can be used to continue to improve learning (Roschelle, Pea, Hoadley, Gordin, & Means, 2000).

Research indicates technology helps support learning, develops higher order critical thinking skills, analysis, and scientific inquiry when used for instructional purposes (Roschelle, Pea, Hoadley, Gordin, & Means, 2000). However, having technology in a classroom doesn't automatically mean there will be better instructional outcomes. The effectiveness of technology depends on which software is available to students, what students actually do with the devices, and how teachers structure and support the educational experiences when technology is being used (Sivin-Kachala & Bialo, 2000).

Those variables have led to mixed results in many studies about the effectiveness of technology in education. Differences in the hardware and software used by schools involved in studies makes it difficult for them to be compared. Technology integration also normally takes place as districts are making other adjustments, such as reforming curriculum and assessment, which doesn't allow for studies to show if the technology is making the instructional differences, or if one of the other variables is. Lastly, due to the difficulty and expense of implementing rigorously structured studies on the isolated effects of technology very few studies have been done, giving limited data to support it (Roschelle, Pea, Hoadley, Gordin, & Means, 2000).

In 2000, the Software and Information Industry Association released an executive summary on the effectiveness of technology in schools. The report shows technology having a significant positive impact on education (Sivin-Kachala & Bialo, 2000). There are a number of reasons behind these findings. The first focuses on the educator. An educator's role is essential for technology to be effective. Educators must be familiar with the technology that is being used and be able to support the students throughout the learning process. Second, in order for technology to be effective in instruction, software must be chosen to meet individual learning traits within the classroom. It must also allow for multiple learning paths to be taken in order to meet student needs. Those paths include simulators, videos to anchor instruction and to connect learning to real-world problems, and the ability to target student misconceptions (Sivin-Kachala & Bialo, 2000).

When technology is used effectively within the instructional setting, research shows evidence of positive gains in a few areas. The strongest gains tend to be in the areas of math and science applications. Technology has been used effectively to support math and science curricula when focusing on problem solving and when helping to support targeted topics. These gains generally applied to both genders in the upper elementary through high school levels (Roschelle, Pea, Hoadley, Gordin, & Means, 2000). Technology has also been shown to provide an advantage in phonological awareness, vocabulary development, reading comprehension, and spelling (Sivin-Kachala & Bialo, 2000).

Increased positive effects in attitudes towards learning and self-concept were also found. These increases were seen in students' self-confidence and self-esteem across a wide range of academic areas. The increases were due to students feeling more successful in school due to the use of technology. Feeling successful led to them being more motivated and engaged in their learning (Sivin-Kachala & Bialo, 2000).

There is no right or wrong way to integrate technology in the educational environment. However, as research has shown, there are important components of making the technology integration effective. Teacher education, appropriate software, and multiple options for students to complete tasks all play a large role in effective implementation. When these aspects are present, students are more likely to become interested and engaged in their learning.

Tying Everything Together

As has been stated throughout this chapter, hands-on experiential approaches, such as nature exploration, can have many benefits for children. These benefits can include increased motivation, enjoyment of learning, and improved communication skills. Including technology in these types of experiences can help to enhance learning and allow students take an interest in nature. Using technology as a tool for observation can help students see their environment in a different way.

Students take pictures on a daily basis. They document their lives through photos and quickly share those photos through social media (Magney et al, 2013). The digital cameras that are built into their mobile devices are high quality. By showing students how to make them into scientific tools, they can start to examine changes in the environment (Holloway & Mahan, 2012).

Digital cameras have been recommended for use in science classrooms for nearly two decades. They are seen as a “scientific visualization tool,” especially when used to monitor plant phenology (Magney et al, 2013, p. 37). When observers use digital cameras in the field, it allows them to validate observations, eliminating bias and creating scientific objectivity. Photos and videos can also be uploaded to websites such as the National Phenology Network, allowing students to track phenology across the country (Magney et al, 2013).

One way that educators are using digital cameras in the science classroom is by having students create digital storybooks. Digital storytelling is a way to present information and combines nature photography with telling a story. Digital cameras from mobile devices, such as iPads, are used to capture images and videos of nature or phenological changes. The photos and video clips are combined with written information to tell the story of the students’ observation process. This requires students to make careful observations and keep specific records, as well as, collaborate with others to get feedback while creating their digital projects. The completed digital storybooks are an example of a 21st-century scientific writing experience (Holloway & Mahan, 2012).

Technology binds the process together, involving creativity, communication, and collaboration which are all necessary 21st-century skills.

Looking Ahead

Through this chapter, literature has shown the skill of observation to be a fundamental skill used by scientists and everyday observers. Children use their senses to observe everyday and can learn to focus their observations and keep detailed records by engaging more than one sense at a time. Phenology and the study of the seasons can help students engage the senses and form a connection with nature. Finally, by integrating iPad technology such as digital cameras, video, and note taking, students become more engaged are able to see relevance in their learning.

Chapter Three will outline the method used to increase observation skills in a third grade class in northern Minnesota. It will present an in-depth look at the process of students gaining new knowledge about the process of observation, learning about their five senses, being introduced to the science of phenology, and using iPad technology as a digital tool to record their observations. It will also explain how the data collected by students is then displayed and shared through a digital book to show how their observation skills increased throughout the process.

CHAPTER THREE

Methodology

As stated in previous chapters, the question this study focuses on is: "Will the use of iPad technology and phenology increase students' observation skills?" The researcher's personal connection to this topic was explained in Chapter One and was followed by the examination of literature and studies done on the topic in Chapter Two. Next, Chapter Three with share the process and methods used to collect data in the study. It will also describe the demographics of the students involved in the study, the data collection tools used, and a timeline in which the research data was collected.

Research Paradigm

Qualitative research is a generic term for investigative methodologies described as ethnographic, naturalistic, anthropological, field, or participant-observer research. It emphasizes the importance of looking at variables in the setting in which they are naturally found. Interaction between variables is important. Detailed data is gathered through open-ended questions. The researcher is an essential part of the study (Key, 1997).

According to the American Institutes for Research (n.d), a quasi-experimental study is "a type of evaluation which aims to determine whether a program or intervention has the intended effect on a study's participants." Quasi-experimental studies can take on many forms, but lack either a pre or post-test, a control group, or random assignment of participants.

The study described in this chapter follows a quasi-experimental, qualitative design involving the selection of a group without any random pre-selection processes. After the group was selected, the experiment proceeded in a way similar to other experiments with a variable being compared over a period of time beginning with a pre-test and ending with a post-test. The researcher analyzed the results from tests and final projects to determine if students' observation skills increased over a period of time through the use of iPad technology and a knowledge of phenology.

Demographics

This study involved a 3rd grade self-contained classroom in a rural public elementary school in northern Minnesota. It is the only elementary school in the community and houses grades kindergarten through fifth grade, along with a few pre-kindergarten classrooms. There are three or four sections of each grade level within the school. The school's current enrollment is 505 students. Demographically, the school student population is composed of 49.9% Caucasian, 47.3% American Indian/Alaskan Native, 1.6% Hispanic, 0.6% Asian/Pacific Islander, and 0.6% Black/Not of Hispanic origin students. Within those demographics, 24.8% of the students within the school receive special education services and 72.9% of the students qualify for free or reduced lunch prices. Those demographics create a diverse population of cultures, backgrounds, and needs within the researcher's classroom.

The class participating in the study consisted of 21 third grade students. Fourteen of the students were girls (66.7%) and seven were boys (33.3%). The students ranged in the ages of 8 to 10 years old. Thirteen (62%) of the students were Caucasian and eight (38%) were American Indian. 23.8% (5 students) received Special Education services for reading, math, or behavior support. All of the students were in the classroom for the entire 2014 - 2015 school year.

Classroom Schedule

The students are engaged in a full day of learning that starts at 8:25 and ends at 2:55 daily. The day includes 110 minutes of English language arts instruction, 70 minutes of math instruction, and 25 minutes each of social studies and science instruction. Students also receive music, physical education, library, and computer time two or three times each week. Since the 3rd grade classrooms are self-contained, it allows for a flexible classroom schedule. Daily instruction can be altered to allow for additional science, social studies, and technology instruction as needed.

Most of the lessons and activities for the study took place within a 45 minute period during the morning hours of each school day, with the exception of one afternoon forest visit and two senses lessons needing to be completed in the afternoon. These lessons and activities were split into three categories: outdoor observation time, lessons on the five senses, and data analysis/technology work time. The outdoor observation activities required about 10 minutes of additional time to account for a pre-activity restroom and drink break and a short walk to and from the forest.

Preparations

Many preparations were made in order to assure the safety of the students involved in the study. District paperwork from the beginning of the school year was completed allowing students to participate in any field trips during the school year. Guardians and students also completed a technology agreement with the district in order to use the iPads and a consent form giving their child permission to participate in the study. All twenty-one students in the class had completed paperwork on file at the school.

Safety Precautions

In addition to restroom/drink breaks before and after each forest observation visit, a two-way radio was carried by the researcher. The radio allowed for immediate contact with the school office, nurse, and additional support staff if it was needed. It also allowed the office staff to communicate with the researcher in case of changes in the weather or situations within or outside of the school building. The researcher checked the weather and radar prior to each trip into the forest to make sure weather conditions were suitable for students to safely be outside.

A first aid kit containing inhalers for students who may use them and blood glucose monitoring equipment and snacks for one student who was diabetic was carried during each trip to the forest. Additional staff members also joined the group to help with group management/supervision and to walk any students back to the building who may have needed to use the restroom, became ill, or were leaving school early.

The school district and the researcher set filters on the iPads limiting the content students could access when on the devices. A code was needed to disable these filters and students did not have access to it. Because students were out of reach of the district WiFi, it was not a concern during forest observation times. During data analysis/ technology work time, students were monitored closely to ensure they were staying on the appropriate applications and could be locked into the applications if needed.

Students participating in the study learned about the five senses. Due to health concerns, students were not allowed to use the sense of taste during forest observation sessions and were encouraged to only touch unidentified living things with adult permission. Taste was combined with smell during the five senses lessons and the importance of not eating plants in the forest was discussed by the phenology expert. Students were reminded of this before each trip into the forest and adults supervised the groups closely. If a student had tasted an unidentified plant, the school nurse would have been notified immediately and the student would have been brought into the building for monitoring.

Action Plan

This study focused on using the study of phenology and the use of iPad technology to increase observation skills in third graders. A group of 21 third grade students were given a pre-test using a video created by the researcher showing a nature setting. As they watched the video, students were asked to record what they observed. Prior to students starting their observations, the classroom lights were shut off, the blinds were pulled, and all extra classroom noise was limited. Students were also asked to sit in a location near the screen which was treated as their observation spot for the pre-test. A piece of masking tape with their student number was placed at the location and remained there until the post-test at the end of the study. Students then watched the video for five minutes and recorded their written observations on a provided response sheet (See Appendix A).

The day after the pre-test took place, students participated in a classroom science lesson focusing on what observation is and how scientists observe. This lesson included a short video from BrainPop, Jr. titled "Making Observations". The video introduced students to different ways to make observations, including the use of the five senses and tools such as rulers and microscopes. Rulers and hand lenses were available to students during their observation sessions. The introduction video also shared ways to record observations, such as drawing pictures, taking photos, and taking written notes. It ended with information about drawing conclusions from collected observation data. At the end of the lesson, the students participated in a discussion about the video and created posters for the classroom wall sharing the information they learned.

The following week, a local phenology expert made a visit to the classroom to have a session with the third graders focusing on what phenology is and how important the five senses and observing are to this type of science. The phenology expert is the host of a radio show focused on phenology in the area. The students had the opportunity to share what they would talk about if they had a radio show similar to his and he helped them make connections between what they were seeing in nature and phenology.

Later that day, students were taken into the school forest to practice moving around the area as observers. Prior to leaving the school building, the class was asked what they thought was important to remember when going into the forest. The students decided that in order to observe in the forest they needed to use whispering voices, walk slowly and safely, and look around closely. The class walked on the trails for about 20 minutes and then returned to the classroom.

During the next lesson, students were split into predetermined teacher-assigned groups of four or five. These were their groups for the rest of the study. The groups were established based on academic, behavioral, and technological strengths and challenges, as well as student attendance records. Students with higher absence records were placed into the larger groups. Each group was assigned a team leader to make sure all of the measurement tools taken into the forest were accounted for during observation sessions. As the class went out into the forest, these groups were assigned to an observation area that had been staked off and flagged by the researcher prior to students entering the area. This was the location in which they would make their observations during the study. Students would visit the site five times over a four week time period.

After finding their observation location, students used their iPads or notebooks to collect data. Students were able to record observations by taking photographs and video using the iPad's camera function. Written/typed notes could also be taken using a document created on their iPad or their notebook**.** After about 30 minutes of observation time, the class returned to the school building. This process was repeated during each of the five observation sessions.

After each visit to their observation spot, students compiled their individual and group data into a group folder on Google Drive. Students also took photos of any handwritten observations taken in notebooks and added the documentation into Google Drive. This allowed all group members to have access to the information. They then began to compile a digital book using a book creation application on their team leader's iPad. Students were able to add photos, video, audio recordings, and written or typed text into the book. Students were limited to creating four pages per observation session in their book to help them stay focused on their most important observations. The book was completed in sections after each forest observation session in order to help students keep their data organized. After each technology work session, students were asked to delete the photos and video clips from their iPads. Since they had already moved all of the information into Google Drive, it was safely stored in their online folder and no longer needed to be stored on the iPads.

In between visits to the forest, students participated in lessons focusing on how humans use the five senses to observe. Lessons included practice sessions in the classroom (See Appendix B). The lessons were taught in the following order: sight, hearing, touch, and smell/taste. Taste is the one sense which was not allowed during classroom visits to the forest, but it was addressed for the benefit of teaching students about all five senses. One new lesson was taught before each forest visit.

Data Analysis

After completing the activities described earlier in the chapter, students were given a post-test using the same video and basic response sheet as used in the pre-test. The students sat in their original observation spot marked by the piece of tape containing their student number. The lights and extra noise were eliminated to replicate the pre-test. The pre-test and post-test observations were compared to see if there was an increase in what students observed in the video from the beginning of the study to the end.

At the end of the study, each group of students had a completed digital book presenting their observations throughout the process. Students shared the books with their classmates and a few school staff members. These books were also used as part of the study's data collection.

The researcher then analyzed the pre and post-test data and the observations included in the digital books. This was completed using charts split into specific areas addressing the total amount of observations made, which of the senses were used to make the observations, and the tools used to document the observations (See Appendices C and D). Throughout this process, the researcher had two specific questions in mind. Did students' notes become more detailed and incorporate more of the senses during each visit to the forest? Were students able to use a variety of methods on the iPad to document and explain their observations clearly in their digital storybook? If the answer to those questions is yes, then the study was a success.

Timeline

The start date for the study was April 1st, 2015, when the pre-test took place. The local phenology expert's visit occurred on April 7th, and the students completed their first official forest observation session on April 8th. A technology work session then took place and was followed by a senses lesson. These lessons led up to the next forest observation session. This rotation continued until the final observation session on April 30th and a few final technology work sessions in the days following to finalize each group's digital book. The process concluded with a post-test on May 7th. The following week, each group of students shared their digital observation books with their classmates, allowing the other students to see the area they had observed in and the process the group used. This entire process was completed within a six week time period.

Limitations

There were three minor limitations during this study. The first limitation was the change in weather conditions from one forest visit to the next. Above average temperatures occurred one week, and the next week there were below average temperatures. Weather ranged from warm and sunny to cold and windy. During one visit, there was snow on the ground. This made the phenological changes slow down and it was more difficult for students to spot seasonal changes.

A second limitation was student responsibility with their iPads. A few students had their iPads taken away due to misuse in class and others did not keep their iPads charged causing the battery to die. These students were unable to use their iPads to record observations and instead needed to work alongside another group member or carry a notebook and pencil with them to record their observations. Using notebooks limited the detail students were able to include when describing their observations.

The last limitation was student attendance. Due to the short project timeline, students who were absent for the five senses lessons were not able to make it up before the next forest visit. There were an average of three students absent during each of the five senses lessons. A few of the students had multiple absences during the study and missed more than one of the senses lessons. This caused some groups to have a member who had not practiced using a particular sense and were not familiar with the strategies of how to use the sense for observation when they were in the forest.

<u>Looking Ahead</u>

In Chapter Three, the methods and procedures of this study were examined. The demographics, safety precautions, action plan, timeline, and limitations of the study were outlined in order to get a sense of how and what was being investigated during the study. Chapter Four will take a close look at the results and data collected during the pre and post-tests and completed student observation projects. This information will be analyzed to see what inferences or conclusions can be made regarding the question: "Will the use of iPad technology and phenology increase students' observation skills?"

CHAPTER FOUR

Results

In Chapter One of this study, the researcher's personal connection to this topic was explained. Chapter Two was an examination of literature and studies done on the topic, looking closely at observation, phenology, and technology. In Chapter Three, the study's process and the methods used to collect data were addressed. Chapter Four will look closely at the data collected during the study, analyze the results, and connect the results to the study's focus question: "Will the use of iPad technology and phenology increase students' observation skills?"

Review of Data Collection Methods

Data was collected in two different ways during this study. Students participated in a pre-test at the beginning of the study and post-test at the end of the study. The test involved students watching a five minute nature video and writing down what they observed on the Observation Response Sheet (see Appendix A). The researcher then analyzed the information using the Pre and Post-Test Data Analysis Tool (see Appendix C) to see if students' observations increased from the beginning of the study to the end of the study.

Students also created digital books to display the observations their group made during visits to the forest. After each forest observation visit, students created four pages in a digital book to display and explain their findings. The researcher then used the Group Digital Book Data Analysis Tool (see Appendix D) to analyze which of the senses students used to make their observations and the technology they used to document each observation.

Pre-Test Results

Twenty-one students participated in the observation pre-test. Those students made a total of 181 observations based on what they saw or heard in the nature video. The mean for the observations made by the class was 8.62 observations per student, with a mode of eight. One hundred sixty-five of the observations made by the students used their sense of sight. This was a mean of 7.86 observations per student and a mode of six. There were also 16 observations made with the sense of hearing, with a mean of 0.76 observations per student and a mode of zero. This classroom data can be seen in Table 1.

Pre-Test	Total Class Observations	Class Observations Using Sight	Class Observations Using Hearing
Number of Observations	181	165	16
Mean	8.62	7.86	0.76
Mode	8	6	0

Table 1: Overall Class Pre-Test Data

Common observations made by the students included seeing trees, logs, leaves, sticks, and snow on the ground. Students also documented hearing birds. It was also common for students to include opinions such as beautiful, pretty, interesting, and weird in their observations. The observations made by the students were very basic and included very few details.

Looking closely at the students' recording sheets, some important information was noted. A few of the students wrote notes on the top of their papers stating they didn't know what observation was. Several students documented seeing deer, squirrels, or a skunk in the video even though the animals did not appear. This connected directly to Eberbach and Crowley's (2009) research addressed in Chapter Two. Their research included information about expectations influencing what observers do and do not notice. Everyday observers often have "conceptual spectacles" and actively seek what meets their expectations, while ignoring the contradictory. These everyday expectations can lead students to observe things they are expecting to see instead of what is actually present.

<u>Post-Test Results</u>

Twenty of the students taking part in the study participated in the post-test. This was one less student than the pre-test. Overall, the class made 182 observations during the post-test. This was a mean of 9.1 observations per student with a mode of seven. One hundred forty-six of the observations were made with the sense of sight, with a mean of 7.3 observations per student and a mode of six. Students made a total of 36 observations using their sense of hearing. This was a mean of 1.8 observations per student with a mode of one. The information from the post-test can be seen in Table 2.

Post-Test	Total Class Observations	Class Observations Using Sight	Class Observations Using Hearing
Number of Observations	182	146	36
Mean	9.1	7.3	1.8
Mode	7	6	1

Table 2: Overall Class Post-Test Data

The researcher noted that observations made during the post-test were much more accurate. Overall observations were similar to the pre-test with a majority of students noting seeing trees, birds, logs, snow, sticks, and leaves. However, students did not report seeing any animals not present in the video. Students also reported seeing moss, sunshine, shadows, and a bird flying around. Most students documented hearing birds and many were able to name the birds they were hearing as crows and chickadees. Observations also became more detailed as students used colors, sizes (little/big), and number amounts of objects they were seeing.

Pre and Post-Test Data Comparison

Comparing the data from the pre and post-tests, classroom observations increased overall from 181 observations to 182 observations. This was an mean increase of 0.48 observations per student. Observations made with the sense of sight decreased by 19 total observations with a mean decrease of 0.56 observations per student. There was an overall increase in the amount of observations made with the sense of hearing from 16 observations during the pre-test to 36 made during the post-test. This was a mean increase of 1.04 observations per student.

The data collected from the pre and post-test does not have enough of a significant change to determine if the use of phenology and technology increased students' observation skills. The small overall increase may also show that although the observation recording sheet was open-ended, there may have been a ceiling on the number of observations it was possible for the students to make. However, the decrease in observations made with the sense of sight and increase in the number of observations made with hearing may show that students were more focused on the use of both senses at the end of the study than they were at the beginning of the study. Students' observations were also more accurate and detailed during the post-test, which shows they were looking and listening more closely, had gained additional information about nature, and were able to make their observations more descriptive.

Digital Book Student Data

Data from the digital books created by students was looked at in two different ways. First, the data was looked at in terms of the four senses students were allowed to use in the forest. The digital books were analyzed looking specifically at which of the four senses each group used to observe their documented observations. The digital books were then analyzed a second time looking specifically at how each group chose to document their observations.

Data collection on the use of the senses in observation. After each forest observation visit, groups completed up to four pages in their digital book documenting their observations. The observation numbers for each group were analyzed (see Appendix E). The numbers were then totaled and placed into Table 3.

Forest Visit	Total Number of Observations Made	Number of Observations Made with Sense of Sight	Number of Observations Made with Sense of Hearing	Number of Observations Made with Sense of Smell	Number of Observations Made with Sense of Touch
1	45	42	0	1	2
2	37	36	0	0	1
3	46	43	3	0	0
4	30	25	0	0	5
5	37	26	3	2	6

Table 3: Class Data for Observations Made with the Senses

Total observation numbers varied by forest visit with students making the most observations during Visit Three (46 observations) and the fewest observations during Visit Four (30 observations). The sense of sight was used the most to make documented observations during all five of the forest visits. None of the other three senses allowed in the forest came close. This relates to Pitt's (2012) information in Chapter Two addressing sight as the most developed of the five senses and the sense that is crucial for learning. Table 4 shows the mean of the observations made with each of the four senses allowed to be used in the forest. Information about the mode for the observations can be found in Appendix F.

Forest Visit	Mean of Total Observations Made	Mean of Total Observations Made with Sense of Sight	Mean of Observations Made with Sense of Hearing	Mean of Observations Made with Sense of Smell	Mean of Observations Made with Sense of Touch
1	7.5	7	0	0.17	0.33
2	6.17	6	0	0	0.17
3	7.67	7.17	0.5	0	0
4	5	4.17	0	0	0.83
5	6.17	4.33	0.5	0.33	1

Table 4: Class Means for Observations Made with the Senses

As shown in Table 4, overall observation numbers increased in some areas and decreased in others. The mean for the total observations made decreased by 1.33 observations per group from Visit One to Visit Five. Visit Three had the highest overall mean of 7.67 observations made by each group. Observations made with the sense of sight also had an overall decrease with the mean changing from seven observations per group during Visit One to 4.33 observations per group during Visit Five.

Observations using the senses of hearing, smell, and touch all had a slight increase from Visit One to Visit Five. The mean for observations made with the sense of hearing increased by 0.5 observations per group. Observations made with the sense of smell increased from a mean of 0.17 during Visit One to 0.33 during Visit Five. The largest mean increase was the sense of touch changing from a mean of 0.33 during Visit One to a mean of one observation per group during Visit Five.

When looking at the focus question "Will the use of iPad technology and phenology increase students' observation skills?", the data collected on the number of observations made using the senses is inconclusive. Although there was an increase in observations for the use of the senses of hearing, smell, and touch, there was a decrease in the overall amount of observations made and the number of observations made with the sense of sight from Visit One to Visit Five. No definite patterns were found in the data to show a significant change.

Data collection on the use of technology in observation. After analyzing group data on the use of the senses in observation, the data was then analyzed looking at the type of technology used to document each observation made. Each group's data was looked at individually (see Appendix G) and was then totaled and analyzed as a whole class. The overall class data can be found in Table 5.

Forest Visit	Total Number of Observations Made Using Technology	Number of Observations Recorded with Photos	Number of Observations Recorded with Video Clips	Number of Observations Recorded with Audio Clips	Number of Observations Recorded with Written Notes Taken on iPad
1	45	33	1	0	11
2	37	29	1	0	7
3	46	28	4	2	12
4	30	23	0	0	7
5	37	21	4	0	12

Table 5: Class Data for Use of Technology to Document Observations

As the table shows, most of the observations made by the class were documented through photos taken with the iPad's camera. Overall, the groups made a total of 195 documented observations. One hundred thirty-four of those observations were made using photographs. This correlates with information addressed earlier about the sense of sight being the most used of the senses to make observations during the study.

Fifty-nine observations were documented using written notes taken on the iPad. These groups took their written notes in several different applications of their choice on the iPad. Groups who took written notes used them along with photos to give more detailed information in their digital book than those who did not take written notes. The detailed notes included information about observations made with the sense of smell and touch, such as, "The moss was soft and rough."

It was observed by the researcher that groups who did not take written notes did so for two reasons. The first reason was no one in the group wanted to be the one to take the written notes. They often argued about the role and everyone refused. The second reason was because the group leader decided all of the group members should take their own written notes and no one actually did. This correlates with Eberbach and Crowley's (2009) findings in which children tend to give the job of recording observational data to others, do not productively generate or use their records, and often will not refer to or track the data.

Overall numbers of technology used to document group observations varied from forest visit to forest visit. Frequency of use of each type of technology and change in use from Visit One to Visit Five was analyzed more closely by looking at the mean for observations documented. The data is shown in Table 6. A table showing the mode for the use of each type of technology can be found in Appendix H.

Forest Visit	Mean of Total Observations Made Using Technology	Mean of Observations Recorded with Photos	Mean of Observations Recorded with Video Clips	Mean of Observations Recorded with Audio Clips	Mean of Observations Recorded with Written Notes Taken on iPad
1	7.5	5.5	0.17	0	1.83
2	6.17	4.83	0.17	0	1.17
3	7.67	4.67	0.67	0.33	2
4	5	3.83	0	0	1.17
5	6.17	3.5	0.67	0	2

Table 6: Class Means for Use of Technology to Document Observations

Similar to the data involving the use of the senses, the data on technology use was a split of increased and decreased means from Visit One to Visit Five. The overall amount of observations made with technology decreased from a mean of 7.5 observations per group during Visit One to a mean of 6.17 observations per group during Visit Five. The mean of observations recorded using photos also decreased from 5.5 observations during Visit One to 3.5 observations per group in Visit Five. The amount of observations documented with photos steadily decreased each week.

Two areas of technology did have slight increases during the study. Observations taken with video clips increased from a mean of 0.17 during Visit One to a mean of 0.67 observations per group during Visit Five. This was the area of largest growth with a mean increase of 0.5 during the study. Observations taken with written notes on the iPad increased from a mean of 1.83 observations per group during Visit One to a mean of two observations per group during Visit Five.

The mean of observations recorded with audio clips stayed the same, with Visit Three being the only week in which any audio clips were recorded. These observations were recorded using the video camera on the iPad, but students discovered they could focus on the audio by placing their hand over the camera lens while recording to block the visual and only get the sound they were trying to record. Several groups used this method to record bird songs.

Group reflections. After completing the five visits to the forest and all of the pages of observation documentation in their digital books, students were asked to reflect as a group on what they learned about phenology and how the iPad helped them be a better observer. Answers varied in wording, but followed a similar theme that showed an increase in knowledge about phenology and using the iPad as a scientific tool. Group Four said, "Phenology helped us learn that observation is important." Observation was also addressed in Group One's answer. They said, "Phenology taught us about observing and how to use our five senses (not taste)."

Although all the groups' answers addressed nature in some way, they didn't necessarily show an understanding of the definition of phenology. However, two groups' answers showed a true understanding of phenology as the study of seasonal changes. Group Two wrote, "We learned that phenology is seeing and watching things grow over time." This connected to Group Six's answer stating, "We learned that nature never stays the same. It changes all the time."

When asked about how technology made them better observers, all six groups answered in very similar ways. The groups wrote about using the camera, video, and notes to record their observations. Group Six said the technology helped them use their five senses. Group Two wrote, "We can use the iPad to do things we wouldn't be able to do." Their answer showed an understanding of using the iPad as a scientific tool and its ability to help with learning and observing.

<u>Overall digital book results.</u> Similar to the data from the pre and post-tests and the data collected on the use of the senses, the information collected on the use of technology to document observations did not have a definite pattern or a significant change. Although some areas of technology use did increase from Visit One to Visit Five, other areas decreased. The third graders found it easiest to document their observations with the iPad's camera. Group reflections on phenology and technology show that students did gain new knowledge during the study, but as far as the focus question, "Will the use of iPad technology and phenology increase students' observation skills?", the data was inconclusive.

<u>Group Five</u>

Throughout the creation of the digital books, there was one group whose data showed the study's desired effect. Group Five's data showed an increase of overall observations from Visit One to Visit Five. During Visit One, the group documented six observations, all of which were made with the sense of sight. The group documented 10 observations during Visit Five. Seven of those observations were made with the sense of sight, two with the sense of smell, and one with the sense of touch. Group Five also consistently took written notes on the iPad and used those notes to give detailed descriptions within their digital book.

Additional Findings

After looking closely at the data analyzed from the creation of the digital books, it was noticed that Visit Three had the highest overall documented observations in four of the five studied areas and had the largest variation in the way technology was used to record the observations. It was also noticed that Visit Four had the lowest overall documented observations and very little variation in how technology was used. The researcher found a few reasons this may have occurred.

Visit Three was done on a cold, windy day following a week of temperatures in the upper 60 and lower 70 degrees Fahrenheit. These above average April temperatures mostly likely resulted in a great amount of phenological changes between Visits Two and Three. As a result, students were able to document many noticeable changes in their area of the forest.

Due to interruptions in the school schedule, Visit Four took place in the afternoon instead of the morning. The class participating in this study was often most focused on academics during the morning hours, and the change in schedule may have affected their ability to focus in the forest. According to Birdlife Australia (n.d), birds are also the most active and vocal in the morning. The difference in the amount of active birds in the area during the morning hours compared to the afternoon hours could also have had an effect on what the students saw and heard while observing.

Looking Ahead

Chapter Four took a close look at the results of a study focusing on the question, "Will the use of iPad technology and phenology increase students' observation skills?" Data collected through observation pre and post-tests showed an increase in overall observations, and an increase in observations made with the sense of hearing, but a decrease in observations made with the sense of sight. Digital books created by the students to display their documented observations using the senses and technology showed increases in some areas and decreases in others. Overall, the data was inconclusive when taking the focus question into consideration.

In Chapter Five, the researcher will reflect on the study as a whole. This will include a review of the study's purpose and major learning the researcher has taken from the study. The review of literature will be revisited and limitations of the study will be addressed. Implications of the study and an action plan for future research will also be discussed. Lastly, the researcher will share a few final thoughts to conclude the study.

CHAPTER FIVE

Conclusion

The study discussed in the previous chapters focused on increasing observation skills of third graders by incorporating phenology and technology into science lessons about the five senses and taking students out into the forest to investigate their surroundings. The goal of the study was to increase students' observation skills from the beginning of the study to the end, but as an educator I also had a bigger picture in mind. This study was completed with the purpose of helping students begin to see how observation is relevant to their lives by noticing the natural world around them, allowing them to begin to become environmentally aware, and gain an appreciation for nature. Chapter Five will take a look back at the previous chapters to reflect on the study, its findings, and its overall effects.

Major Learning

Going into this study, I had the expectation of seeing huge growth in observation skills from the beginning of the project to the end. Looking at the collected data while writing Chapter Four, I was disappointed by what I saw. My expectations had not been met, and I started to wonder what had gone wrong. I realized, however, that the numbers shown in the data are not the only way I could measure growth and the success of the study.

Taking a close look at the data, the pre and post-test showed a small increase in overall observations. Unfortunately, the increase was not substantial enough to consider the study a success. What caught my interest about the small overall increase, however, was seeing a decrease in the number of observations made by sight and an increase in the observations made with hearing. The increase in observations made with the sense of hearing shows that students were more aware of that particular sense during the post-test than they were at the beginning of the study.

Students' observations also became more accurate and detailed from the pre-test to the post-test. Their observations included descriptive words (big/little, green/white) instead of the opinion words (beautiful, pretty, weird) seen in the pre-test observations. Students reported seeing a number of animals during the pre-test that were not present in the video clip they were watching. This was not discussed between the pre and post-tests, but a focus was put on helping students understand observation as what we actually notice with our senses, not what we think we should notice. During the post-test, no students reported seeing any animals not in the video. The data from the tests may not have shown a huge amount of growth, but the inclusion of descriptive words and the accuracy of the students' observations show an awareness and attention to detail not present at the beginning of the study.

Digital books created by the students to display their documented observations did not show a significant amount of growth in observation skills either. Students consistently used the iPad's camera to document observations using their sense of sight throughout the study. The use of the other senses and observation documentation methods varied by visit and no pattern or significant increases or decreases were found.

As far as the focus question: "Will the use of iPad technology and phenology increase students' observation skills?", the overall data was inconclusive.

The group reflections at the end of the digital books showed growth in my overall big picture of the study. My hope was for students to gain an appreciation and awareness of the environment, and begin to understand how observation is relevant to their lives. Groups reflected on what they had learned about phenology and how technology helped them become better observers. In a variety of ways, students expressed seeing changes in nature and an understanding of the importance observation. They also reflected on the iPad technology allowing them to take photos, video, and notes about what they were seeing when they observed. These are lessons I am hoping students will carry with them throughout their lives. They may not have been able to accurately document what they were observing, but they know what observation is and have practiced the skill while interacting with their environment. They also gained an understanding of a science they were not familiar with before the study.

Although the data may not look like I hoped it would, the excitement I saw in my students each day of the study showed me the process was well worth all of the time and effort put into it. Students were motivated and engaged during each of the five senses lessons, the forest visits, and the technology work time. They would ask what we were doing in science each day and would check the board every morning to see which day they needed to come dressed for a forest visit. Behavior issues often seen in the classroom did not occur during forest visits due to students being engaged in the learning process. Students also used the 21st century skills of communication, collaboration, creativity, and critical-thinking each time they went into the forest or worked on their digital books. In my mind, these all made the project a success!

Review of Literature

In Chapter Two, a review of literature was done focusing on the areas of observation, the five senses, phenology, and technology. I found similarities between the research discussed in the literature review and the data collected during my study. The similarities helped me make connections between my data and possible reasons behind the numbers.

The limited background knowledge my third graders had about nature and phenology before starting the study could be one of the reasons a significant increase was not seen in their overall observations. To observe scientifically, requires a coordination of disciplinary knowledge, theory, practice, and scientists' habits of attention. When there is a disconnect between observation and disciplinary context, we are simply seeing instead of observing. Students are everyday observers and are more likely to have a lack of domain knowledge to use as their basis for observing (Eberbach & Crowley, 2009). A disconnect between what they were observing and why it was occurring in nature most likely limited their ability to document accurate observations and explain their findings. The research shows the need for some pre-teaching to take place in order to prepare students for scientific experiences and to help them support their observations.

The review of literature also showed the detail of students' observations can be dependent on whether or not the children use their own note taking system. Using their own system allows the students to create, critique, and revise their notes (Eberbach & Crowley, 2009). After seeing this research, I allowed the students to document their observations in any way they wanted using their iPads or a notebook during the study. During forest visits and technology work time, I would circulate between the groups asking them what they had observed, what senses they had used to observe, and why they had made those observations. Students were able to give appropriate answers to my questions. After looking at the documented observations they added to their digital books, I noticed the third graders may have needed more scaffolding on how to use the iPad tools when documenting observations, and what important components should be included in their notes. This brought me back to another study that said students need a guide and facilitator to encourage them and help them assess their data (Anderson, Martin, & Faszewski, 2006). I made an assumption of students being able to verbally express their findings meaning they were documenting them correctly, when actually the students needed my support to accurately and effectively record their observations.

Research in the review of literature address the importance of using phenology in the classroom to increase observation skills. Phenology helps students begin to focus and note changes in color, shape, and patterns they see in nature. It also encourages them to make observations and share their findings (Sterling, 2006). Through data collected from the pre and post-tests, I was able to see an increase in the detail and accuracy of my students' observations. They were able to use more descriptive words when writing down their observations. Students were also able to use the senses to notice differences while in the forest by focusing on colors, smells, and sounds they may not have noticed during their last visit to the forest. Using phenology as a basis for observation gave the students a place to start their observing and many of the natural changes they were seeing were evident enough to catch their attention and spark new interest and curiosity.

Not a lot of research has been done on the effectiveness of technology in education, but it has been proven that mobile technology devices can be used as tools to enhance children's connection with nature by creating engaging and relevant experiences (Holloway & Mahan, 2012). The data from this study was inconclusive when looking at the idea of technology increasing observation skills. However, documenting observations through tools on the iPad and creating a digital book to display those observations gave students additional experience with technology. Students were motivated by the use of technology and were able to produce a book to share their scientific findings with others. This shows the iPad can be an effective tool for scientific investigations.

Limitations

Time was a major limitation in this study. As stated in the demographics in Chapter Three, 72.9% of the students in the school where the study took place receive free or reduced lunch. Expanded learning time and multiple opportunities for students to work with ideas they are learning are important strategies used when educating children of poverty (National Education Association, 2008). According to The After-School Corporation (2013), by the time they reach 6th grade, children of poverty have 6,000 less hours of education than their peers not born into poverty. This is due to a lack of resources at home and limited access to technology, field trips, and hands-on opportunities outside of the school day.

The short six week time period of the study did not allow for students to have multiple opportunities to interact with the new ideas being introduced. It limited the amount of time we were able to spend on practicing using the five senses, practicing our observation skills, and learning to document observations using the iPads. The number of visits we were able to make into the forest was also limited, which didn't allow the students to see all of the seasonal changes taking place during the spring months. Ideas of how this could be addressed in another study will be discussed later in this chapter.

Implications

The outcome of this study gave me many ideas to think about when considering how to move forward. As stated earlier, there hasn't been a lot of research done on the effectiveness of technology in education. It has been shown to be an effective tool for a variety of purposes, but the effectiveness depends on how the devices are used and the structures put in place. Continuing to use the iPad as a scientific tool in the future involves providing students will the scaffolding they need to be successful using it. Practice, practice, and more practice need to be provided in order for students to get as much out of the use of the device as possible. The study proved to me the need for students to have multiple opportunities to practice with the device before being asked to use the tool with a specific purpose in mind.

The results of the study did solidify the importance of teaching students observations skills. Since observation is part of our daily lives, students need to have the tools to observe effectively and communicate what they are seeing. Observation helps them make good choices and keep themselves safe, as well as connect with their environment. In the future, I will be incorporating observation into my students' day in as many ways as possible. Using basic observation language and asking students what they notice is a way to connect students to the world around them and may help reach the goal of increasing the students' observation skills.

Future Research

Thinking back to the information about poverty from earlier in this chapter, I started brainstorming how this study could be more successful if it was adjusted and tried again next year. Since the population within my school has a high poverty rate and children of poverty need extended learning opportunities, a longer timeline for the study could be used. For my own personal research and the benefit of my students, I will be trying this study again next year for the entire school year. Lessons will begin in September and will conclude in May.

A timeline consisting of an entire school year will allow students to become more familiar with and practice using their five senses in and out of the classroom. It will also allow for more visits from the local phenology expert. These visits will give students more background knowledge about their environment, will help them learn the names and characteristics of plants and animal species they are observing, and will give them a relevant connection to their community by having the opportunity to report their findings to a local radio station each week. The phenology expert has already been contacted about this action plan for next year and is ready to support my classroom in any way possible.

Throughout the entire school year, I will also be able to teach students how to more effectively use their iPads to document their observations. During this initial study, students were focused on taking photographs of what they were seeing, but most groups were not taking any other notes helping them remember what they took photos of or why. By giving students more opportunities to practice using the iPad as a scientific tool in and out of the classroom and connecting the tool to the new knowledge they are gaining from the additional phenology lessons, their observations should become more detailed and relevant to their lives.

Looking Ahead

I have learned a lot about myself as an educator throughout the process of completing this study. The ability to be strategic and constantly keeping my students' best interests in mind have allowed me to see my study as a success. My hope for this study was not only to help students increase their observation skills, but also to help them interact and connect with nature. The data may not always look the way we want it to, but other areas of growth and the smile seen on a child's face while learning are just as important and meaningful. As I continue with the process of research on this topic in the future, I can't wait to see the effect it has on my future students and our environment.

APPENDIX A

Observation Response Sheet

Observation Response Sheet

Student Number:_________________________Date:______________

You will watch a short nature video. In the space below, write everything you observe during the video. Don't worry about spelling.

APPENDIX B

Fives Senses Lesson Plan

Five Senses Lesson Plan

Learning Goal: Students will use iPad technology and phenology to increase their observation skills.

Learning Target: I can identify the five senses and describe how each one can help me make observations.

Timeline: This lesson is a combination of four mini lessons that will take place within a three week time period. Lessons will be taught in the order shown in the procedure section of the lesson plan.

Reference Materials: The book First Human Body Encyclopedia by Discovery Kids.

Procedure:

A. Introduction

- Review the learning goal and learning target. Have students rate themselves (1-4 chin score) on their understanding of the five senses. Then have the students "think, pair, and share" about what they already know.
- Explain to the students how the five senses help us figure out what's going on around us and help us decide if we should enjoy or not enjoy an experience. Our eyes help us see, our ears help us hear, our hands help us feel, our noses help us smell, and our tongues help us taste. These are all important when we are observing new things and will be very important each time we are in our observation spots in the forest.

A. Let the students know that the class will be doing some activities between our forest visits to help them become more aware of each of their senses and how they can help us be better observers. They will learn about a different sense each lesson.

B. Senses Lesson One - Sight

- Show students pages 38 - 43 from the Discovery Kids book. Read and discuss the page paying particular attention to certain facts either mentioned in the book or brought up in discussion.
    - Without light there is no sight. Light from an object moves to the eye and the brain interprets it. It's very technical, but just know that there must be light to see.
    - Our sense of sight is the most used of the five senses.
    - The sense of sight protects us. We can see to move around without being hurt. We see dangerous situations to avoid, but sight also helps us see beautiful things.
    - A person who cannot see is said to be blind.
    - Glasses and contact lenses can help those with poor vision.
    - Never put objects or toxic liquids in the eye.
    - Do not stare at the sun.

- Give students a detailed picture and a list of things to find within it. Discuss what strategies they used to find the objects. Were there certain things that they looked for first? Which things were the most difficult to find?
- How will our sense of sight help us be better observers in the forest? What seasonal changes could we use our sense of sight to notice?
- They are now ready to use their sense of sight to make good observations in the forest.

C. Senses Lesson Two - Hearing

- Begin with pages 44 - 45 in the Discovery Kids book. Read and discuss the book paying particular attention to certain facts either mentioned in the book or brought up in discussion.
  - Your ears collect the sounds and send messages to the brain. Your brain tells you what you are hearing.
  - You can hear sounds that are loud or soft, close or far away, high or low.
  - People that cannot hear are deaf. Sign language and hearing aids can help them.
  - Never put objects in your ear. It can damage your ear.
  - We hear different things in different places and in different seasons. We may hear different sounds at school than at home. We may hear different sounds in summer than in winter.

- Our sense of hearing can protect us from danger. For example you may hear a car horn honking to warn you when you are riding your bike, or you may hear the fire alarm if there is a fire in the building.
- Because we have two ears, it is easier to tell where a sound is coming from.

- Have students participate in an activity to practice using their ears to observe.
    - Have each student put a blindfold on to help them focus on listening.
        - Play some short audio clips of different sounds that are heard in nature or in the community. Have students try to identify the sound. Discuss how they figured out what the sounds were, or what would make it easier if they weren't sure of the sounds. Would any other senses have helped you identify the sound? How will our sense of hearing help us be better observers in the forest?
- What seasonal changes might we notice using our sense of hearing? They are now ready to use their sense of hearing to make good observations in the forest.

D. Senses Lesson Three - Touch

- Read pages 34 - 35 in the Discovery Kids book.
- Discuss how there are tiny nerve endings on our skin that send a message to our brain telling it if things are warm or cold.
- One thing that we don't like about our sense of touch is that we can feel pain. If we touch something that is hot, it hurts us, and we immediately take our hand away. That is one way our sense of touch protects us.

- Have students participate in a few activities to use their sense of touch to observe.
- Discovery Bags
  - Have a few mystery bags on the table. One student at a time will put their hand in the bag and explain what they feel without telling what the object is. Have the other students put their hands in the bag and add any information they think is needed to better describe the object. Then let students guess what object in the bag is. How can our sense of touch help us be better observers in the forest? What seasonal changes could our sense of touch help us notice?
- They are now ready to use their sense of touch to make good observations in the forest. Remind students that they should not touch any living things during our forest observations without checking with an adult first. Some plants and animals can be dangerous to us.

E. Senses Lesson Four - Smell/Taste

- Review with the students the senses that we have already learned about. Let them know that the class will be learning about the last two senses today - smell and taste. We are combining the last two because we don't use our sense of taste when we observe in the forest. It is dangerous to taste things in the forest because we aren't always sure what they are.
- Read pages 36 - 37 in the Discovery Kids book. Ask students about how they use their sense of smell to observe. How does the smell of different things make you react? How does the smell of baking cookies make you feel? The smell of a

skunk? Does everybody react to smells the same way? When we smell things, our nostrils are sending messages to our brain. Those messages are often based on experiences we have had before.

- Have students participate in an activity to practice observing with their sense of smell.
  - Blindfold Smell Test - Have each student put a blindfold on. Walk around with a cup containing a mystery substance. Allow each student to smell the substance. Items could include lemon juice, soap, vinegar, vanilla, peanut butter, pepper, etc. Discuss items that were easy to identify and things that were more difficult. What other senses could help us figure out what you were smelling?
- Have students participate in an activity to show why we don't use the sense of taste in the forest.
  - Red Jelly Bean Activity - Show the students a bag of red jellybeans. Make sure the bag has a mixture of flavors of red jellybeans. Give each student one jellybean. Ask each student to write down a prediction of what flavor they think the jellybeans are. Have all the students eat their jellybean at the same time. Have them write down what flavor their jellybean actually was. Was their prediction correct? How does this activity help us remember not to taste things in the forest?

- Remind the students that they have now learned about all five senses and know how they can use them to be better observers. They are ready to use hearing, sight, touch, and smell to make good observations in the forest.

Assessment: Assessment will be done through observation of participation in the lessons and activities. Informal rating scales will also be used throughout the lessons to track individual student process. The summative assessment will be the finished digital observation book.

APPENDIX C

Pre and Post-Test Data Analysis Tool

Pre and Post-Test Data Analysis Tool

Student Number:_________

Video observations focus only on the sense of sight and sense of hearing.

	Total number of observations made by student	**Number of observations made with sense of sight**	**Number of observations made with sense of hearing**
Pre-test:			
Post-test			

Additional comments on student observations:

APPENDIX D

Group Digital Book Data Analysis Tool

Group Digital Book Data Analysis Tool

Group Number:________

Date of Forest Observation/ Forest Visit Number	Total Number of Observations Made	Number of Observations Made with Sense of Sight.	Number of Observations Made with Sense of Hearing	Number of Observations Made with Sense of Smell	Number of Observations Made with Sense of Touch

Date of Forest Observation/ Forest Visit Number	Total Number of Observations Made Using Technology	Number of Observations Recorded with Photos	Number of Observations Recorded with Video Clips	Number of Observations Recorded with Audio Clips	Number of Observations Recorded with Written Notes Taken on iPad.

APPENDIX E

Individual Group Data for Observations Made with the Senses

Individual Group Data for Observations Made with the Senses

Group One

Forest Observation Visit Number	Total Number of Observations Made	Number of Observations Made with the Sense of Sight	Number of Observations Made with the Sense of Hearing	Number of Observations Made with the Sense of Smell	Number of Observations Made with the Sense of Touch
Visit 1	11	10	0	1	0
Visit 2	11	11	0	0	0
Visit 3	14	14	0	0	0
Visit 4	5	5	0	0	0
Visit 5	6	4	1	0	1

Group Two

Forest Observation Visit Number	Total Number of Observations Made	Number of Observations Made with the Sense of Sight	Number of Observations Made with the Sense of Hearing	Number of Observations Made with the Sense of Smell	Number of Observations Made with the Sense of Touch
Visit 1	9	9	0	0	0
Visit 2	5	5	0	0	0
Visit 3	9	8	1	0	0
Visit 4	3	3	0	0	0
Visit 5	5	4	1	0	0

Group Three

Forest Observation Visit Number	Total Number of Observations Made	Number of Observations Made with the Sense of Sight	Number of Observations Made with the Sense of Hearing	Number of Observations Made with the Sense of Smell	Number of Observations Made with the Sense of Touch
Visit 1	7	7	0	0	0
Visit 2	6	5	0	0	1
Visit 3	7	6	1	0	0
Visit 4	2	2	0	0	0
Visit 5	7	4	1	0	2

Group Four

Forest Observation Visit Number	Total Number of Observations Made	Number of Observations Made with the Sense of Sight	Number of Observations Made with the Sense of Hearing	Number of Observations Made with the Sense of Smell	Number of Observations Made with the Sense of Touch
Visit 1	7	5	0	0	2
Visit 2	3	3	0	0	0
Visit 3	4	4	0	0	0
Visit 4	6	4	0	0	2
Visit 5	4	4	0	0	0

Group Five

Forest Observation Visit Number	Total Number of Observations Made	Number of Observations Made with the Sense of Sight	Number of Observations Made with the Sense of Hearing	Number of Observations Made with the Sense of Smell	Number of Observations Made with the Sense of Touch
Visit 1	6	6	0	0	0
Visit 2	7	7	0	0	0
Visit 3	5	4	1	0	0
Visit 4	8	5	0	0	3
Visit 5	10	7	0	2	1

Group Six

Forest Observation Visit Number	Total Number of Observations Made	Number of Observations Made with the Sense of Sight	Number of Observations Made with the Sense of Hearing	Number of Observations Made with the Sense of Smell	Number of Observations Made with the Sense of Touch
Visit 1	5	5	0	0	0
Visit 2	5	5	0	0	0
Visit 3	7	7	0	0	0
Visit 4	6	6	0	0	0
Visit 5	5	3	0	0	2

APPENDIX F

Class Modes for Observations Made with the Senses

Class Modes for Observations Made with the Senses

Forest Visit	Mode of Total Observations Made	Mode of Total Observations Made with Sense of Sight	Mode of Observations Made with Sense of Hearing	Mode of Observations Made with Sense of Smell	Mode of Observations Made with Sense of Touch
1	7	5	0	0	0
2	5	5	0	0	0
3	7	4	0,1	0	0
4	6	5	0	0	0
5	5	4	0,1	0	0,1,2

APPENDIX G

Individual Group Data for Use of Technology to Document Observations

Individual Group Data for Use of Technology to Document Observations

Group One

Forest Observation Visit Number	Total Number of Observations Made Using Technology	Number of Observations Recorded with Photos	Number of Observations Recorded with Video Clips	Number of Observations Recorded with Audio Clips	Number of Observations Recorded with Written Notes Taken on iPad
Visit 1	11	4	0	0	7
Visit 2	11	6	1	0	4
Visit 3	14	6	1	0	7
Visit 4	5	4	0	0	1
Visit 5	6	4	1	0	1

Group Two

Forest Observation Visit Number	Total Number of Observations Made Using Technology	Number of Observations Recorded with Photos	Number of Observations Recorded with Video Clips	Number of Observations Recorded with Audio Clips	Number of Observations Recorded with Written Notes Taken on iPad
Visit 1	9	8	1	0	0
Visit 2	5	5	0	0	0
Visit 3	9	7	2	0	0
Visit 4	3	3	0	0	0
Visit 5	5	3	2	0	0

Group Three

Forest Observation Visit Number	Total Number of Observations Made Using Technology	Number of Observations Recorded with Photos	Number of Observations Recorded with Video Clips	Number of Observations Recorded with Audio Clips	Number of Observations Recorded with Written Notes Taken on iPad
Visit 1	7	7	0	0	0
Visit 2	6	4	0	0	2
Visit 3	7	3	0	1	3
Visit 4	2	2	0	0	0
Visit 5	7	2	1	0	4

Group Four

Forest Observation Visit Number	Total Number of Observations Made Using Technology	Number of Observations Recorded with Photos	Number of Observations Recorded with Video Clips	Number of Observations Recorded with Audio Clips	Number of Observations Recorded with Written Notes Taken on iPad
Visit 1	7	5	0	0	2
Visit 2	3	3	0	0	0
Visit 3	4	4	0	0	0
Visit 4	6	4	0	0	2
Visit 5	4	4	0	0	0

Group Five

Forest Observation Visit Number	Total Number of Observations Made Using Technology	Number of Observations Recorded with Photos	Number of Observations Recorded with Video Clips	Number of Observations Recorded with Audio Clips	Number of Observations Recorded with Written Notes Taken on iPad
Visit 1	6	5	0	0	1
Visit 2	7	6	0	0	1
Visit 3	5	2	1	1	1
Visit 4	8	4	0	0	4
Visit 5	10	5	0	0	5

Group Six

Forest Observation Visit Number	Total Number of Observations Made Using Technology	Number of Observations Recorded with Photos	Number of Observations Recorded with Video Clips	Number of Observations Recorded with Audio Clips	Number of Observations Recorded with Written Notes Taken on iPad
Visit 1	5	4	0	0	1
Visit 2	5	5	0	0	0
Visit 3	7	6	0	0	1
Visit 4	6	6	0	0	0
Visit 5	5	3	0	0	2

APPENDIX H

Class Modes for Use of Technology to Document Observations

Class Modes for Use of Technology to Document Observations

Forest Visit	Mode of Total Observations Made Using Technology	Mode of Observations Recorded with Photos	Mode of Observations Recorded with Video Clips	Mode of Observations Recorded with Audio Clips	Mode of Observations Recorded with Written Notes Taken on iPad
1	7	4,5	0	0	0,1
2	5	5,6	0	0	0
3	7	6	0	0	0,1
4	6	4	0	0	0
5	5	3,4	0	0	0

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