Building an Understanding of Elementary Science Teachers' Beliefs about Science Literacy

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This paper provides a case study of two elementary science teachers' perspectives on science literacy and the role a reading specialist can play by providing them with a personalized professional development program. This paper seeks to gain insights into two research questions:

1.) What beliefs do two focus third grade teachers hold about science literacy prior to participating in a personalized professional development program related to science literacy?

2.) How do the views of these two teachers evolve as a result of participating in a reading specialist-led professional development program?

The findings showed that in response to question one, the two teachers held different perspectives: one held a mix of traditional and reformed views, while the other held reformed views. In response to question two, after the personalized professional development program, the views of the more traditional teacher evolved to become reformed, while the teacher who held the more reformed views at the beginning of the study remained consistent in her views. In this study, there was evidence that a reading specialist-led personalized professional development has the potential to support the participating teachers' evolving perspectives of science literacy and foster collaboration to offer support for the improvement of instruction.

The study offers an example of the way in which mentoring can beget mentoring within the school community, and highlights the importance of the following aspects for reading

specialists who offer personalized professional development to elementary content teachers: 1) *the importance of meeting regularly with the participants*, 2) *the importance of ensuring the participants are comfortable teaching,* 3) *the importance of frequent follow-ups at the end of the day to ensure the lessons went well and to answer any questions.*

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1.0 Introduction

The Problem of Practice (PoP) I identified for my work within the Ed.D. program focused on two elementary science teachers' beliefs on science literacy. For the purpose of this paper, science literacy is defined as being able to use inquiry to ask good questions, design and perform experiments, decode scientific texts, and display information accurately in presentations (Shanahan & Shanahan, 2008). In addition, science literacy means being literate in science content, defined as science knowledge, as well as in disciplinary literacy, defined as being able to create and interpret science knowledge in the manner that real scientists use in the discipline (Shanahan & Shanahan, 2012). Teachers' beliefs on science literacy matter because they directly influence whether a teacher chooses to teach science literacy through science texts and labs, or teach only labs (Israel, Maynard, & Williamson, 2013, Sampson, Enderle, & Grooms, 2013, Shanahan and Shanahan, 2012). Many researchers agree that when students read about science through science literacy, they build the background knowledge necessary to understand complex science concepts and models (Ball, Thames, & Phelps, 2008, Shanahan and Shanahan, 2012). Without science literacy, students do not learn the theoretical background nor do they acquire the ability to articulate what they observe in science labs or the natural world. Therefore, there is a push for science instruction to be delivered through science literacy and labs, rather than solely through lab-based instruction. This problem is significant because teachers' beliefs about science literacy directly influences how they choose to teach science and which pedagogical delivery method they select.

In elementary schools, most science teachers have received preservice training in elementary education (U.S. Department of Education, 2017). Teacher preparation programs are primarily regulated by each state which dictates the curriculum and requirements for enrollment and graduation in college preservice educator programs. These types of programs afford teacher candidates broad, general preparation in subjects across the curriculum. However, in departmentalized settings, these same elementary teachers may function as content area teachers (i.e., "science teachers") utilizing science instructional materials in their primary teaching role. These materials may include science kits (with consumable lab components such as straws or sand) and science texts that support students' learning of science content.

In the study that follows, the participating school district has wrestled with the balance in the areas of science and literacy, and recently purchased a commercially-produced science textbook that includes lab materials. Prior to this purchase, the district provided teachers with a lab-based science kit which included general worksheets on science topics. Teachers openly expressed their excitement when the curriculum director announced the district was going to adopt a new science textbook. Many of the science teachers stated aloud that they wanted relevant science books for their students. However once the teachers received the new books, they openly expressed disappointment in both the quantity and the quality of the texts included within them. They indicated that the texts gave only general information on each topic and were relatively short in length given the grade level for which they were designed. Their disappointment in the newly-purchased curriculum highlighted a need for support in enhancing their instructional materials for developing science literacy within the district. Given the current emphasis in supporting science literacy, it is believed that reading specialists could offer important support for science teachers in creating and utilizing curriculum materials that offer the most benefit for both students and teachers.

This dissertation-in-practice explores whether teachers' beliefs about science literacy will change when they are provided with science-literacy materials during a voluntary and personalized professional development program led by a reading specialist in their school building. Specifically, this study looks the potential effects of a personalized-professional development program on teachers' perspectives about science literacy. In addition, this dissertation-in-practice documents and probes the ways in which one reading specialist can support science literacy in two, third grade classrooms.

Within the framework of this professional development, teachers participated in weekly-scheduled meetings with a reading specialist (myself, the researcher) to discuss science literacy in their classrooms. For this study, I wanted to build an understanding of the science literacy-beliefs of two third grade science teachers prior to, during, and after a personalized professional plan. In addition, I wanted to gauge how a reading specialist, such as myself, might impact science literacy instruction in two classrooms.

1.1 Description of the Organization

The organization on which I focused is a Schoolwide-Designated Title I K-5 suburban elementary school in southwestern Pennsylvania. The school district reports that 52.4% of students qualify for free and reduced lunch. Approximately twenty percent of the students at the school are refugees and 9.8% of the all the students are English learners, most of whom are also refugees. My school employs two Title I reading teachers, of whom I am one. Together, we support students in English Language Arts (ELA) classes only. One of the reasons I chose this

Problem of Practice is because I wanted to find a way to support students in reading during their science classes.

1.2 Description of the Individuals, Groups of Individuals, and Stakeholders Demographics, and Key Characteristics Central to the Problem

There are many stakeholders who are involved in or affect the Title I program at our school. The school board is comprised of recently appointed members, who were elected to the board approximately two years prior to the study. The administration consists of a superintendent, assistant superintendent, and curriculum director, who all directly affect the program. Because the school has moved from Targeted Title I Assistance to a Schoolwide Title I, the administrators have more flexibility to decide how to use the Title teachers and monies allocated from the federal government. In addition to school personnel, there are other community supports. One example of this is an afterschool program at a church that teaches our refugee students, many of whom receive reading support. Parents and many community members are interested in the success and future of the Title I program. In addition, teachers have a vested interest in the success of the students. The students are also primary stakeholders because the success of our school's reading program directly impacts them.

1.3 Problem of Practice

For this study, my focus was on building an understanding of the beliefs science teachers hold about science literacy in the elementary-science classroom and gauging the ways in which a reading specialist can positively impact science literacy. I chose to focus on science and literacy instruction because at my school, we saw a dramatic dip in our third through fifth grade English Language Arts (ELA) scores (specifically in non-fiction text) on the Pennsylvania System of School Assessment (PSSA) scores. Using the Pennsylvania Value-Added Assessment Scores (PVAAS), I drilled down to the subgroup scores and found a growing disparity between the overall school's ELA score and two subgroups in particular. The overall ELA score according to the 2018 PSSA data retrieved from PVAAS was 71.4% proficient (passing). Meanwhile, the score for the students who identify as Black was 60% proficient and the score for students who are English Learners was 35.4% proficient. For my long-term goals, I want to support students' science content knowledge and reading goals by enhancing the science instructional materials to ensure that all students, in particular marginalized subgroups, are receiving an equitable opportunity for science achievement.

The history of the district's science curriculum materials began with the district using the ASSET science kits. ASSET provided a commercially-produced program for elementary schools that was lab-based. This program included excellent lab content and hands-on materials for the students, but offered scant science texts. The texts received were limited to worksheets. For the majority of my tenure at the district, we used ASSET as our sole curriculum. Only recently, has the district switched to a textbook-based curriculum. The district adopted a new curriculum because the science committee had voiced their concern over lack of a core text for the science program. Because of this lack of a core text, I was also concerned that our students did not know how to comprehend science informational texts. Due to my concern, I asked to join the science committee, in which we worked to adopt a new textbook. After reviewing the newly adopted science textbook, I found that there were many lessons that could be improved with scaffolds. Scaffolds are a way in which teachers build upon what students know by providing supports to bridge the gap between what they know and what they need to learn (Vygotsky, 1979). Scaffolding the texts with instructional supports for students in science literacy was an area where a collaboration between reading specialists and science teachers could be beneficial to both parties.

Many reading specialists have expertise that can support both teachers and students. For this study, I relied on my own preparation and experiences as a reading specialist, along with the knowledge developed about practitioner inquiry, disciplinary literacy, and content area literacy during my doctoral studies. From these experiences, I started thinking about my own teaching context and how research could inform my practice. In terms of my Problem of Practice, I wondered about the teachers' beliefs and how this might influence the way they taught science. I also thought about the opportunity to collaborate in science. Since I was co-teaching only in English Language Arts at the time, I felt that I was missing an opportunity to collaborate with science teachers. I thought that if perhaps the science teachers and I worked together collaboratively, I could provide scaffolding to support students in science literacy. That is how I came to focus my research on teachers' beliefs about science literacy and the ways in which reading specialists could potentially support students in the elementary science classroom.

1.4 Purpose of the Study

The purpose of the study was to build an understanding of elementary science teachers' beliefs about science literacy. As a reading specialist and a former third grade science teacher, I am interested in the intersection of science and literacy. Since teachers' beliefs are known to influence the general ways they teach, it follows that teachers' perspectives on science literacy may influence the way they teach science. In addition, I wanted to gauge the ways in which a reading specialist, like myself, could support science literacy instruction through a personalized professional development program.

1.5 Significance of the Study

The study has the potential to offer a better understanding of teachers' beliefs about science literacy. This is significant because teachers' beliefs about science literacy may affect the ways in which they teach science, which in turn may impact what students learn in the classroom. Science literacy is a currently a very compelling topic as it addresses both STEM (Science, Technology, Engineering, and Mathematics) and literacy (Shanahan & Shanahan, 2014). That is why my study is timely and significant.

1.6 Research Questions

In this study, I was guided by two research questions:

1. What beliefs do two focus third grade teachers hold about science literacy prior to participating in a personalized professional development program related to science literacy?
2. How do the views of these two teachers evolve as a result of participating in a reading specialist-led professional development program?

2.0 Literature Review

The material in this review of the literature is focused on teachers' beliefs about science literacy and the potential of a personalized professional development program for impacting these teachers' beliefs.

2.1 Teacher Beliefs

Science teachers' beliefs may impact how and what they teach (Farrell & Ives, 2015; Thomson & Nietfeld, 2016). Oftentimes, teachers' beliefs about content and pedagogy are based on their personal beliefs rather than research-based practices (Sampson & Benton, 2006). Researchers can explore relationships between teachers' stated beliefs and observed classroom practices. In addition, Professional Development (PD) may have an impact on teachers' beliefs concerning science literacy (Farrell & Ives, 2015). Therefore, professional development could affect teachers by affirming or changing their beliefs and possibly grounding those beliefs in research-based practices.

In a study by Thomson and Nietfeld (2016), the researchers wanted to learn about teachers' reformed and traditional science beliefs. The researchers believed that in order for science-teaching reforms to be effective, teachers would need to subscribe to the current science education reform movement. The reform movement was defined as changes to how teachers thought about science teaching and the way they taught science to students. If administrators could learn ahead of time which teachers would have an easier or harder time adopting reform initiatives, they could alter

PD to meet their staff's needs more effectively. Therefore, teachers' beliefs prior to PD implementation matter in determining what type of PD would best help them enact reforms.

2.2 Reflective Practice Through Journaling

Researchers can learn from teachers' reflective practice. Reflective practice occurs in situations in which teachers think about what they do, how they do it, and why they do it (Farrell, & Ives, 2015). By reflecting on their teaching, they will either affirm or change the way they teach because their practice does not match their beliefs. Reflective practice allows teachers to realize how their beliefs impact the way they teach and make teaching decisions. In order to enact teaching reforms, many school districts hold PD. In such PD, teachers may be encouraged to reflect and refine their teaching based on what they learn.

The use of teacher journals during PD can help teachers explore their stated beliefs and reflective practices. One such example was a study by Farrell and Ives (2015) which explored teacher beliefs through classroom and reflective practices. Farrell and Ives asked a teacher to keep a journal in order to reflect on his teaching, and gave him the freedom to write as much as he wanted to and in any format. The purpose of the journal was to serve as evidence of changes in his teaching' beliefs where he was reflecting-on-action, reflecting-in-action, and reflecting-for-action. Basically, the researchers would check his reflections to view his thoughts before, during, and after teaching a lesson. Similar to Donald Schon's landmark research on reflective practice, Farrell and Ives stated that teachers should *reflect-in-action* (Wieringa, 2011). That is, teachers may revise their teaching as they teach to provide better instruction. Where Farrell and Ives differ from Schon's study is in their journal protocols. Farrell and Ives had an open-ended protocol whereas Schon encouraged a focused journal-protocol. For example, Schon gave more specifics on what and when teachers should be reflecting on within their practice (as cited in Wieringa, 2011). He believed that teachers needed to define their problems of practice by naming what their focus is on and framing their problem in the context of where it occurred. He coined the terms *knowing-in-action* and *reflection-in-action* where *knowing-in-action* focuses on teachers' everyday routines and *reflection-in-action* is the way teachers improvise and adjust their lessons by reflecting on them as they are teaching. Schon also detailed how a teacher' knowledge base consists of at least three areas: (1) *types* known as past situations or lessons, (2) *rules* where the teacher's theories are put into action, and (3) *appreciative systems* where the teacher experiments as they *reflect-in-action*. Both Farrell and Ives' and Schon's study are examples of reflective-practice theory. They have validity and purpose based on the context of where they are used. However, each method works best for its own purpose. Schon's more focused method is more effective at asking specific questions, while the work of Farrell and Ives is better for understanding teachers' beliefs without parameters through open-ended reflections.

2.3 Professional Development in Science Education

In a PD study in science education by Lee, Maerten-Rivera, Penfield, LeRoy, and Secada (2008), specific curricular supports were provided for teachers with the goal of increasing science achievement. The research project lasted five years but focused on the first year of PD. The participants included third grade teachers at seven elementary schools. The researchers held a PD intervention which included (a) curriculum units with student booklets, teachers' guides, and science supplies, and (b) teacher workshops throughout the school year. The three curriculum units for third grade were Measurement, States of Matter, and Water Cycle and Weather. It is noteworthy that the team included a diverse group of educators, administrators, and scientists to create the units. The units were created by the materials development team, consisting of scientists, science educators, bilingual/ESOL educators, mathematics educators, and district administrators. Typically, science units are created by science teachers in conjunction with the district's curriculum director. However, this team was carefully selected for its knowledge of linguistic and cultural practices of ELs and its ability to select appropriate inquiry-based content for elementary students.

Next, the team created its curriculum, including teacher guides, each composed of several units. Each scripted unit promoted scientific inquiry and key concepts called "big ideas" and included cross-cutting concepts (tied to related content areas). Each unit's lesson included (b) a glossary of science vocabulary; (d) a list of materials for each hands-on activity; (e) transparencies of pictures, drawings, tables, graphs, and charts; and (f) teaching suggestions to support student learning.

Lee et al.'s appendices included writing prompts, field trips, trade books and literature related to science topics. The use of paired texts and trade books to accompany the basal reader strengthened students' comprehension of complicated science concepts (Guthrie, 2004). Beyond print-based materials, teachers used digital means such as video-clips or short activities to give students shared experiences in acquiring background knowledge. They included text features such as diagrams, graphic organizers, or other visual representations of the concepts. The text features aided in teacher-guided discussions. The teacher pushed the conversations further and consistently employed content-specific vocabulary. Guided discussions enabled students to engage more deeply in science class.

Professional-development workshops facilitated optimal use of unit guides and materials. The teachers attended five full-day workshops on regular school days. The team that actually designed the units taught the workshops. Teachers actively participated by sharing questions, suggestions, and examples of their own beliefs and teaching practices. During the first few workshops, instructors explained the project's goals; teachers filled out consent forms; instructors taught the teachers how to implement activities and collect corresponding data. The last workshop included an open-ended protocol on how teachers should write reflections and feedback on the lessons. After workshops, the first two researchers, Lee and Lewis, conducted classroom observations (Lee et al notes that further details on the observations are in her previous 2006 study). The observations were held twice during the school year to examine classroom practices in scientific understanding and inquiry, teachers' knowledge of science content, and teacher support of ELs language development. The result of the study was that students in the treatment group made statistically significant gains in science achievement.

2.4 Teacher Interviews and Surveys

PD for teachers may affirm or change teachers' beliefs. Teacher interviews and surveys are methods that can be used to explore their beliefs. In the aforementioned study, Farrell and Ives (2015) collected data for four weeks through semi-structured interviews, teacher observations and teacher journals. The data included six one-hour classroom observations with 15-20 minute pre- and post-lesson interviews. The first interview's purpose was to learn about the teacher's beliefs on teaching. The pre-observation interviews were held three hours before each class and were recorded. The post-interviews were held one hour after each class. The final interview was held one week after the final observation and focused on revisiting the questions from the initial interview. The teacher was asked about their teaching beliefs and specifically about their teaching beliefs on reading, along with questions focused on other aspects of teaching. The interviews were semi-structured with the purpose being to have teachers reflect their own teaching beliefs. The final interview occurred two months after the study concluded in order to obtain the teacher's reaction to the findings. During the six teacher observations, the researcher used a tape recorder and took observational notes. The observations and recordings were used for discussion of what the teacher did and why. During the interviews, Lee and her colleagues used probes (2006). The probes focused on teaching practices to promote scientific understanding and inquiry, and teaching practices to support English language development. The subset questions for probe one included the following:

- I'd like to know about the strategies that you use to teach science (with a focus on scientific understanding and inquiry).
- How much or little do you think your students understood the science topic in today's lesson (with a focus on scientific understanding and inquiry)?
- I'd like to know about the strategies that you use to promote students' English language development.
- Do you have ESOL students in your class? I'd like to know about the strategies that you use to promote ESOL students' English language development.

Alternatively, in a study by Stoddart, Pinal, Latzke, and Canaday (2002), researchers used rubrics to gauge levels of teachers' science literacy after conducting interviews. In this particular study, teachers attended the Language Acquisition through Science Education in Rural Schools (LASERS) summer academy where they learned best teaching practices in science literacy.

LASERS prepared experienced teachers to provide science inquiry science instruction to third grade Latino students learning English as a second language. While, the study did not divulge the specifics on best teaching practices, the study provided details on the teacher interviews that researchers held to determine teachers' understanding of science-language integration.

The interviews were held before and after the training. There were four areas that the interviews were based upon: Level 1-no integration, Level 2-thematic instruction, Level 3-interdisciplinary, and Level 4-integrated. Through this model, the researchers noted the "three principal approaches to the integration of content areas: (i) a thematic approach characterized by the use of overarching themes to create connections among domains; (ii) an interdisciplinary approach in which content or processes in one domain are used to support learning in another; and (iii) an integrated approach, in which emphasis on two or more domains is balanced" (Dickinson & Young, 1998). Through the rubric, the researchers had an extensive and concrete way of detailing the depth at which the teachers understood of science language integration. The study showed that teachers grew in the domain they initially reported being weak. They also held more sophisticated views of science literacy including a greater understanding of the relationship between literacy and science, how instructional strategies such as writing and questioning can tie science and literacy together, and how to reflect on their teaching practices.

Surveys are another proven method that researchers have used to learn about science teachers' beliefs. Sampson and Benton (2006) created the Beliefs About Reformed Science Teaching and Learning Questionnaire (BARSTL). This 24-item survey focuses on measuring teachers' reformed and traditional beliefs about teaching and learning about science. It is grouped into four categories: how people learn about science, lesson design and implementation, characteristics of teachers and the learning environment, and the nature of the science curriculum.

Another survey applicable to science teachers is the Science Teaching Efficacy Beliefs Instrument by Enochs and Riggs (as cited in Bleicher, 2004). This instrument contains a 23-item inventory used to measure personal teaching efficacy and outcome expectancy for teaching science. It focuses on two subscales: Personal Science Teaching Efficacy (PSTE) and Science Teaching Outcome Expectancy (STOE). The scores are averaged for the mean. High mean scores reflect high efficacy beliefs about science teaching. Both of these instruments have been proven to be useful tools (Thompson and Nietfield, 2016).

2.5 Role of the Reading Specialist or Reading Coach

According to the International Literacy Association (ILA) (Bean and Kern, 2018), the roles of literacy professionals can include specialized literacy professionals, classroom teachers, principals, teacher educators, and literacy partners. The category of specialized literacy professionals only includes reading/literacy specialists, literacy coaches, and literacy coordinators/supervisors. In this document, ILA defines reading literacy specialists as professionals who focus on planning, teaching, and evaluating instructions for students experiencing difficulties with reading and writing. Meanwhile, literacy coaches are defined as professionals who focus on improving classroom instruction by supporting learning and facilitating school literacy program efforts. Lastly, literacy coordinators/supervisors are defined as professionals who focus on developing, leading, coordinating, and evaluating the school or district literacy program. In spite of these distinctions, ILA also recognizes that there may be some overlap between the roles of a specialized literacy professional. For example, a reading specialist might have some coaching responsibilities without being formally designated as a literacy coach

(Bean and Kern, 2018). Therefore, a reading specialist who also is a literacy coach has the opportunity to play a pivotal role as a resource to content area teachers as both a fellow teacher and a coach (Bean, Swan, Knaub, 2003). Coaching can provide support for educators in a nonthreatening, nonevaluative, and supportive way (Poglinco, Bach, Hovde, Rosenblum, Saunders, and Supovitz, 2003). Reading specialists who also serve as coaches can play an informal role which aids in developing professional working relationships with content area teachers where they develop curriculum with colleagues and participate in professional development with one another (International Reading Association, 2017). In this manner, reading specialists can work together with other educators on the common ground of literacy and content area instruction.

2.6 Chapter Summary

As mentioned in this overview, a reading specialist may take on the role of a literacy coach in their school. Therefore, reading specialists may also create PD for their fellow teachers in science literacy. Some studies show that teachers hold beliefs regarding science literacy that may be impacted by this PD. Through the aforementioned research studies on PD, teachers were given access to additional curricular materials to enhance science instruction (Lee et al., 2008). In order to explore how teachers' beliefs were affirmed or changed, several data sources such as surveys, interviews, and journals. Through surveys, researchers explore teacher beliefs in science. Through interviews, some researchers have used rubrics to further explore teachers' beliefs (Stoddart et al., 2002) In addition to rubrics, researchers can explore teachers' beliefs by categorizing their approach to science literacy. Through journaling, teachers may engage in reflective practice allowing them to realize how their beliefs translate into action. All of this matters because PD effects on teachers' beliefs may materialize in their journal reflections, teacher observations and interviews. Thus, these studies provide evidence that teachers' beliefs on science literacy were affirmed or changed through PD. Reading specialists who also act as coaches can collaborate with content area teachers by providing a supportive role at the intersection of literacy and content instruction through PD. Therefore, effective methods of data collection after PD on science literacy by reading specialists or reading coaches could explore teachers' beliefs in science instruction.

3.0 Methods

3.1 Introduction

The purpose of this research study was to better understand two third grade science teachers' beliefs related to science literacy. Prior to the current school year in which I conducted my study, the selection of science texts in this school context was limited to worksheets to support the science curriculum, ASSET science. The lessons were lab-based without texts to support science literacy. Two years ago, the district purchased a new science curriculum that included a basal text that served as the foundation of the lessons. With the implementation of an anchor text in science, students could benefit from additional supports to help them access the text. As a reading specialist, I was uniquely poised to provide literacy support to students and teachers in science classrooms. In order to better support the two science teachers and third grade students, I created a science literacy kit to enrich the current science instructional materials. In addition to developing an understanding of two third grade science teachers' beliefs related to science literacy, I collected a variety of evidence on teachers' reactions to implementing a science literacy kit and the PD that was provided to support the kit.

3.2 Nature of the Study and Research Questions

My goal was to conduct a qualitative case study of two elementary science teachers, in an effort to better understand their beliefs related to science literacy. Qualitative studies focus on understanding the participants' perspectives by interacting frequently and extensively with the study's participants (Gay, Mills, & Airasian, 2009). In this study, I worked closely with two teachers with the goal of gaining insights into their practice. Data collection included interviews, journals and teachers' notes in order to gather authentic information about the classroom to form a narrative of what was been experienced by the teachers during the study in the most natural setting possible. The focus of the study was to gain meaning from the data and interpret evidence through a narrative story instead of measuring data (Holloway & Biley, 2011).

Since this was a small qualitative study, I provide descriptions of my findings for this specific context. It was not possible for me to make sweeping findings or generalizations due to the size of my study. Therefore, I provided rich descriptions related to each of the teachers and their work in the findings section of the research study.

In this chapter, I will introduce the research methods and design for the study, as they relate to the investigation of the following research questions:

1. What beliefs do two focus third grade teachers hold about science literacy prior to participating in a personalized professional development program related to science literacy?
2. How do the views of these two teachers evolve as a result of participating in a reading specialist-led professional development program?

3.3 Study Participants

I focused on two third grade general science teachers within the specific context of the K-5 school, in which I serve as the reading specialist. In this setting, the teachers in grades three, four, and five, taught on teams. Only two teachers taught science per grade level. Teachers were assigned content areas to teach based on their preferences and strengths. This study focused on the perspectives and practices of the two third grade science teachers in the school.

The focus of this study included the following participants:

- Focus teacher, John (pseudonym), was a third-grade general science teacher who taught two science classes and two math classes to approximately 30 students in each class for 45 minutes per class per day. He identified himself as a Caucasian male. He has taught for twenty-one years, including fifteen years as a general elementary teacher and for one year specializing as a third-grade science teacher. He previously taught high school for three years and then middle school for three years.
- Focus teacher, Rose (pseudonym), was a third-grade general science and language arts teacher who taught two science classes and two language arts classes to approximately 30 students in each class for 45 minutes per class per day. She identified herself as a Caucasian female and has been teaching English Language Arts and science for thirteen years, holding a bachelor's degree in elementary education. She has taught third grade for eleven years and previously fourth grade for two years.

3.4 Setting

The setting for the study was a Schoolwide-Designated Title I K-5 suburban elementary school in southwestern Pennsylvania. The school was a Quad A school district of 784 students with 52.4% of students qualifying for free and reduced lunch. One-third of the students at the school were refugees some of whom are also English Learners. 9.8% of the students at the school were English Language Learners.

3.5 Research Methodology

3.5.1 Introduction

In order to investigate my two research questions related to the teachers' beliefs in science literacy and how a reading specialist can support science literacy, I engaged in a qualitative case study that focused on two teachers in Valley School District (pseudonym) who taught a science unit related to animal adaptations and survival. Data was collected through a series of interviews and document analysis.

I explored teachers' beliefs on science literacy and the effects, if any, a personalized professional development program had on their beliefs. There were several curricular materials enhanced with additional science literacy materials and then gave them to the two science teachers. The materials included a teacher's binder and supplemental materials in a teacher's enhanced science kit. The teacher's binder and enhance science kit were based on the work of Lee, Maerten-Rivera, Penfield, LeRoy, and Secada (2008). Similarly, I included the following materials in each binder for each lesson (a) a list of key vocabulary terms which I expanded to include science vocabulary; (d) a list of materials for each hands-on activity; (e) website links and pictures of drawings, tables, and maps (instead of the transparencies as Lee suggested); and (f) teaching suggestions to support student learning. The teacher's guide also included lesson-specific trade books (See Appendix E). Prior to teachers using the kit and guide, I met with each of them individually the week before the intervention to review everything that was in the bin and guide to ensure that I had explained the kit and answer any questions they had.

3.5.2 Instruments and Protocol

3.5.2.1 Overview of Curricular Materials (See Table 4)

Lesson 1-Coral Reef Biome (Week 1)

The focus of this lesson was to build students' prior knowledge on coral reefs through scaffolding. The intention was to ensure that students had adequate background knowledge on such topics as tropical oceans, coral reefs, and birds' different types of beaks. Since the school was landlocked and far away from the ocean, the lesson built upon their background knowledge on coral reef animals and plants using print and non-print based materials (Alexander, Winters, Loughlin, & Grossnickle, 2012; Buckingham, 2007). Scaffolding was central to the best practices in reading that supported science literacy and was a key component to supporting students in learning about coral reefs (Vygotsky, 1979). Thus, in the teacher binder, I included scaffolding tasks to build background knowledge.

One model for scaffolding texts, and evidence of science literacy, was the Kintch *construction-integration model* where students built upon their prior knowledge to understand the lessons' contents (Kintsch, 2004). I asked the teachers to use scaffolding starting with the first part of the lesson. The textbook showed a picture of a coral reef environment with a few yellow fish and a few plants, none of which area labeled. I wanted the teachers to go beyond the basal text's example answers listed as trees, bushes, grasses, fish, and pink corals by having students use the websites, watch videos, read a book to generate a longer, more detailed lists and share out in a group discussion what they had learned from the lesson. The students would then record their lists in their notebooks and generate a shared class list in order to increase their ability to remember what they have read about and viewed online and in print format and gain more knowledge about coral reefs by sharing their lists. I wanted to learn about teachers' perspectives on the lesson adjustment from the original scripted lessons to the new version. Based on their reactions and the comments they made when talking about the lessons, I hope to learn about their perspectives.

Lesson 2-Bird Beaks (Week 2)

Lesson Two began with a lab on the following topic: What clues do beak shapes give about birds? There were three pictures of birds-a hummingbird, a cardinal, and an eagle. Students were expected to use tweezers, chopsticks, tongs, and a straw to pick up beads, yard and water out of a test tube to determine which beaks could pick up what food. They used a variety of materials for beaks and bird food in order to increase their experience with many more types of bird beaks. In addition, I wanted students to have more than a one-paragraph textbook article on bird beaks. I provided several books, website videos and articles to increase students background knowledge on birds' beaks and their function.

Also, I provided scaffolding to help students take what they learned about animals in tropical ocean reefs and apply that knowledge to mainland birds. In the textbook, the article jumped from coral reef biomes to bird beaks without an obvious connection to the two topics. I made connections for the students on the techniques birds use to pick up food and how that correlates with their beak shape. That was why I provided the teachers with plastic ocean animals and plastic birds so that students could touch and feel the beaks of birds to speculate on what type of foods they could pick up. In this way, the students would learn more than the content that was provided in their textbook.

Table 1 Original Kit Compared to Enhanced Kit

Lesson	Original Kit Contents	Enhanced Kit Contents
Lesson 1: Coral Reefs	1. Original Lesson Unlabeled Single Photo of a Coral Reef – Students guess what a coral reef is and what lives in a coral reef.	1. Interactive Websites: Coral Reefs 101 National Geographic, Smithsonian's Bizarre and Beautiful Coral Reef Animals, Reef Guide, Coral Reefs World Map 2. T-Chart for students to use to record what plants and animals live in coral reefs (after viewing interactive websites and reading the book) 3. Big Book of the Ocean 4. Feeding Strategies Lab – Students use plastic fish and corresponding fish photos to decide what type of feeding strategy they use and what food they eat. Students have to provide solid reasoning behind their choices.
Lesson 2: Bird Beaks	1. Original Lab - Pictures of Three Types of Birds – Students write what type of food three birds in particular would eat.	1. Interactive Websites: DK Find Out - Different Types of Bird Beaks, Zoo Portraits – Bird Beaks and Their Uses, Bird Diet Types Article 2. Beaks Book 3. Enhanced Lab 'Fill the Bill': 8 Stations of Bird Types, 8 Bird Beak Tools, 8 Simulated Bird Food Examples
Lesson 3: Wetlands Food Web	1. The textbook did not include any information on food webs. I included the text on wetland food webs since lessons 1 and 2 included information on animal feeding habits and lesson 4 included information on animal habitats. The lesson on food webs linked 1 and 2 with 4.	1. Interactive Website: Food Chain Consumers Flow Chart Video, SlideShare hierarchy of plants and animals in a food web, Wetland Ecosystem Food Web Video 2. Wetlands Book 3. Wetlands Food Web Mat with description and photo cards – Students engage in class discussion to decide where card belong on the food web

Lesson 4: Frog Habitats	1. Original Lesson – Unlabeled Picture of a single frog on a lily pad – Students guess what frogs need to survive in their habitat.	1. Interactive Website: Shedd's Aquarium Video on Frog Types, San Diego Zoo's website on frog and toad habitats, pet store video on how to make a tree frog habitat 2. Frogs Book 3. Diorama – Students Make a frog habitat by selecting materials to represent what frogs need to thrive in a habitat.

Lesson 3-Wetlands Food Web (Week 3)

The lesson started with students looking at a photograph of a frog on a rock by a pond and deciding how to create a habitat for frogs at a zoo. It was unclear in the photograph, other than moss, water, and a rock, what the frog would need to thrive in a man-made habitat. I asked the teachers to build upon students' background knowledge on what animals, such as frogs, need to survive by first having students build a food web. Students gained experience with building a food chain from previous lessons but had not yet put those chains together to form a food web. Therefore, I included videos and an online food web to show the interdependent relationships between members of the web. I chose a group food web activity where students learned how members of the web depend on each other. I wanted the students to have a hands-on activity to help them visualize and interact with the food web to increase student engagement (Guthrie, 2004).

Lesson 4-Frog Habitat (Week 4)

My goal was to increase students' background knowledge on what frogs needed to thrive in their environment. I asked the teachers to have their students watch frog habitat videos from pet stores since their environment will be man-made. They also viewed the San Diego Zoo website on frog and toad habitats. Last, the teachers read aloud a book on frogs from a specific chapter on frog habitats. Then, the students applied their knowledge by selecting materials out of the Unit Bin to create their frog habitat. I included unnecessary items for frog habitats so that the students can be formatively be assessed by the teacher on whether they could correctly select the materials frogs need to thrive and discard the unnecessary materials. Then, the students sat on the floor in a circle with their habitats and discuss why they put each item in their container. They were required to justify choices for items in the habitats. In this way, the teacher could assess if students mastered the lesson in a hands-on, student-friendly manner.

3.5.3 Meeting with the Teachers

As mentioned previously, some reading specialists also take on the role of a literacy coach as well (Bean and Kern, 2018). I have also taken on both roles in my school. It is important to note that due to my professional duties, there was no designated time for me to officially meet with John and Rose. However, I carved out time to meet with them, before, during, and after the school day, because this was a priority of mine. Although some meetings were fluid, the following times were scheduled for meetings: Four days a week, we had Personalized Learning Community (PLC) time from 8:00-8:50 a.m. while on the fifth day our building administration would hold schoolwide teacher meetings with us. The PLC times during the four mornings were a time set aside for teachers to collaborate on whatever they deemed important that day. Throughout the course of the study, I worked with John and Rose almost every morning to ensure they felt comfortable teaching the lessons for that day and the next day. I was also cognizant that they needed that time to set up their own classroom for the day. Therefore, I talked frequently with them about what was the best time to meet with them each week. I also used my planning time to assist them in setting up the labs and to stop in during their lessons to make sure everything was going well. I talked to them with whatever time I had available in between teaching my own classes, before school, during my lunch or planning time, and after school, as shown in Table 5.

Table 2 Typical Researcher Schedule During Study

Time	**Class**
8:00-8:50	**PLC 4 Days/week, Schoolwide Meeting 1 day/week**
8:50-9:20	**Plan – Meeting with John or Rose**
9:20-10:45	**Co-Teaching Third Grade**
10:45-11:30	**Teaching 2nd Grade Class Section 1 in my classroom (reading support)**
11:30-12:00	**Lunch/Meeting with John or Rose**
12:00-12:30	**Plan – Meeting with John or Rose**
12:30-1:15	**Teaching 2nd Grade Class Section 2 in my classroom (reading support)**
1:15-2:05	**Teaching small group of kindergarteners in their classroom (reading support)**
2:05-3:35	**Teaching 2nd Grade Class Section 3 in my classroom (reading support)**
3:35-4:00	**Duty – Bus Dismissal**

3.5.4 Interviews and Interview Rubric

In order to guide my inquiry about teachers' perspectives science literacy, I conducted a series of interviews with the focus teachers in the study based on the work of Sampson, Enderle, and Grooms (2013). I wanted to gain insights into where their views on science literacy fell on the continuum from traditional to reformed beliefs. I engaged the two science teachers in conversations to discuss the completed lessons and the upcoming lessons via weekly meetings. Among other questions, I asked the teachers how useful the print and digital binder and the enhanced kit supports were from their two teachers' perspectives, with the purpose of gaining insights as to how I, as a reading specialist, could best support teachers in science literacy. The teachers also wrote in a journal after every lesson to comment on what lessons they felt worked well, what could be improved, and what did not work well in the lesson. In that way, I hoped to learn more about their perspectives on science literacy and the ways in which I could support their teaching of science literacy.

I conducted semi-structured interviews with teachers before, during, and after the study in order to gather information on each teachers' science literacy beliefs (See Appendix C). I adapted the interview questions from Stoddart and his colleagues to accomplish this task (2002). The only questions I altered are the ones specific to English Learners (ELs), changing them to fit my specific context. Here are the interview questions I posed to the teachers:

- What do you consider to be the features of effective science instruction?
- What experiences are necessary for students to become successful in learning science?
- What do you think would be effective instruction and what experiences are necessary for students who could benefit from reading support to become successful readers?
- What do you think are the most effective strategies for teaching science to students who could benefit from reading support?
- What are your thoughts about integrating science and literacy instruction?
- Was there a specific [integrated science literacy] lesson that you felt was particularly challenging, that your students may have misunderstood?

- Was there a specific [integrated science literacy] lesson that you felt was particularly successful, that your students really understood?

3.5.5 Semi-Structured Interview Questions

When I met with teachers together, I asked them these questions:

- Tell me a little about this week's science lessons.
- What went well or did not go as planned?
- Did you notice any differences between last year's lesson and this year's lesson using the kit? (Probe: Or with previous kits such as the ASSET kits you used in the past)
- Did you notice any difference in student engagement as compared to previous years? (Probe: If you noticed a difference, what did you notice?)
- How did the kit support science literacy in your classroom?
- What could be changed to improve the science kits? (Probe: How can the kits support science literacy? That is, how can the kits support students in reading in science class and understanding science concepts?)
- Anything else you would like me to know this week's lessons?

These were the questions I asked prior to the teachers using the kit with students:

- What do you consider to be the features of effective science instruction?
- What experiences are necessary for students to become successful in learning science?
- What do you think would be effective instruction and what experiences are necessary for students to become successful readers?

- What do you think are the most effective strategies for teaching science to students?
- What are your thoughts about integrating science and literacy instruction?

These were the questions I asked after the teachers have finished using the kit with students:

- What do you consider to be the features of effective science instruction?
- What experiences are necessary for students to become successful in learning science?
- What do you think would be effective instruction and what experiences are necessary for students to become successful readers?
- What do you think are the most effective strategies for teaching science to students?
- What are your thoughts about integrating science and literacy instruction?
- Was there a specific [integrated science literacy] lesson that you felt was particularly challenging, that your students may have misunderstood?
- Was there a specific [integrated science literacy] lesson that you felt was particularly successful, that your students really understood?

3.5.6 Data Analysis

I analyzed my data sources in the following manner. I used the responses from the BARSTL survey to inform and refine my interview protocol. After giving the BARSTL to the participants, I added or refined any questions I may have missed or wished to expand upon. I used emergent coding based on the continuum of traditional to reformed science instruction (Sampson et al., 2013)

3.5.7 Description of Inquiry Product and How It Informs Practice and Influences Policy

My inquiry product focused on adding to the field on teachers' beliefs in science literacy. In addition, participation in the study may have influenced the two science teachers' beliefs around science literacy.

3.5.8 Methods Summary Outline

<u>Major Focus: Teachers' Beliefs on Science Literacy</u>

1. Survey (before and after PD)
    a. BARSTL-Beliefs About Science Teaching and Learning (Sampson & Benton, 2006)
2. Reflective Journals (before, during, and after PD)
    a. Donald Schon (Wieringa, 2011)-Reflecting-In-Action – closed protocol
    b. Farrell & Ives (2015) – open-ended protocol
3. PD Intervention (6 weeks)
    a. Science literacy kit (Lee et al., 2008)
4. Interviews (before, mid-point at 3 weeks, after PD)
    a. Probes/Questions
        i. Lee et al. (2008)
    b. Rubrics to gauge science literacy integration
        i. Stoddart et al. (2002)
        ii. Dickinson & Young (1998)

4.0 Findings

The purpose of the research study was to better understand two third grade science teachers' beliefs related to science literacy and the impact that a reading specialist-led personalized professional development program could have on these beliefs. In this chapter, I discuss the findings related to the study's research questions:

1. What beliefs do two focus third grade teachers hold about science literacy prior to participating in a personalized professional development program related to science literacy?
2. How do the views of these two teachers evolve as a result of participating in a reading specialist-led professional development program?

This chapter contains findings relevant to the research questions, drawing upon the results of the Beliefs About Reformed Science Teaching and Learning (BARSTL) Questionnaires, narratives of the teacher interviews, and insights gleaned from the teacher and researcher journals.

4.1 Findings: Question 1

In order to answer the first research question, responses were gathered from the first administration of the BARSTL Questionnaire and initial individual interviews. The analysis of these data sources offers a look at the participants' beliefs about science literacy prior to participating in the personalized professional development program.

4.1.1 BARSTL Survey Results

Although surveys are usually used to obtain and compare answers from larger groups, the BARSTL was used in this study to provide specific insights about the baseline beliefs of the two teachers on whom the study focused. Participants provided their viewpoints concerning the ways students learn about science, lesson design and implementation, characteristics of teachers and classroom learning environments, and ways students can learn about science while in school. The BARSTL Questionnaire is an instrument used to assess teachers' beliefs about science teaching and learning. This instrument, known as the Beliefs About Reformed Science Teaching and Learning (BARSTL) Questionnaire, was based upon current national science education reform efforts (Sampson et al., 2013). The purpose of the instrument was to define a teaching and learning belief continuum, ranging from traditional to reformed views (See Table 1).

Table 3 Dimensions of Traditional and Reformed Minded Beliefs Associated with Each Subscale of the BARSTL Questionnaire
(Sampson et al., 2013)

BARSTL Scales	Traditional Perspective	Reformed Perspective
How people learn about science	• Compared with "blank slates" • Learning is an accumulation of information	• What students learn is influenced by their existing ideas • Learning is the modification of existing ideas
Lesson design and implementation	• Teacher-prescribed activities • Frontal-teaching – telling and showing students	• Student-directed learning • Relies heavily on student-developed investigations, manipulative materials, and primary sources of data

	• Relies heavily on textbooks and workbooks	
Characteristics of teachers and the learning environment	• The teacher acts as a dispenser of knowledge • Focus on independent work and learning by rote	• The teacher acts as facilitator, listener, and coach • Focus on learning together and valuing others ideas and ways of thinking
The nature of the science curriculum	• Focus on basic skills (foundations) • Curriculum is fixed • Focus on breadth over depth	• Focus on conceptual understanding and the application of concepts • Curriculum is flexible and changes with student questions and interest • Focus on depth over breadth

The BARSTL had been proven to be a valid and reliable instrument for measuring prospective elementary teachers' beliefs about science literacy (Sampson et al., 2013).

The study participants provided their viewpoints concerning the ways students learn about science, lesson design and implementation, characteristics of teachers and classroom learning environments, and ways students can learn about science while in school. For the purposes of answering this research question, John's and Rose's specific responses were presented below:

Table 4 Initial BARSTL Questionnaire Responses

Key to Responses (SA: Strongly Agree, A: Agree, SD: Strongly Disagree, D: Disagree)

BARSTL Category 1: How People Learn About Science – John's Responses	Before PD
1. Students develop many ideas about how the world works before they ever study about science in school.	D
2. Students learn in a disorderly fashion; they create their own knowledge by modifying their existing ideas in an effort to make sense of new and past experiences.	A
3. People are either talented at science or they are not, therefore student achievement in science is a reflection of their natural abilities.	SD
4. Students are more likely to understand a scientific concept if the teacher explains the concept in a way that is clear and easy to understand.	SA
5. Frequently, students have difficulty learning scientific concepts in school because their ideas about how the world works are often resistant to change.	D
6. Learning science is an orderly process; students learn by gradually accumulating more information about a topic overtime.	D
7. Students learn the most when they are able to test, discuss, and debate many possible answers during activities that involve social interaction.	SA
8. Students learn the most when they are able to test, discuss, and debate many possible answers during activities that involve social interaction.	SA

BARSTL Category 2: Lesson Design and Implementation – John’s Responses	Before PD
9. During a lesson, students should explore and conduct their own experiments with hands-on materials before the teacher discusses any scientific concepts with them.	D
10. During a lesson, teachers should spend more time asking questions that trigger divergent ways of thinking than they do explaining the concepts to students.	A
11. Whenever students conduct an experiment during a science lesson, the teacher should give step-by-step instructions for the students to follow in order to prevent confusion and make sure the students get the correct results.	A
12. Experiments should be included in lessons as a way to reinforce the scientific concepts students have already learned in class.	SA
13. Lessons should be designed in a way that allows students to learn new concepts through inquiry instead of through a lecture, reading, or a demonstration.	D
14. During a lesson, students need to be given opportunities to test, debate, and challenge ideas with their peers.	SA
15. During a lesson, all of the students in the class should be encouraged to use the same approach for conducting an experiment or solving a problem.	D
16. Assessments in science classes should only be given after instruction is completed; that way, the teachers can determine if the students have learned the material covered in class.	D

BARSTL Category 3: Characteristics of Teachers and the Learning Environment – John's Responses	Before PD
17. Students should do most of the talking in the science classroom.	SD
18. Students should work independently as much as possible so they do not learn to rely on other students to do their work for them.	D
19. In science classrooms, students should be encouraged to challenge ideas while maintaining a climate of respect for what others have to say.	SA
20. Teachers should allow students to help determine the direction and the focus of a lesson.	SA
21. Students should be willing to accept the scientific ideas and theories presented to them during class without question.	D
22. An excellent science teacher is someone who is really good at explaining complicated concepts clearly so that everyone understands.	SA
23. The teacher should motivate students to finish their work as quickly as possible.	SD
24. Science teachers should primarily act as a resource person working to support and enhance student investigations rather than explaining how things work.	D

BARSTL Category 4: The Nature of the Science Curriculum – John's Responses	Before PD
25. A good science curriculum should focus on only a few scientific concepts a year, but in great detail.	SD
26. The science curriculum should focus on the basic facts and skills of science that students will need to know later.	D

27. Students should know that scientific knowledge is discovered using the scientific method.	A
28. The science curriculum should encourage students to learn the value alternative modes of investigation and problem solving.	A
29. In order to prepare students for future classes, college, or a career in science, the science curriculum should cover as many topics as possible over the course of the school year.	D
30. The science curriculum should help students develop reasoning skills and habits of mind necessary to do science.	SA
31. Students should learn that all science is based on a single scientific method- a step-by-step procedure that begins with “define the problem” and ends with “reporting the results.”	A
32. A good science curriculum should focus on the history and nature of science and how science affects people and societies.	A

BARSTL Category 1: How People Learn About Science – Rose’s Responses	Before PD
1. Students develop many ideas about how the world works before they ever study about science in school.	SA
2. Students learn in a disorderly fashion; they create their own knowledge by modifying their existing ideas in an effort to make sense of new and past experiences.	A
3. People are either talented at science or they are not, therefore student achievement in science is a reflection of their natural abilities.	D

4. Students are more likely to understand a scientific concept if the teacher explains the concept in a way that is clear and easy to understand.	A
5. Frequently, students have difficulty learning scientific concepts in school because their ideas about how the world works are often resistant to change.	D
6. Learning science is an orderly process; students learn by gradually accumulating more information about a topic overtime.	A
7. Students learn the most when they are able to test, discuss, and debate many possible answers during activities that involve social interaction.	SA
8. Students learn the most when they are able to test, discuss, and debate many possible answers during activities that involve social interaction.	SA

BARSTL Category 2: Lesson Design and Implementation – Rose's Responses	Before PD
9. During a lesson, students should explore and conduct their own experiments with hands-on materials before the teacher discusses any scientific concepts with them.	D
10. During a lesson, teachers should spend more time asking questions that trigger divergent ways of thinking than they do explaining the concepts to students.	A
11. Whenever students conduct an experiment during a science lesson, the teacher should give step-by-step instructions for the students to follow in order to prevent confusion and make sure the students get the correct results.	D
12. Experiments should be included in lessons as a way to reinforce the scientific concepts students have already learned in class.	D

13. Lessons should be designed in a way that allows students to learn new concepts through inquiry instead of through a lecture, reading, or a demonstration.	A
14. During a lesson, students need to be given opportunities to test, debate, and challenge ideas with their peers.	SA
15. During a lesson, all of the students in the class should be encouraged to use the same approach for conducting an experiment or solving a problem.	D
16. Assessments in science classes should only be given after instruction is completed; that way, the teachers can determine if the students have learned the material covered in class.	SA

BARSTL Category 3: Characteristics of Teachers and the Learning Environment – Rose's Responses	Before PD
17. Students should do most of the talking in the science classroom.	A
18. Students should work independently as much as possible so they do not learn to rely on other students to do their work for them.	D
19. In science classrooms, students should be encouraged to challenge ideas while maintaining a climate of respect for what others have to say.	SA
20. Teachers should allow students to help determine the direction and the focus of a lesson.	A
21. Students should be willing to accept the scientific ideas and theories presented to them during class without question.	D

22. An excellent science teacher is someone who is really good at explaining complicated concepts clearly so that everyone understands.	A
23. The teacher should motivate students to finish their work as quickly as possible.	SD
24. Science teachers should primarily act as a resource person working to support and enhance student investigations rather than explaining how things work.	A

BARSTL Category 4: The Nature of the Science Curriculum – Rose's Responses	Before PD
25. A good science curriculum should focus on only a few scientific concepts a year, but in great detail.	A
26. The science curriculum should focus on the basic facts and skills of science that students will need to know later.	D
27. Students should know that scientific knowledge is discovered using the scientific method.	A
28. The science curriculum should encourage students to learn the value alternative modes of investigation and problem solving.	A
29. In order to prepare students for future classes, college, or a career in science, the science curriculum should cover as many topics as possible over the course of the school year.	D
30. The science curriculum should help students develop reasoning skills and habits of mind necessary to do science.	SA

31. Students should learn that all science is based on a single scientific method- a step-by-step procedure that begins with “define the problem” and ends with “reporting the results.”	D
32. A good science curriculum should focus on the history and nature of science and how science affects people and societies.	D

4.1.1.1 BARSTL Questionnaire 1 Exploration of Findings – Prior to Professional Development

The BARSTL categorized teachers as having traditional or reformed beliefs across four key categories. Within each of these four main categories, there were eight statements below each category. The participants’ beliefs on each of the statements ranged from strongly agree to strongly disagree. John and Rose held similar perspectives in most category statements, indicated by the fact they both strongly agreed/agreed or strongly disagreed/disagreed with one another on the majority of statements. However, there were a few areas where John and Rose differed in their perspectives.

Category 1 focused upon the *ways in which people learn science*. In this category, John and Rose disagreed with each other on two out of eight statements. Rose strongly agreed that students develop many ideas about how the world works before they ever study about science in school while John disagreed with this statement. This seemed to suggest that John would favor a perspective where students depend on teachers the majority of their content knowledge while Rose would favor a Funds of Knowledge perspective, indicating that students come to school with their own lived experiences and knowledge (Hogg, 2011). In another example, John disagreed while Rose agreed that learning science is an orderly process where students learn by gradually accumulating more information over time. This may have suggested that John sees learning as a modification of existing ideas whereas Rose saw learning as an accumulation of ideas (Sampson et al., 2013).

Category 2 focused upon *lesson design and implementation*. In this category, John and Rose disagreed with each other on three out of eight statements. John agreed while Rose disagreed as to whether teachers, when conducting labs, should give step-by-step instructions for the students to follow in order to prevent confusion and make sure the students give correct results. Similarly, John thought teachers should favor scripted lessons, while Rose thought teachers should not do so. This seemed to suggest that Rose favored more inquiry-based lessons and John favored more scripted lessons. Rose agreed with inquiry-based lesson design while John disagreed with this type of lesson design. In regards to giving students assessments, Rose strongly agreed that assessments should only be given after instruction is completed while John disagreed with this. This may have indicated that John favored formative assessments while Rose favored summative assessments.

Category 3 focused upon *teacher characteristics and the learning environment*. In this category, John and Rose disagreed with each other two out of eight times. Rose agreed that students should do most of the talking in the science classroom, while John disagreed. This may have indicated that John favored a more traditional classroom while Rose have favored a more interactive, constructivist approach to teaching in her classroom. Rose agreed that a science teacher should primarily act as a resource person, while John disagreed that this should be the primary role of a science teacher. This may have suggested that John had a more traditional view of his work as a science teacher, while Rose had a more reformed view of her role in this regard.

Category 4 focused upon the *nature of science curriculum*. In this category, John and Rose disagreed with each other three out of eight times. Rose agreed that a good science curriculum should focus on only a few scientific concepts a year but include great detail about these concepts, while John strongly disagreed with this statement. John seemed to favor breadth over depth of knowledge, while Rose may have had an opposing viewpoint. In the same category, John agreed that students should learn that all science is based on a single scientific method-a step-by-step procedure that begins with "define the problem" and ends with "reporting the results," while Rose disagreed. This seemed to indicate that John may have held a view science learning in a linear fashion while Rose may have held a view science learning in a non-linear fashion. This was the second time during the questionnaire John agreed with "step-by-step" teaching approach in which knowledge is dispensed knowledge to students using a prescribed curriculum (Sampson et al., 2013). Lastly, John agreed with a statement indicating that a good science curriculum should focus on the history and nature of science and how science affects people and societies, while Rose disagreed with this statement.

Overall, based on their responses to the BARSTL, John agreed with a number of more traditional views, while Rose agreed with a number of views on science literacy that could be considered to be more reformed.

4.1.1.2 Interview Results

Prior to taking part in the personalized professional development program for the science literacy kit on *Topic 6: Animal Adaptations*, the researcher interviewed John and Rose separately to learn more about their views on science literacy. The interviews were transcribed and reviewed multiple times by two people. A grounded-theory approach was used to identify emergent themes based on John and Rose's beliefs about science literacy. Then, the interviews were coded by the same two people who were in general agreement on the themes that emerged from the interviews. Differences were resolved by discussion.

Interview 1

John's Initial Interview

During John's interview, the content included the two main categories of science instruction and science literacy. Regarding science literacy, John expressed his preference for teaching inquiry-based, hands-on instruction through what he called, "hands-on help".

When asked how he delivered science instruction, John explained that he broke his instruction down into concrete and abstract categories. He defined concrete instruction as "the doing" part, such as the labs. No matter what lab or lesson he was teaching, he grouped students collaboratively to foster social skills. However, he claimed that the concrete-lab part seemed easier for the students to perform than the writing part. He defined abstract instruction as "the writing" part of the lessons. When probed if he saw an importance to teaching reading and writing in science class, he commented that teaching basic reading skills, such as fluency, decoding, and related skills were important skills to be taught to students. He defined this as giving students graphic organizers, visual clues, word walls, and thinking maps. When specifically probed about a reading-science connection, John stated, "You can't have science without knowing how to read." However, he spent more time during the interview talking about the math-science connection than a reading-science connection, which he only mentioned when prompted to respond about such a connection. In one such instance, John stated,

> I am new to this so this is my first go-round. I haven't been trained on it. So to be honest, I am trying this one lesson at a time and get through the lessons that they have in there. I

am hoping to become more creative as time goes on. But no, I haven't been able to bring any books in with it.

He expressed a desire to engage in science literacy, but had not yet included outside texts from the curriculum at this point. He seemed to have a mixed philosophy on science literacy where many of his views were traditional and some were reformed. For a complete transcript, please see Appendix E.

Rose's Initial Interview

During Rose's interview, the same two main categories of science instruction and science literacy were the focus of the interview. In relation to science literacy connections, Rose expressed a preference for instructing students in a hands-on, student-centered, and engaging manner. She spoke several times of wanting to make-real-life connections to what students were learning in class. She expressed concern that many students come to school with a lack of academic background knowledge in science. She hoped to remedy this through making real-life connections and by using the same strategies in language arts and science. One example of a reading strategy she used with students was that of picture boxes, graphic organizers in which the student wrote the word, drew a picture, labeled the part of speech, and defined the word in order to remember its meaning. She said they helped students understand academic vocabulary in science. She continued to discuss the importance of vocabulary and added that by using the strategy of visualization, students could conceptualize difficult words such as "atmosphere". She explained that each year the students struggled to understand the concept behind the term atmosphere. However, once they visualized it as a blanket that wrapped around the Earth, they gained a better understanding of the word. She had found that related discussion and performance-based assessments were the best way to determine if students learned the lesson's content.

When asked about a connection between science and literacy, Rose stated that she brought in her own books to enhance the curriculum's basal text. When she referred to vocabulary instruction, she stated that she always put words into student-friendly terms, which she indicated the textbook was not always effective at doing. She expressed beliefs in cross-curricular connections between language arts and science multiple times. She gave an example of helping students with writing tasks which she deemed to be the most difficult task in both language arts and science. She stated that she told her students that just because they were doing science, they were not allowed to forget about writing in solid paragraphs and complete sentences. Overall, she had a reformed philosophy on science literacy and was most concerned about vocabulary, making connections, and cross-curricular applications. For a complete transcript, please see Appendix E.

4.1.1.3 Overall Initial Beliefs of Participating Teachers

The first research question focused on teacher beliefs prior to the professional development plan. A complex portrait emerged of each teacher. In general, salient themes emerged for each teacher based on the BARSTL Questionnaires and initial interviews.

John's Initial Beliefs

During his interview, John referred to himself as a math teacher and many of his comments were centered around math applications for science instruction. In addition, he mentioned several times his preference for giving "hands-on-help" to students. He also preferred hands-on lessons. He said that students had more difficulty with "abstract" lessons such as writing rather than "concrete" lessons such as science labs.

From the BARSTL Questionnaire, John tended to hold many traditional beliefs such as always giving students step-by-step directions. In reference to how students first learned about science, he believed that students learn science first at school rather than learning science before they start school from the environment. As for his role as a teacher, he strongly disagreed that a science teacher should serve as a resource person to support and enhance student investigations reinforcing his preference for a teacher-led classroom. He believed he should be doing most of the talking in class rather than the students. In addition, he indicated a preference for covering multiple topics in a science textbook rather than a few topics in depth. He also believed that assessments should only be given when all lessons in each unit are completed. While John held many traditional views of science teaching such as having a teacher-led classroom, he also seemed to be reformed in his beliefs that there should be "hands-on help" and that students should be actively engaged in learning. Therefore, he presented as a teacher with mixed beliefs ranging from traditional to reformed beliefs.

Rose's Initial Beliefs

During her interview, Rose referred to herself as a hands-on, student-centered teacher. She spoke several times of her desire to make real-life connections for her students. She was interested in vocabulary instruction to increase students' content knowledge. She put vocabulary in student-friendly terms to increase understanding. Also, she expressed several self-reflective statements when talking about how she would improve lessons next year. She saw the curriculum as flexible where she adjusted and made changes to meet students' interests and needs. In addition, she mentioned making cross-curricular connects for students, particularly in social studies and language arts. She helped students use their prior knowledge from other subject areas and apply it to science.

Based on her response to the BARSTL Questionnaire, Rose tended to hold many reformed beliefs such as not using step-by step directions in teaching. In reference to how students first learn about science, she believed that students first learn science prior to coming to school. As for her role as a teacher, she agreed that students should do most of the talking in class and accordingly, saw her role as a resource person to support their investigations. In addition, she preferred to cover a few topics in detail rather than many topics at a superficial level. She believed that lessons should be given throughout the science unit. She presented as a student-centered teacher with a reformed science teaching perspective, with a focus on language arts and social studies instruction during science class.

4.2 Findings: Research Question #2

In order to answer the second research question, *How do the views of teachers evolve as a result of participating in a reading specialist-led professional development program?* data was gathered from ongoing interviews, journal responses, and a second administration of the BARSTL questionnaire.

4.2.1 Teachers' Beliefs During Week 2-6 Interviews

A series of individual interviews were conducted between the researcher and the participants during weeks two through six. During this time, a complex portrait continued to emerge of each teacher. In general, salient themes emerged for each teacher based on the week two to six interviews. The interviews were conducted once a week after each week's lessons had concluded.

4.2.1.1 John's Week 2-6 Interviews

During John's interviews, he expressed many comments reflective of a mixed science teaching perspective. That is, John expressed some comments reflective of a traditional perspective and others of a reformed perspective. He spoke about letting the students lead the class in several lessons. John said during that interview that he did this again after the next week's lessons when he held a student-led, whole-class discussion on wetland features. He had the students decide where the wetland cards should be placed on the boards. He only corrected the students if none of them gave correct answers on the card placement. Otherwise, he let them work it out on their own. John pushed the students' discussion forward by saying, "Do you think this one (card) fits here?" He claimed the students enjoyed the lesson because the students were working together as a class. In these examples, John was acting as a facilitator which was reflective of a reformed view of his role as a science teacher.

At the same time, John expressed some views that were contrary to his reformed views and reflected some traditional views that he held of himself as a science teacher. When John talked about how he defined his role as a science teacher, he also began to reveal that he viewed himself as a math teacher primarily, and not a reading teacher. John said that he did not usually read to his students because he was their math and science teacher. After the third lesson, he said that the students really loved the books provided in the kit and he acknowledged that, "It's been a long time since I read to them." He claimed they enjoyed it because it got them out of their seats and gave them a chance to sit on the carpet to listen to the story. John conceded that this was something different for them because he did not usually do that since he was their math teacher. This was impactful because the students were given a science textbook. However, he had not taught them how to approach this genre. Instead, he assigned them sections to read and his focus was on the content of the text, not on the text. In this example, John was acting as a dispenser of knowledge where he focused on independent work and learning by rote memorization of facts and was reflective of a traditional perspective on science teaching. In addition, John commented that the students enjoyed the bird beaks labs and were disappointed that they were not repeating the lab. This was also evidence of a traditional teaching perspective because instead of providing an extension for the lab due to their piqued interest in the lessons' comment, he stayed with the schedule and moved on to the next lesson.

Table 5 Dimensions of Traditional and Reformed Minded Beliefs Associated with Each Subscale of the BARSTL Questionnaire (Sampson et al., 2013)

BARSTL Scales	Traditional Perspective	Reformed Perspective
How people learn about science	• Compared with "blank slates" • Learning is an accumulation of information	• What students learn is influenced by their existing ideas • Learning is the modification of existing ideas
Lesson design and implementation	• Teacher-prescribed activities • Frontal-teaching – telling and showing students • Relies heavily on textbooks and workbooks	• Student-directed learning • Relies heavily on student-developed investigations, manipulative materials, and primary sources of data
Characteristics of teachers and	• The teacher acts as a dispenser of knowledge	• The teacher acts as facilitator, listener, and coach

the learning environment	• Focus on independent work and learning by rote	• Focus on learning together and valuing others ideas and ways of thinking
The nature of the science curriculum	• Focus on basic skills (foundations) • Curriculum is fixed • Focus on breadth over depth	• Focus on conceptual understanding and the application of concepts • Curriculum is flexible and changes with student questions and interest • Focus on depth over breadth

According to Sampson and his colleagues' (2013) continuum of Traditional to Reformed Minded Beliefs of Science Teaching (See Table 3), as previously presented in this chapter, John saw the curriculum from a traditional perspective as fixed (Sampson et al., 2013). In addition, John commented that he liked the order of the Bird Beaks Lessons. He said,

> Usually when I'm giving them information, I'm giving them the answers to what they're supposed to be getting from the lab. Whereas the lab came first so, they got their true answers from inquiry rather than me telling them.

This was evidence of John's growing reformed view of science teaching. Prior to the professional development, he taught the students the content and then had them participate in the lab. However, he commented that he liked the pacing of the lesson where the inquiry came first and the students came up with their own answers instead of him giving them the answers. According to Sampson and his colleagues' (2013) continuum of Traditional to Reformed Minded Beliefs of Science Teaching (See Table 3), John was shifting from a traditional science teaching perspective where the teacher acted as a dispenser of knowledge to the teacher acting as the facilitator.

During the final interview, John expressed a growing reformed view of science teaching. He commented that he preferred hands-on lessons which is indicative of student-directed learning, and in which John's role was being a facilitator. When asked what experiences are necessary for students to become successful in learning science, he also responded in keeping with his previous stated belief that students should have hands-on experiences in science. When asked what strategies were most effective in teaching science, he said that he uses a hands-on approach. When asked what his favorite lesson was in the unit, he said he liked the Bird Beaks Lessons the best because they were hands-on. Alternatively to his reformed views, John saw learning as an accumulation of information indicative of the traditional view of science teaching. For example, he said he would know if they mastered the lesson's content when the students could conduct an experiment correctly. Still, most of his comments reflected a growing reformed teaching perspective at this point in the professional development lessons.

Overall, John's experiences reflected a mixed view of himself as a science teacher with a growing view of himself as a reformed science teacher. He continued to see himself as a math teacher first and made connections more easily between math to science. He also saw connections being built by the students between art and science when building a model of a habitat. He would express connections between reading and science when prompted through questioning but primarily when he was asked directly how the two were interrelated therefore showing his view of himself as a traditional science teacher. However, many of his comments reflected his preference for hands-on, inquiry-based lessons where his role was to be a facilitator, where he helped his students to navigate the lessons. Just as frequently, he expressed reformed views. For example, he commented favorably toward students being actively engaged in lessons and using their creativity in project work. He liked to pair his students up or have them work in groups. John liked lessons that involved realistic, hands-on manipulatives. He held a growing view of himself as a reformed science teacher.

4.2.1.2 Rose's Week 2-6 Interviews

During Rose's interviews, she expressed many comments reflective of a reformed science teaching perspective. Themes related to this began to emerge related to her preference for using technology, hands-on learning, and keeping students actively engaged in lessons. Rose expressed many comments reflective of reformed science teaching. Rose expressed statements that she enjoyed the hands-on lesson on fish feeding strategies where the students were using the plastic to match fish with their diets. Rose said that the students enjoyed the lesson because it was hands-on. According to Rose's responses to the BARSTL questionnaire, this was evidence of Rose's reformed science teaching perspective because her role during the lesson was that of a facilitator helping the students to form their own knowledge during the lessons. In addition, Rose stated her preference for hands-on lessons that seemed to increase student engagement during these lessons in particular. She commented several times during the interviews that during these lessons many of the students were coming up to her with lots of questions during classroom discussions due to their interest in the lesson content. Rose commented that she would add technology to some of the lessons to show the students how they could find the answers to their questions. According to Sampson and his colleagues' (2013) continuum of Traditional to Reformed Minded Beliefs of Science Teaching (See Table 3), this example was evidence that Rose held a reformed view of science teaching and believed the curriculum was flexible and changed with student questions and interest. During these discussions, she again shared her use of the general reading strategies of building background knowledge and visualization. This showed Rose's reformed view of science teaching as she expressed that what students learn was influenced by their existing ideas from their background knowledge.

Rose commented about using the strategies of building background knowledge and visualization during classroom discussions. She was focused on the students learning together and valuing each other's ideas and ways of thinking which was indicative of a reformed view of science teaching. She again stated her interest in increasing students' vocabulary and did this by putting words into student-friendly terms to build upon their existing ideas and prior knowledge. In addition, she made cross-curricular applications for the students in science as it applied to language arts and social studies in order to focus on conceptual understanding and the application of concepts. She said, "Language arts in science go hand-in-hand." This was indicative of Rose's reformed view of science teaching.

4.2.2 Journals

Recognizing that there could be more personal, reflective information that would not surface in interviews, both participants were asked to keep a journal. These journals were launched at the beginning of the lessons and continued throughout the study.

4.2.2.1 John's Journal

In John's journal, he expressed a mixed perspective on teaching science. He commented that his students enjoyed the student-centered lesson activities (J 1-14-20). According to Figure 1, John's notes were reflected of a reformed perspective, seeing himself as a facilitator of the lessons. Then, John transitioned to the topic of lesson pacing. He seemed to be concerned about how fast or slow he should pace the lessons (J 2-16-20). He noted that he made the decision to pace the lessons slower starting with the second week's lessons. He noted on the same day that he would pace the lesson by extending the number of days in the lesson next time (J 2-22-20). He noted lesson pacing again, commenting that he would reverse the order of the tasks the next time he does the same lesson (J 1-23-20). Oftentimes, John commented to me that he wanted to stick to the lesson pacing in the guide. I reassured him several times that it was a pacing guide and that he could slow down the lessons to meet the needs of his students. However, John continued to express his desire to cover all of the topics in the prescribed pacing guide timeframe. According to Table 1, these examples were indicative of a traditional perspective where there is a focus on breadth over depth when pacing lessons.

John also wrote about how much he enjoyed hands-on lessons. He wrote that both he and the students enjoyed the hands-on lessons (J 1-23-20). John commented he would prefer this particular lesson to be more hands-on by pairing students together to work on the task instead of having a whole group lesson (J 2-22-20). According to Figure 1, this is indicative of a reformed science teaching perspective because John was seeing himself as the facilitator of hands-on lessons, coaching his students through the lessons but allowing them to form their own knowledge.

Overall, John held mixed views of himself as a science teacher. He was concerned with covering as many topics as possible in a prescribed timeframe which was reflected of a traditional science teaching perspective. However, he also expressed enjoyment in his role as a facilitator for his students through the hands-on science lessons. John held a mixed perspective grappling with new ideas and methods of teaching science.

4.2.2.2 Rose's Journal

In Rose's journal, she regularly expressed beliefs consistent with a reformed perspective on teaching science. In the first lesson, Rose gave her students examples of the definition of 'biome' to help them understand the meaning of the word (R 1-14-20). She introduced the key vocabulary words as the first activity of the lesson (R 1-16-20 and 2-5-20). According to Figure 1, Rose built on what students have learned by adding to their existing ideas indicative of a reformed view of science teaching.

When commenting on the use of technology, Rose placed value on student-directed learning and collaboration, noting that she paired up students using iPads to explore the coral reef websites (R 1-14-20). After exploring the websites, she had the students come back together for a group discussion of coral reefs animals and plants. According to Sampson and his colleagues' (2013) continuum of Traditional to Reformed Minded Beliefs of Science Teaching (See Table 3), these examples were indicative of a reformed view of science teaching because Rose focused on students learning together and valued others ideas and ways of thinking.

Also, Rose noted that she decided to extend the bird beak lessons because the students were really enjoying this lesson, and that she gave them more time to do more online reading about bird beaks as an extension to the lessons (R 1-29-20). According to Sampson and his colleagues' (2013) continuum of Traditional to Reformed Minded Beliefs of Science Teaching (See Table 3), this example was indicative of a reformed view of science teaching because Rose is showing that the curriculum is flexible and changes with students' questions and interests.

Overall, Rose's journal was indicative of her reformed view of science teaching. She made several teaching moves that reflected this perspective. Rose built upon students' prior knowledge to expound upon their existing thinking. She facilitated students' group discussion after a website exploration. Also, she created a lesson extension due to students' expressed interest in the lesson topic. All of Rose's journal notes reflected a reformed view of science teaching.

4.2.2.3 Journal Summary

Most of the journal findings were consistent with themes that emerged from the interview findings. For example, John talked about preferring hands-on lessons that had a technology component to them. Rose talked about integrating language arts and social studies into science class. She used vocabulary instruction to support readings in science class. The themes from the journals and the interviews were consistent in representing a picture of John and Rose's views on science literacy.

4.2.3 BARSTL Questionnaire Exploration of Findings – After Professional Development

From the first to the second administration of the BARSTL Questionnaire, John and Rose kept most of their beliefs consistent. However, John and Rose changed their beliefs on some statements. Most of John's answers stayed consistent from the first questionnaire to the second questionnaire. Some of his views became more traditional, such as believing that he should cover more topics of study in science class rather than a few topics in depth. However, in the category of *Characteristics of Teachers and the Learning Environment*, John changed his answer to reflect his beliefs that a science teacher's role is to act as a resource person, working to support and enhance students' investigations rather than explaining how things work. He seemed to view himself in a more reformed manner in his role as a science teacher. This was also reflected in his interviews with the researcher.

Most of Rose's views were also consistent between the two administrations of the questionnaires. She only changed one response, which was related to *Lesson Design and Implementation*. On the second administration, Rose changed her answer indicating she now believed that students should explore and conduct experiments before the teacher discussed any scientific concepts with them. This seemed to reflect the reformed view of inquiry-based teaching.

Overall, John changed more of his beliefs from traditional to reformed views than Rose. This might have been because Rose held stronger views related to the reformed perspective prior to the professional development than John did. For a more detailed perspective, please see Figure 3, Pre and Post Responses to BARSTL Areas of change are highlighted for clarity.

Table 6 Before and After PD BARSTL Questionnaire Responses

Key to Responses (SA: Strongly Agree, A: Agree, SD: Strongly Disagree, D: Disagree)

BARSTL Category 1: How People Learn About Science – John's Responses	Before PD	After PD
1. Students develop many ideas about how the world works before they ever study about science in school.	D	D
2. Students learn in a disorderly fashion; they create their own knowledge by modifying their existing ideas in an effort to make sense of new and past experiences.	A	A
3. People are either talented at science or they are not, therefore student achievement in science is a reflection of their natural abilities.	SD	SD

4. Students are more likely to understand a scientific concept if the teacher explains the concept in a way that is clear and easy to understand.	SA	SA
5. Frequently, students have difficulty learning scientific concepts in school because their ideas about how the world works are often resistant to change.	D	SD
6. Learning science is an orderly process; students learn by gradually accumulating more information about a topic overtime.	D	SA
7. Students learn the most when they are able to test, discuss, and debate many possible answers during activities that involve social interaction.	SA	D
7. Students learn the most when they are able to test, discuss, and debate many possible answers during activities that involve social interaction.	SA	SA

BARSTL Category 2: Lesson Design and Implementation – John's Responses	Before PD	After PD
8. During a lesson, students should explore and conduct their own experiments with hands-on materials before the teacher discusses any scientific concepts with them.	D	D
9. During a lesson, teachers should spend more time asking questions that trigger divergent ways of thinking than they do explaining the concepts to students.	A	A

10. Whenever students conduct an experiment during a science lesson, the teacher should give step-by-step instructions for the students to follow in order to prevent confusion and make sure the students get the correct results.	A	A
11. Whenever students conduct an experiment during a science lesson, the teacher should give step-by-step instructions for the students to follow in order to prevent confusion and make sure the students get the correct results.	A	A
12. Experiments should be included in lessons as a way to reinforce the scientific concepts students have already learned in class.	SA	SD
13. Lessons should be designed in a way that allows students to learn new concepts through inquiry instead of through a lecture, reading, or a demonstration.	D	A
14. During a lesson, students need to be given opportunities to test, debate, and challenge ideas with their peers.	SA	SA
15. During a lesson, all of the students in the class should be encouraged to use the same approach for conducting an experiment or solving a problem.	D	A
16. Assessments in science classes should only be given after instruction is completed; that way, the teachers can determine if the students have learned the material covered in class.	D	A

BARSTL Category 3: Characteristics of Teachers and the Learning Environment – John's Responses	Before PD	After PD
17. Students should do most of the talking in the science classroom.	SD	D
18. Students should work independently as much as possible so they do not learn to rely on other students to do their work for them.	D	D
19. In science classrooms, students should be encouraged to challenge ideas while maintaining a climate of respect for what others have to say.	SA	SA
20. Teachers should allow students to help determine the direction and the focus of a lesson.	SA	D
21. Students should be willing to accept the scientific ideas and theories presented to them during class without question.	D	D
22. An excellent science teacher is someone who is really good at explaining complicated concepts clearly so that everyone understands.	SA	A
23. The teacher should motivate students to finish their work as quickly as possible.	SD	SD
24. Science teachers should primarily act as a resource person working to support and enhance student investigations rather than explaining how things work.	D	A

BARSTL Category 4: The Nature of the Science Curriculum – John’s Responses	Before PD	After PD
25. A good science curriculum should focus on only a few scientific concepts a year, but in great detail.	SD	D
26. The science curriculum should focus on the basic facts and skills of science that students will need to know later.	D	A
27. Students should know that scientific knowledge is discovered using the scientific method.	A	A
28. The science curriculum should encourage students to learn the value alternative modes of investigation and problem solving.	A	SA
29. In order to prepare students for future classes, college, or a career in science, the science curriculum should cover as many topics as possible over the course of the school year.	D	A
30. The science curriculum should help students develop reasoning skills and habits of mind necessary to do science.	SA	SA
31. Students should learn that all science is based on a single scientific method-a step-by-step procedure that begins with “define the problem” and ends with “reporting the results.”	A	A
32. A good science curriculum should focus on the history and nature of science and how science affects people and societies.	A	D

BARSTL Category 1: How People Learn About Science – Rose's Responses	Before PD	After PD
1. Students develop many ideas about how the world works before they ever study about science in school.	SA	SA
2. Students learn in a disorderly fashion; they create their own knowledge by modifying their existing ideas in an effort to make sense of new and past experiences.	A	A
3. People are either talented at science or they are not, therefore student achievement in science is a reflection of their natural abilities.	D	D
4. Students are more likely to understand a scientific concept if the teacher explains the concept in a way that is clear and easy to understand.	A	A
5. Frequently, students have difficulty learning scientific concepts in school because their ideas about how the world works are often resistant to change.	D	D
6. Learning science is an orderly process; students learn by gradually accumulating more information about a topic overtime.	A	A
7. Students learn the most when they are able to test, discuss, and debate many possible answers during activities that involve social interaction.	SA	D

8. Students learn the most when they are able to test, discuss, and debate many possible answers during activities that involve social interaction.	SA	A

BARSTL Category 2: Lesson Design and Implementation – Rose's Responses	Before PD	After PD
9. During a lesson, students should explore and conduct their own experiments with hands-on materials before the teacher discusses any scientific concepts with them.	D	A
10. During a lesson, teachers should spend more time asking questions that trigger divergent ways of thinking than they do explaining the concepts to students.	A	A
11. Whenever students conduct an experiment during a science lesson, the teacher should give step-by-step instructions for the students to follow in order to prevent confusion and make sure the students get the correct results.	D	D
12. Experiments should be included in lessons as a way to reinforce the scientific concepts students have already learned in class.	D	D
13. Lessons should be designed in a way that allows students to learn new concepts through inquiry instead of through a lecture, reading, or a demonstration.	A	A

14. During a lesson, students need to be given opportunities to test, debate, and challenge ideas with their peers.	SA	SA
15. During a lesson, all of the students in the class should be encouraged to use the same approach for conducting an experiment or solving a problem.	D	D
16. Assessments in science classes should only be given after instruction is completed; that way, the teachers can determine if the students have learned the material covered in class.	SA	A

BARSTL Category 3: Characteristics of Teachers and the Learning Environment – Rose's Responses	Before PD	After PD
17. Students should do most of the talking in the science classroom.	A	A
18. Students should work independently as much as possible so they do not learn to rely on other students to do their work for them.	D	D
19. In science classrooms, students should be encouraged to challenge ideas while maintaining a climate of respect for what others have to say.	SA	SA
20. Teachers should allow students to help determine the direction and the focus of a lesson.	A	A
21. Students should be willing to accept the scientific ideas and theories presented to them during class without question.	D	D

22. An excellent science teacher is someone who is really good at explaining complicated concepts clearly so that everyone understands.	A	A
23. The teacher should motivate students to finish their work as quickly as possible.	SD	D
24. Science teachers should primarily act as a resource person working to support and enhance student investigations rather than explaining how things work.	A	A

BARSTL Category 4: The Nature of the Science Curriculum – Rose's Responses	Before PD	After PD
25. A good science curriculum should focus on only a few scientific concepts a year, but in great detail.	A	A
26. The science curriculum should focus on the basic facts and skills of science that students will need to know later.	D	D
27. Students should know that scientific knowledge is discovered using the scientific method.	A	A
28. The science curriculum should encourage students to learn the value alternative modes of investigation and problem solving.	A	SA
29. In order to prepare students for future classes, college, or a career in science, the science curriculum should cover as many topics as possible over the course of the school year.	D	D

30. The science curriculum should help students develop reasoning skills and habits of mind necessary to do science.	SA	A
31. Students should learn that all science is based on a single scientific method-a step-by-step procedure that begins with “define the problem” and ends with “reporting the results.”	D	SD
32. A good science curriculum should focus on the history and nature of science and how science affects people and societies.	D	D

4.3 Summary of Findings

Overall, the BARSTL Questionnaires, interviews, and journal entries consistently reflected a picture of each teacher’s views on science literacy. John held mixed views of himself as a science teacher, which seemed primarily grounded in a traditional perspective, but also showed openness to reform. For example, he said many times that he saw himself as a math teacher first. However, he also began to see his teaching role as a guide where he would shape and assist students in their own learning in varied contexts. Thus, this role reflected a growing reformed view of himself as a science teacher.

Rose’s views were primarily reformed. She was already working to apply cross-curricular connections in social studies and reading class. For example, she had referred to a social studies’ lesson on the Everglades when teaching wetlands in science class. Oftentimes, she showed her mentorship capacity by staying a week ahead of John’s lessons in order to help him plan the lesson. She gave him tips on what she had done and how to help students during the lesson. Also, she seemed the most receptive to working with the researcher from the start. This was particularly true because both Rose and I expressed enjoyment teaching reading and science. Whereas, John seemed timid about working together at first but opened up much more as the weeks progressed. By the end of the professional development, John started approaching me with ideas for what he would do next time to improve the lessons, whereas Rose had done this throughout the study. Both teachers were open to working as a team to improve lessons during the professional development.

5.0 Discussion and Limitations

My goal in this research study was to build an understanding of elementary science teachers' perspectives on science literacy. My purpose was to learn not only about science teachers' perspectives, but also how a reading specialist like myself could support science teachers. As part of this research study, I interviewed two third grade science teachers and collected reflective journals from them on their experiences using a science kit that I created to support literacy in the science classroom. I provided personalized professional development to two science teachers in order to promote discussions on science literacy and to create a conversation around literacy in science instruction.

In this chapter, I discuss the conclusions I have come to regarding this research study and the two research questions I focused on during my study. Following the presentation of my conclusions, I detail the study's implications on science literacy instruction and how a reading specialist can support teachers in an elementary science classroom. Then, I will discuss the limitations of the study and concluded with my personal reflections as a result of the study.

5.1 Conclusions

I sought to answer the following research questions:

1. What beliefs do two focus third grade teachers hold about science literacy prior to participating in a personalized professional development program related to science literacy?

2. How do the views of these two teachers evolve as a result of participating in a reading specialist-led professional development program?

Based on this analysis, it can be concluded that in response to question 1, the two teachers' views became more reflective of reformed perspectives than they had been prior to the study. In response to question 2, it seemed clear that the perspectives of the teachers in the study were impacted by participation in this reading specialist-led personalized professional development program.

5.1.1 Research Question 1

The first question centered around each third grade teacher's perspective on science literacy prior to the professional development. After giving each teacher the BARSTL Questionnaire, interviewing each teacher and reading their journals, I gained some insights on their perspectives on science literacy and how they changed or remained consistent throughout the study. When I reviewed John's first BARSTL Questionnaire, I noticed that many of his answers reflected a traditional perspective on science teaching with a few answers having reflected a reformed science teaching perspective. For example, John disagreed with the reformed statement: *Students develop many ideas about how the world works before they ever study about science in school*. This may have indicated that held a traditional view of students as blank slates regarding how they learned about science prior to entering formal schooling. However, he strongly agreed with the reformed statement: *Students learn the most when they are able to test, discuss, and debate many possible answers during activities that involve social interaction*. This may have indicated that he held a reformed view of learning being socially-constructed. Therefore, John held a mixed perspective on science literacy prior to professional development.

During the study, I noticed that John's perspectives were evolving toward more reformed views of science teaching. The most striking comment he made during the interviews was when he revealed that since he saw himself as a math teacher primarily. He did not usually read to his students and said, "It's been a long time since I read to them." When he read the books from the kit to the students during the professional development study, he said the students really enjoyed him reading to them. He also said that he planned on reading more to his students in the future because of the reactions from the students and positive feedback he received when reading to them.

I noticed other ways that his views were shifting to reformed views. At the beginning of the professional development, he mentioned as well that he was concerned about staying with the prescribed pacing for the lessons, even after I assured him that the pacing was flexible and he could add time to the lessons according to his students' needs and interests. He had expressed that his students really enjoyed the lab on Bird Beaks because of its interactive nature and from the feedback the students gave to him. They were disappointed the day after the lab when they found out that they would not be repeating the lab. This could have been an opportunity for John to create an extension or enrichment for the lesson based on students' interests. Because he expressed being focused on aligning to the prescribed pacing of the lessons, he moved on the next week's lessons and might have missed an opportunity to grow students' content knowledge in an area in which they expressed heightened interest. However, toward the end of the professional development, John let the students have an extra two days when creating their frog habitats. He expressed that the students were delighted to spend more time on their projects. He recounted the story of how his students impressed him with their creativity and ingenuity in coming up with ways to create a habitat using scrap materials. He gave them free reign to come up with their projects because they had expressed such excitement in taking ownership and creative freedom in their projects. He expressed pride and surprise when his students impressed him with their creations. This was reflective of John's growing reformed perspectives on science literacy since he allowed self-directed student projects based on students' interests.

During the study, I noticed that the vast majority of Rose's BARSTL Questionnaire and interview responses reflected a reformed perspective. For example, during the first and second administration of the BARSTL questionnaire, she strongly agreed with the statement: *Students develop many ideas about how the world works before they ever study about science in school.* She maintained this same belief when responding *Strongly Agree* to the same question on the second administration of the BARSTL questionnaire. Throughout the interviews, Rose made comments reflective of a reformed perspective as well. She talked about her experiences conducting classroom discussions where students valued each other's ideas as she built upon their background knowledge to construct new ideas. This again was reflective of her reformed views on science teaching.

However, the most impactful insights I gained from interviewing Rose were the comments regarding collaborating together after the study concluded. She expressed consistently after every interview that she was going to miss the collaboration at the end of the study. She also said that she wanted to continue collaborating after the lessons concluded because she said that working together made planning the lessons a lot easier, and helped her generate ideas and modify her ideas for the lessons to benefit the students.

5.1.2 Research Question 2

For the second research question, I addressed specifically: How do the views of these two teachers evolve as a result of participating in a reading specialist-led professional development program? Through the BARSTL Questionnaire, teacher interviews, and the teacher journals, my goal was to gain an understanding of the opportunity in which I, as a reading specialist, could support the teachers during the professional development program. From the results of the first questionnaire, there were some of traditional views held by John and Rose that I wanted to have a positive effect on. I was seeking to understand their views and gently shift their traditional view to reformed views. For example, prior to the professional development, John held the view that scripted lessons were the best way to deliver science instruction. I wanted to see if John's views would change after using the kit and the professional development program. Perhaps he might see that student-led, discovery-based lessons could be beneficial as well. After the professional development, John took the BARSTL Questionnaire a second time and changed his view on unscripted lessons from disagree to strongly agreeing with their use in the classroom. During the weekly interviews, I wanted to see if John would be open to reading to his students, particularly because he identified first as a math teacher. He did report this change during one of the interviews that he really enjoyed reading to the students and they seemed to enjoy it as well. He also reported this in his journal on two occasions (J 2-20-20 and J 3-2-20).

Rose's views were more reformed when compared to John's views from the start of the teacher professional development. I wanted to learn more about Rose's experiences with the kit and how she, as a reformed science teacher, used the kit. Throughout the interviews, she reported adding her own materials to the kit such as recording sheets for the students to use during the lessons. Also, she actively sought out working with me to come up with ideas and modifications for the next time she taught the lessons. For example, during the last interview, she said she enjoyed all of the books in the kit and wanted to add more books to her collection for the next time she taught the lesson. She mentioned how much she enjoyed working together and coming up with ideas together and would really miss meeting with me after the professional development was over. I reassured her that we could collaborate on more science kits in the future. Both John and Rose opened up more as the weeks progressed. There were many opportunities for all of us to collaborate on science literacy. In summary, my role as a reading specialist afforded the opportunity to facilitate conversations via the interviews with John and Rose to start the dialogue around science literacy instruction in science class, through this personalized professional development program.

5.1.3 Lessons Learned as a Professional Development Leader

During this research study, I learned many valuable lessons about what it meant to be a professional development leader. Regarding this, I wrote about events in my own journal that I felt were important for supporting teachers through professional development. At the beginning of my journal, I noted *the importance of meeting with the participants* regularly to explain the lessons and answer questions or take suggestions for future lessons (S 1-9-2). Also, I noted the importance of spending time explaining the contents of the kit with John and Rose (S 1-9-20). I spent time with them answering their questions on the kit and noted *the importance of ensuring the participants were comfortable teaching* the first lesson (S 1-13-20). I followed up with John and Rose the same day, after they had taught the lesson, to ensure everything went smoothly and to answer any questions they had (S 1-16-20). I noted that it was also important to reassure the participants during the lessons (S 1-16-20). In the same entry, I noted John had told me he was concerned about whether he was pacing the lessons too fast or too slow. I reassured him that the pacing was an estimate and was therefore flexible. I continued to have daily morning meetings with the participants and *found that frequent follow ups up at the end of the day to ensure the lessons went well and to answer any questions were crucial*.

In addition to these important lessons, I noted that *mentoring can beget mentoring*. Rose had told me she was mentoring John (S 1-24-20). She had been sharing materials she had created to accompany the kit and her experiences with the kit with John (S 2-20-20). Rose had started adding materials to the kit early on in the professional development. Rose told me that she had not mentored John in science instruction prior to the professional development. But as Rose and I worked together adding to and modifying lessons, she spent time working with John on how to implement the lessons. Rose always stayed a week ahead of John's lessons so that she could help him by explaining how to conduct the lessons and answer any of his questions. That was another positive aspect of the professional development because my working with Rose as a reading specialist opened the door for Rose to work with John to mentor him in science instruction and started a dialogue between the two on best practices in science teaching.

5.1.4 Impact of the Study

Not only will this study help future professionals, the PD has already impacted approximately 120 students in John and Rose's classrooms as a benefit from the enhanced lessons. I hope to expand the science literacy PD to other grade levels by working with other elementary science teachers at the school to create their own enhanced science literacy kits. Since the district has three elementary schools, there is also an opportunity for me to expand the kit's use to the other science teachers as well.

5.1.5 Challenges of Being a Reading Specialist and a Literacy Coach

There are challenges to being a reading specialist in addition to being a literacy coach. I was hired as a reading specialist but as my career has progressed, I also recognized the need for a literacy coach in the school. As in every school, there are a finite amount of funds to hire reading specialists and coaches. Since we have no literacy coaches in the school and because there was a need for PD in science literacy, I decided to take on an additional role as a literacy coach.

In addition to all schools facing a finite amount of funds, there is also a finite amount of time in the school day. I wanted to be considerate of John and Rose's time as well as ensuring they had the support to conduct science literacy lessons from the enhanced science kits which I had provided to them. Because it was very important to me to support the teachers and science literacy instruction, I found time in the day to work with John and Rose. I came in early, worked through my lunches and planning time, and at times stayed after to work with them. I based my availability on what times they had available and built a schedule week by week based on their availability. This type of work is challenging but I believe that when a topic or initiative is important to you, you can always find the time to make it work. John and Rose were kind enough to offer their time and participation in the study. As a teacher and a full-time research practitioner, I gave them my time and availability in return.

5.2 Implications

While qualitative research is not generalizable by design, there were aspects of the professional development that could change professional development in my own district. The professional development I have experienced in the past has been in the format of trainings led by administrators and guided by district-led initiatives. However, after this study, I believed even more so that there was value in personalized professional development for educators. My colleagues were able to find the juxtaposition at which our content areas intersect and then work together to improve our instruction. Since the area of professional development was personalized to our needs as educators and our skills sets, the work we engaged in became more meaningful than a prescribed professional development would have been in its place. Perhaps districts could learn from this study that not only are district-led professional development initiatives important, there is also value in teacher-driven, teacher-centered development and personalized professional development. Therefore if districts were able to provide the time, support, and funding for reading specialists and reading coaches in these roles, more initiatives that positively impact teacher instruction could be successfully implemented.

5.3 Limitations

Due to the qualitative nature of the study, the findings are not generalizable to populations of teachers and can only be used to provide general insights that may prove beneficial to other science teachers and reading specialists in the field. Limitations of the study included the small case study's participant population of two science teachers and myself, a reading specialist. Since the participants in the study were colleagues of mine, there was a possibility that John's and Rose's responses about their enjoyment of the kit could have been more favorable in nature.

5.4 Ideas for Future Research

For my own research and professional development, I plan on continuing my collaboration with John and Rose on future science literacy lessons. Both John and Rose have invested a considerable amount of time and effort in the science literacy lessons throughout the PD. I believe that the three of us working together can improve science literacy instruction as well as enhance future science kits for students.

In terms of ideas for future research after this study, it would be interesting to see how a personalized professional development in science literacy could work in a larger study and with different grade level participants, building more insights on science literacy and the impact of collaboration between reading specialists and elementary science teachers. It would also be interesting to gain insights into the viewpoints of a diverse collection of participants' perspectives on science literacy.

Appendix A Informed Consent Form for School District

Thank you for considering my research at the University of Pittsburgh on the ways in which reading specialists can support students in the elementary science classroom. My name is Brooke Stebler. I have been working with my advisor, Dr. Patricia Crawford, at the University of Pittsburgh. My research entails that I collaborate with two third grade science teachers to provide personalized professional development on science literacy. I would like to provide each of the two teachers a Unit Bin of materials (including trade books, hands-on teaching materials, and enhanced labs), teacher's guide, and lessons in the kit that work alongside our science textbook free of cost to the district. My goal is to provide scaffolding for students to increase science background knowledge, add more hands-on activities, use more technology, and increase student engagement and academic achievement when reading informational texts.

In order to learn teachers' opinions on what worked well from the kit, what did not work well, and what could be changed to improve it, I would like to interview the teachers four times during the process. I would also like the teachers to write in a journal after each lesson to record their thoughts on the kits. If the personalized professional development is successful, I would like to work with other grade levels to increase collaboration between reading specialists and content area teachers. I believe this relationship could be beneficial to both parties and most importantly the students.

Please contact me with any questions or concerns.

Sincerely,

Brooke Stebler

District Consent Signature: ____

Date: ____

Principal Investigator Signature: ______________________________________

Date: ____

Appendix B Baseline Interview of Participants

Each teacher was interviewed separately for 30 minutes. The interviews were audio-recorded for the purpose of accurately transcribing the interviews.

The interviewees were asked the same questions:

1. How many years have you been a teacher?
2. What levels have you taught (i.e. elementary, middle, high school)?
3. What content have you taught (i.e. science, English Language Arts, etc.)
4. What do you consider to be the features of effective science instruction?
5. What experiences are necessary for students to become successful in learning science?
6. What do you think would be effective instruction and what experiences are necessary for students to become successful readers?
7. What do you think are the most effective strategies for teaching science to students who could?
8. What are your thoughts about integrating science and literacy instruction? (Probe: What do you believe is the best way or ways to teach science and literacy)

Appendix C Weekly Interview of Subjects

The two science teachers were interviewed once a week for 15 minutes. The interviews were audio-recorded for the purpose of accurately transcribing the interviews.

The interviewees were asked this question each week:

Tell me about what went well, any surprises, and what could be changed about this weeks lessons.

During the final interview, each teacher was interviewed separately for 30 minutes. The interviewees were asked these questions:

1. What do you consider to be the features of effective science instruction?
2. What experiences are necessary for students to become successful in learning science?
3. What do you think would be effective instruction and what experiences are necessary for students to become successful readers?
4. What do you think are the most effective strategies for teaching science to students who could?
5. What are your thoughts about integrating science and literacy instruction? (Probe: What do you believe is the best way to teach science and literacy)
6. Was there a specific [integrated science literacy] lesson that you felt was particularly challenging, that your students may have misunderstood?
7. Was there a specific [integrated science literacy] lesson that you felt was particularly successful, that your students really understood?

Appendix D Teacher Journal Instructions

Please fill out the journal daily after each science lesson for all lessons. I appreciate your honest thoughts on the lessons. I would like to know what worked, what did not work, and what could be improved. In that way, we can work together after the lessons have concluded and adjust, add, or delete whatever is necessary to improve them for the benefit of the students. Any noticings, thoughts, surprises, and reactions to the lessons. Your feedback is valuable.

Sincerely,

Brooke Stebler

Appendix E Teacher-Binder Lessons

Appendix E.1 Introduction

You will be working on Unit Six, Topic One: Adaptations and Survival-Survival of Individuals from the Pearson Elevate Science Series. Topic One's Essential Question is: What happens to living things when their environments change? It was important to pick vocabulary that is both rigorous and matches the lesson content (Uccelli, Galloway, Barr, Meneses, & Dobbs, 2015). The unit vocabulary listed in the teacher's manual. I chose to replace some of the words listed in the commercially-produced teacher's manual with my own adapted teacher's binder. I changed some of the words to more challenging words because most third grade students have already mastered these words. For example, I replaced the word 'survive' with the more rigorous, content-specific vocabulary word 'biome'. Biome is a world they may not be familiar. It describes a community of animals that live in one particular habitat such as the plants and animals in a coral reef. Insectivore, herbivore, decomposer, and ecosystem will be important vocabulary when they start talking about making a frog habitat and the wetland ecosystem.

After editing the vocabulary list, I detailed each of the days in the lessons below. I listed the title, lesson goal, vocabulary word(s), and scaffolding tasks to build background knowledge. You will have a Unit Binder that includes all of the lessons and directions. You will also receive a Unit Bin with all of the lab materials and the trade books for the lessons. When considering additional scaffolding supports I provided in the binder, it was important to pick high-interest texts for instruction to accompany the basal text (Buckingham, 2013; Guthrie, 2004). All of the materials you will need to teach the lessons are in the bin. In addition, I included a supply list because some of the materials will need to be replenished the following year.

Appendix E.2 Week 1: Coral Reefs (Duration-3 Days)

Goal: Build students' background knowledge about the animals and plants that live in coral reefs.

Vocabulary Word: 'biome'-major habitat

Objective: Explain to students that a biome is a place where plants and animals live. The coral reef biome is one of the major habitats on the Earth. Today they will focus on identifying plants and animals that live in coral reefs.

Scaffolding Tasks:

Days 1-2, Task 1: Have students take out their notebooks and write at the top: Coral Reef Biome-Animals and Plants List. Tell students that as they watch the next video and share a book on coral reefs, they are to write down as many different animals and plants as possible that live in the coral reef biome. Show students the following websites or have them access the websites on their IPads/Chromebooks:

1. YouTube video: Coral Reefs 101 National Geographic: https://www.youtube.com/watch?v=ZiULxLLP32s,
2. Smithsonian's Bizarre and Beautiful Coral Reef Animals: https://ocean.si.edu/ocean-life/reptiles/bizarre-and-beautiful-coral-reef-animals
3. Tropical Reefs: https://reefguide.org/index1.html

4. Coral Reefs of the World-Map:

   https://databasin.org/datasets/b983863c0a1a41e8839383b40ade437d

Days 1-2, Task 2: Share with students the trade book National Geographic Readers: Coral Reefs, By: Kristin Rattini (Paperback-July 14, 2015). Have students continue to write in their student notebooks as many different living things as they can that live in coral reefs. After five minutes, have students share out the animals and plants they listed. Create a class list on paper and have the students use markers to add as many different animals and plants they found in the book and on the website. Have students put checkmarks next to animals and plants they have on their lists that another student mentioned first.

Day 3, Task 1: Review with students the names of the coral reef fish they found yesterday (on plants/animals). Glue paper in student notebook.

Day 3, Task 2: Put students in groups of 3-4 students. Give students set of coral reef fish cards and feeding strategies. Have students sort fish into three groups (pass out coral reef fish sorting paper): Generalized carnivores, Specialized Carnivores, and Herbivores (vocabulary – review that carnivores are meat eaters and herbivores are plant eaters; review that generalized carnivores means they can eat many different types of fish/prey; review that specialized carnivores means they can only eat one type of fish/prey; herbivores fish only eat plants. Encourage students to explain what made them put the students in each groups. Call students back together after 10-15 minutes and review answers of which fish belong in which groups. Display cards on document camera or chalkboard.

Answer Key:

Generalized Carnivore – Bluestripe Snapper, Moray Eels, Grouper (all three fish eat just about anything edible that they can swallow)

Specialized Carnivore – Titan Triggerfish (eats crustaceans like shrimp), Cardinalfish (eats crustaceans like shrimp), Barracuda (eats grouper)

Herbivore – Damselfishes (eats algae), Parrotfishes (eats plants growing on coral), Rabbitfishes (eats algae)

Photo Cards:

Bluestripe Snapper

[All Photo Cards Retrieved from: https://en.wikipedia.org/wiki/Coral_reef-fish]

Coral Reef Grouper

Cardinalfish

Damselfish

Moray Eel

Porcupinefish

Titan Triggerfish (largest fish in the image)

Parrotfish

Coral Rabbitfish

Appendix E.3 Week 2: Bird Beaks (Duration-3 Days)

Goal: Build students' background knowledge on the different types of bird beaks and how they are made to pick up specific types of food.

Scaffolding Tasks:

Day 1:

1. Task: Review how coral reef fish have different feeding strategies. Explain to students that some fish have teeth because they are carnivores and some fish have no teeth because they are herbivores and do not need them to eat plants. Explain that the shape of a fish's mouth is a made for the type of food they eat.
2. Task: Ask students: "What kinds of beaks students have seen (long, pointy, short, wide)." Explain that bird beaks are adapted to match the type of food they eat just like the fish they look at in the previous lesson have beaks and mouths that match their food type. For example, explain that clownfish's small mouth allows them to algae, zooplankton, worms, and small crustaceans. Then, tell students that it is the same with birds. Their beaks are shaped differently to allow them to eat different food. Some eat worms, some eat fish, some eat nectar, and some eat seeds. Explain the definition of adapted-a change that plants and animals make to survive in their environment. Many birds have tweezers-like beaks so they can reach and eat animals that burrow deep (Show students the tools they will be using for the lab as you talk about the beaks i.e. tweezers, chopsticks, spoons, etcetera). Some birds have scissor-like beaks that rip food apart into bite-sized pieces. Other birds have clothespin-shaped beaks that can crush the hard covering of seeds. Birds with spoon-like beaks can scoop up large numbers of small fish or strain plant material from mud. The different diets of birds allow them to live in the same area at the same time (coexist). This is why many types of birds feed together in one

area. Show beak types by using colored printouts of bird beaks and ask the students what kinds of birds have beaks are similar. For example, a spoon beak belongs to a mallard duck and a pelican.

Day 2:

1. Task: Bird Beak Lab-Use the printout, Figure 1.0 Fill the Bill, from the Alabama Outdoor Classroom Website https://www.washcoll.edu/live/files/4260-fill-the-bill to teach students about how each bird's beak is specially designed to pick up a particular type of food. Set up the Bird Beak Lab Stations according to the printout.

Fill the Bill Activity

Fill the Bill

ALABAMA OUTDOOR CLASSROOM ACTIVITY

Grade Levels
3-8

Overview
Students participate in eight activity stations that demonstrate how different types of beaks help birds eat specific types of food.

Subject Areas
Science, Art, Math

Duration
Prep: 15 minutes
Activity: 30 minutes

Learning Objectives
Students will describe different types of beaks and explain how each is adapted to feed on different foods.

Alabama Course of Study Objective Correlations for Science
Third: 3, 5, & 8
Fourth: 5 & 6
Fifth: 8 & 9
Seventh: 1, 5, 6, 7, & 8

Materials
- Fill the Bill worksheets (copies)
- 3 eyedroppers or straws
- 4 pairs of chopsticks
- 3 pliers (or nutcrackers)
- 2 large scoops (or slotted spoons)
- 3 strainers
- 3 envelopes (or small fishnets)
- 3 forceps (or tweezers)
- 3 tongs
- small log or piece of wood
- popcorn or tiny marshmallows
- rice & puffed rice
- 2 aquariums (or large bowls)
- fake worms (or grapes)
- oatmeal
- stemmed cherries (or cotton balls)
- tall, thin vase
- large saucepan
- walnuts (or other nuts)
- Styrofoam chunks
- String

Adapted from Ranger Rick's Nature Scope: Birds, Birds, Birds!

Background Info

It would be impossible for a hummingbird to gobble up a mouse. And it would be just as impossible for a hawk to slurp up some nectar from a flower. Each type of bird has a special beak and tongue adapted to eating a certain type of food. In this demonstration your group can find out which beaks are best for tearing, scooping, cracking, and picking by going to different stations you've set up and trying to find out which "tools" go with which types of "food."

Talk about different bird beaks to get the kids thinking about how beaks help birds survive. Here are some examples of birds and beaks you can talk about:
Hummingbirds have long hollow beaks that they use to probe flowers for nectar. The beak protects the tongue which slurps up the nectar.
Curlew, godwits, kiwis and snipes have very long beaks that they use to probe for worms, crustaceans, and other small creatures in mud and water.
Cardinals, sparrows, grosbeaks, and other finchlike birds have very short, conical beaks. The beaks are very strong and can break even tough seeds.
Spoonbills and pelicans have long, flattened or pouchlike beaks that they use to scoop up fish and other aquatic creatures.
Flamingos and some ducks have bills that act like strainers to filter tiny plants and animals from the water. (Only certain kinds of ducks are filter feeders.)
Nighthawks, whip-poor-wills, swifts, and swallows have large, gaping mouths that act like nets to trap insects. These birds catch insects on the wing.
Warblers have small, sharp, pointed beaks for eating insects from leaves, twigs & logs.
Toucans have very long, thick beaks for reaching out and plucking fruit from trees.

Preparation

You'll need to set up eight different stations, each with a special type of "food" that fits one of the eight different types of beaks we've described. And at each station you will need three different tools—one that fits the food and two that don't fit as well. Also, have a sign at each station that tells what type of food is represented. For example, have a sign that says "nectar" at Station #1, one that says "worms in the mud" at Station #2, and so on. Here's a list of food and tools for each station (the * indicates the tool that best fits the food).

Station #1: Water in a tall, thin vase to represent nectar in a flower. (hummingbirds). Tools include eyedropper or straw*, envelope or small fishnet, and large scoop or slotted spoon.

Station #2: Large saucepan filled with dry oatmeal and fake worms (or grapes) on the bottom to represent worms buried in the mud. (curlews, godwits, kiwis, & snipes) Tools include chopsticks*, nutcracker or pliers, and strainer.

Station #3: Whole walnuts or other nuts to represent seeds with hard coverings. (sparrows, cardinals, grosbeaks, & other finchlike birds) Tools include nutcracker or pliers*, tongs, and chopsticks.

Station #4: Styrofoam chunks floating in an aquarium filled with water to represent fish and other aquatic animals. (spoonbills & pelicans) Tools include large scoop or slotted spoon*, eyedropper or straw, and chopsticks.

Station #5: Puffed rice in an aquarium filled with water to represent tiny aquatic plants and animals. (flamingos & some ducks) Tools include strainer*, forceps or tweezers, and tongs.

Fill the Bill

ALABAMA OUTDOOR CLASSROOM ACTIVITY

Grade Levels
3-8

Alabama Course of Study Objective Correlations for Science
Third: 3, 5, & 8
Fourth: 5 & 6
Fifth: 8 & 9
Seventh: 1, 5, 6, 7, & 8

Outdoor Classroom Connections
Observe birds and their different types of beaks in your outdoor classroom's songbird habitat.

Literature Connections
⇒ *Bird* (DK Eyewitness) by David Burnie (ISBN: 10-0756606578)

Bird Field Guides
⇒ *National Audubon Society Field Guide to Southeast United States* (ISBN-10: 0679446834)
⇒ *The Sibley Field Guide to Birds of Eastern North America* by David Allen Sibley (ISBN: 067945120X)
⇒ *Birds of Alabama Field Guide* by Stan Tekiela *with Birds of Alabama Audio CD* (ISBN: 1591931517)

Project Learning Tree
⇒ *Charting Diversity*
⇒ *Planet Diversity*

Project WILD
⇒ *Which Niche*

Flying WILD
⇒ *Fill the Bill*
⇒ *Bird Buffet*

Discovering Alabama Videos
⇒ *Red-cockaded Woodpecker*

Preparation continued…

Station #6: Popcorn or tiny marshmallows tossed in the air (which must be caught while in the air) to represent flying insects. (nighthawks & whip-poor-wills) Tools include envelope or small fishnet*, forceps or tweezers, and chopsticks.

Station #7: Rice spread on a log to represent caterpillars and other insects. (warblers) Tools include forceps or tweezers*, envelope or small fishnet, and nutcracker or pliers.

Station #8: Cherries hanging from a string to represent fruit hanging from a branch. (toucans) Tools include tongs*, eyedropper or straw, and strainer.

Procedure

1. Pass out a copy of the Fill the Bill worksheet to each student.

2. Divide the class into eight teams and start each team at a different station.

3. Explain that there will be three different tools at each station, each of which represents a different type of bird beak function. Each group must decide which tool would most efficiently get the food at each station by trying out each tool. Once they pick the best tool, they should write the name of the tool on their worksheet in the appropriate square. (You might want to set a time limit for each station to keep the teams moving.)

4. Underneath the squares are pictures of different birds and their beaks. On the line under each picture, they should write the number of the square that represents the correct beak. For example, they should write "8" on the line under the toucan.

Assessment

▶ Review answers on worksheet.
▶ Discuss beak adaptations in general. Explain that many birds, after millions and millions of generations, have evolved very specialized beaks (beaks that can eat only one certain type of food). Ask the group how specialized beaks can help some birds stay alive. (A bird with a specialized beak can often eat a type of food that no other bird can eat.) Then ask how a specialized beak might hurt a bird. (If the bird's habitat changes and its food is no longer available, the bird might die because it can't eat anything else.) Explain that some birds, such as crows, have very versatile beaks which allow them to eat fruits, nuts, berries, dead animals, and even fish and small rodents.

Extension

Discuss the different foods (such as seed, suet, etc in your bird feeders) found in your outdoor classroom's bird habitat, the types of birds that eat those foods, and the types of beaks those birds have.

Bird Watcher's Name:______________________

Please write the name of the tool that works best at each station:

Station #1: ______________________	**Station #5:** ______________________
Station #2: ______________________	**Station #6:** ______________________
Station #3: ______________________	**Station #7:** ______________________
Station #4: ______________________	**Station #8:** ______________________

Please note which station best represents the birds below:

 Common Snipe: _____	 Hummingbird: _____
 Toucan: _____	 Yellow Warbler: _____
 Brown Pelican: _____	 Northern Shoveler: _____
 Northern Cardinal: _____	 Whip-poor-will: _____

Day 3:

1. Task: Review the lab by revealing the correct matches between birds and their beaks. Then, show students or have students use their IPads/Chromebooks to read about Different Types of Bird Beaks at DK Find Out: https://www.dkfindout.com/us/animals-and-nature/birds/types-beak/ and Types of Bird Beaks and their Uses at the Zoo Portraits: https://www.zooportraits.com/birds-different-beaks-functions/. Read the trade book, Bird Beaks, aloud to students and discuss the different type of beaks different birds have any the specific food each bird can each with their beak.

Appendix E.4 Week 3-Wetland Biome (Duration: 2 Days)

Goal: Build students' background knowledge about how food webs function and specifically how each member of the food web is dependent on the one before for survival.

Vocabulary Words:

1. ecosystem-organisms that live together and interact with their environment
2. food web-multiple food chains
3. wetland-land that is full of water such as a marsh or swamp
4. decomposer-organism that breaks down materials
5. herbivore-animal that eats plants
6. insectivore-animal that eats insects
7. omnivore-animal that can eat animals or plants

Scaffolding Tasks:

Day 1:

Task 1: Show or have students watch the following videos and slides on their IPads/ Chromebooks:

1. YouTube video of Food Chain Consumers Flow Chart: https://www.youtube.com/watch?v=hLq2datPo5M
2. SlideShare hierarchy of the plants and animals in the food web from the website https://www.slideshare.net/ireloro/wetlands-food-chain-food-webs
3. Wetland Ecosystem Food Web-example video: http://museum.wa/go.au/edu-whiteboards/explorefroghabitats.html

Task 2: Read and discuss the tradebook, specifically the chapter about wetlands, to students-Plants and Tree Ecosystems! From Wetlands to Forests – Botany for Kids, By: Left Brain Kids (Paperback – May 15, 2018).

Day 2:

Task: Wetlands Food Web Lab

Step 1 Directions: Take out the lime-colored cloth mat from the Unit Bin. Have the students help you spread the mat on the floor. Have the students sit in a rectangle around the mat. Take out the Wetlands Food Web Lab cards (See Figure 1.3) that are in a labeled bag in the Unit Bin as well as the picture cards in the bin (See Figure 1.4). Have the students help you spread them out in the middle of the mat. Use Figure 1.1 and 1.2 to guide your placement of the cards on the food web. It is okay if students put the cards in the wrong place. Use the guide to inform your students of the correct placements of the food web cards.

Step 2 Read Teacher's Script:

We have our mat which will be our wetland food web. Let's put our title, Wetland Ecosystems (blue card), at the top of the mat. Right under that we are going to put where energy comes from. Look at the yellow cards? Where does energy come from? (Sun/Soil-yellow card) Sun/Soil goes at the top of our web. Can you find the matching pictures that shows the sun? What is the purpose of sun and soil in our food web? Look at the red cards (Energy's Main Source). What white cards tell you what sun and soil does for our wetland ecosystem? (white cards #1-3)

What yellow card goes next? Where does the energy from the suns and nutrients from the soil transfer to? (Plants-yellow card) Let's put the plant card under our Sun/Soil's cards. Put the blue arrow pointing to the Plants cards. Can you find the matching picture of a plant? Now, we are going to sort the red cards. These cards show us if our main categories are producers, primary producers, consumers or decomposers. Plants and algae are all what? (Producers-red card). What roles do plants have as producers? Look at the white cards. (white cards #4-7)

Who eats the plants? Who does the energy from the plants transfer to? (Herbivores-yellow card). Let's put the Herbivores card under the Plants' cards. Put the blue arrow pointing to the Herbivores' card. Can you find the matching picture of a herbivore? What are herbivores' purpose in the food web? Do they produce, consume? Are they predators or prey? (Consumers and Prey-two red cards). What roles do herbivores have as consumers and prey. Look at the white cards. (white cards #9-10)

Who eats the herbivores? Whom does their energy transfer to? (Insectivores-yellow card). Let's put the Insectivores' card to the left of the Herbivores' card. Put the blue arrow pointing to the Insectivores' card. Can you find the matching picture of an insectivore? What is their role in the food web? Consumers, producers? (Primary Consumers-red card). What are insectivores' roles in the food web. Look at the white cards. (white cards #11-12)

Who eats insectivores? Whom does their energy transfer to? (Predators-orange card). Let's put the Predators' card above the Insectivores' cards. Put the blue arrow pointing to the Predators' card. Can you find the matching picture of a predator? Are they producers or consumers? (Secondary Consumers-red card) What are the predators' roles in the food web? Look at the white cards. (white card #13)

Where do predators' energy transfer to? (Fungi/Bacteria-yellow card) What is their main role in the food web? (Decomposers-red card) Let's put the Decomposers' card above the Predators' cards. Put the blue arrow pointing to the Decomposers' card. Can you find the matching picture of a decomposer? What roles do they play in the food web? Look at the white cards. (white cards #14-16)

Where does the decomposed material return to? (Soil-red card) Place a blue arrow back to Sun/Soil at the top. We have completed the cycle in the Wetland Food Web.

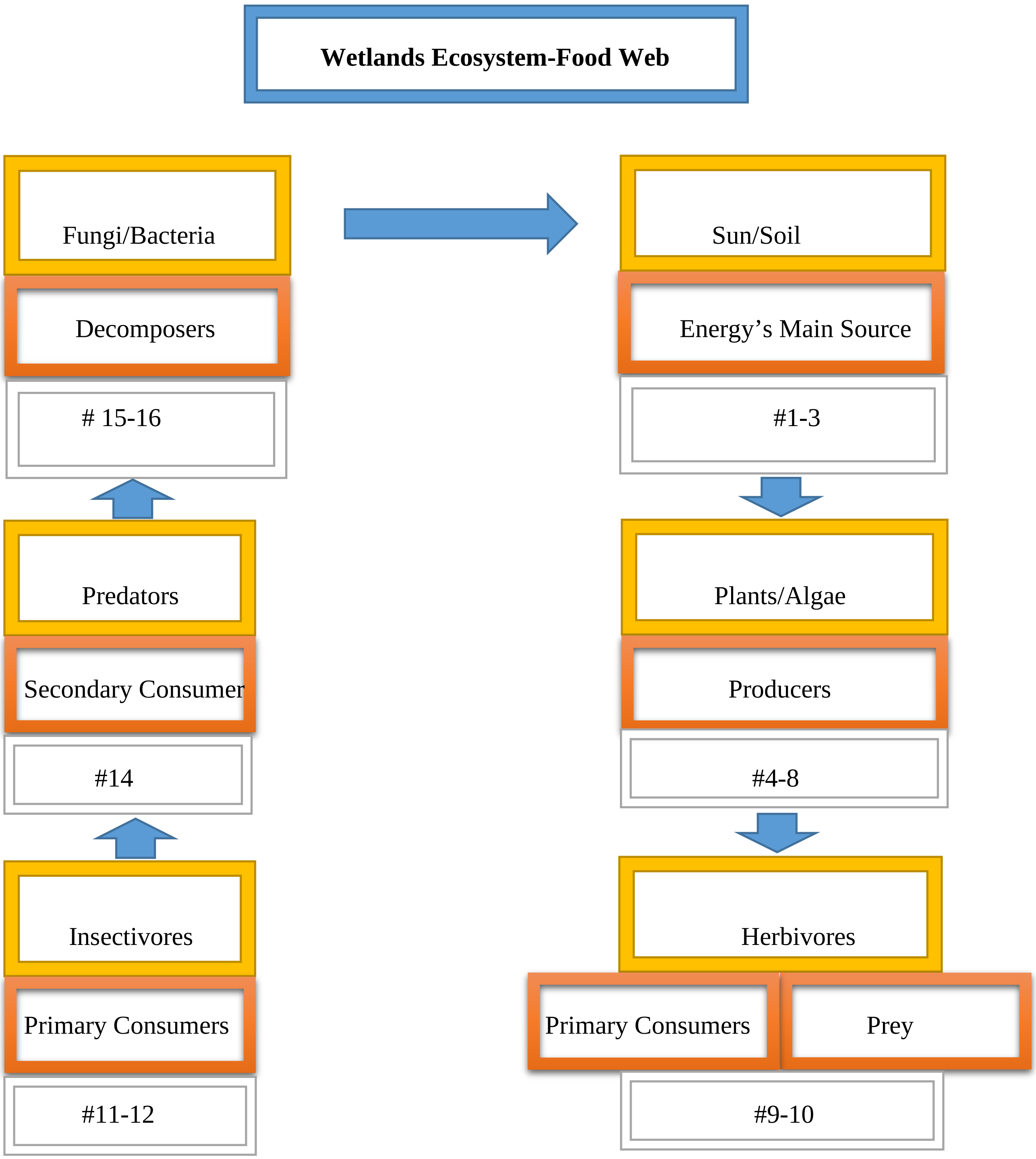

Figure 1 Wetlands Ecosystem Food Web-Diagram

Wetlands Ecosystem Food Web-Flowchart of Cards

(red, orange, white cards)

Sun/Soil (yellow card) > Energy's Main Source (red card) >White Cards #1-3

Plants/Algae (yellow card) > Producers (red card) > White cards #4-8

Herbivores (yellow card) > Consumers and Prey (two red cards) > White cards #9-10

Insectivores (yellow card) > Primary Consumers (red card) > White cards#11-12

Predators (yellow card) > Secondary Consumers (red card) > White card #13

Fungi/Bacteria (yellow card) > Decomposers (red card) > White cards #14-15

Wetlands Ecosystem Food Web-White Cards List

1. It provides light and energy for plants so they can make their own food.
2. It provides warmth for cold-blooded animals.
3. It provides nutrients for plants.
4. They give animals energy (food) from the sun. They give off carbon dioxide for animals to breathe.
5. They produce their own food through photosynthesis. This food gets passed down to herbivores, then insectivores, and then carnivores.
6. They stop erosion from happening.
7. They feed the herbivores and they provide shelter for small insects and frogs.

    8. They give off oxygen in the air and water so land and water animals can survive.

8. They digest the plants' nutrients.
9. They are food for insectivores.
10. Tadpoles are insectivores.

11. Insectivores eat mainly insects. They can be animals or carnivorous plants like Venus fly traps.

12. Carnivores are predators. They eat meat and prey on insectivores.

13. They also include bacteria and some invertebrate organisms.

14. Fungi are decomposers are nature's garbage disposers and keep the environment clean.

Wetlands Ecosystem Food Web-White Cards to Cut-Out for Mat

It provides light and energy for plants so they can make their own food.

It provides warmth for cold-blooded animals.

It provides nutrients for plants.

They give animals energy (food) from the sun. They give off carbon dioxide for animals to breathe.

They produce their own food through photosynthesis. This food gets passed down to herbivores, then insectivores, and then carnivores.

They stop erosion from occurring.

They feed the herbivores and they provide shelter for small insects and frogs.

They give off oxygen in the air and water so land and water animals can survive.

They digest the plants' nutrients.

They are food for insectivores.

Tadpoles are insectivores.

Insectivores eat mainly insects. They can be animals or carnivorous plants like Venus fly traps.

Carnivores are predators. They eat meat and prey on insectivores.

They also include bacteria and some invertebrate organisms.

Fungi are decomposers are nature's garbage disposers and keep the environment clean.

Wetlands Ecosystem Food Web-Photo Cards for Mat

Retrieved from: [https://www.pexels.com/search/animal/] on 1/19/19

*Students put corresponding pictures under yellow cards.

Sun/Soil-Provides light and nutrients to plants

Lilypad-Collects sunlight and produces food through photosynthesis.

Brown Tree Frog-Diet: Crickets, grasshoppers

Raccoon-Diet: frogs, fish, birds

Brown Mushroom-Breaks down materials.

Appendix E.5 Week 4: Frog Habitat (Duration: 2 Days)

Goal: Build students' background knowledge about frog habitats.

Vocabulary Words:

1. habitat-an animal's or plant's home
2. substrate-material that an animal or plant lives on top of

Scaffolding Tasks:

Day 1:

Task 1: Teacher talks with students about how in the Wetland Food Web Lab, they learned about how members of the web depend on the one before in the web for survival. It is the same with frogs. Frogs require several things to survive.

Task 2: Share or have students watch:

1. YouTube Video from Shedd's Aquarium on Frog Types:

   https://www.youtube.com/watch?v=aeTMNTywZZg

2. The San Diego Zoo's Website on Frog's and Toad's Habitat:

   https://animals.sandiegozoo.org/animals/frog-and-toad

3. YouTube Pet Store Video on How to Make a Tree Frog Habitat:

   https://www.youtube.com/watch?v=d8WqFbW1UcA

Task 3: Read aloud the habitat chapter from the trade book:

1. Everything You Need to Know About Frogs and Other Slippery Creatures, By: Carrie Love (Paperback – August 1, 2011)

Task 4: Teacher tells students they are going to make their own man-made frog habitat using materials in the Unit Bin. Tell students there are many materials in the bin and to only pick out materials that frogs need to survive (teacher can put in various materials that are not needed by frogs for survival such as cotton balls). See Figure 1.5 for the supply list for this activity.

Appendix E.5.1 Frog Habitat Supply List

1. Shoeboxes/container to serve as aquarium habitat.
2. Substrate such as coconut husk shavings from pet store.
3. Plastic dish
4. Artificial Plants
5. Artificial Crickets/Insects
6. Several items such as cotton balls that frogs do not need to survive.

Appendix E.6 Transcribed Interviews

Appendix E.6.1 Interview #1 with John-Before the Lessons Start

Researcher: "This is interview one for the preinterview. Today is January 10th, 2020. How are you doing?"

John: "I'm doing great. How are you?"

Researcher: "Good. Question #1: How many years have you been a teacher."

John: "21 years."

Researcher: "Have you taught the elementary for third grade the whole time or have you taught other subjects?"

John: "I've taught other subjects. I have also taught at different levels. I've been at the elementary, started at high school with special ed. and then went to the middle school for sixth grade. That was language arts and math and down here at the elementary. I've taught reading, math, science, social studies, and health.

Researcher: "Then, how many years have you taught each?"

John: "Okay, high school was three years, middle school was three years, so that leaves me with the (pause)."

Researcher: "Remainder here?"

John: "Remainder."

Researcher: "Okay and how many years have you taught science? Because I know we used to have science, we used to teach all the subjects and then we departmentalized"

John: "This is my first year back so the last three I didn't (teach science). So that would be thirteen years.

Researcher: “Okay.”

John: “Thirteen years.”

Researcher: “Thirteen years teaching science?”

John: “At the third grade level.”

Researcher: “When you’re teaching science, what do you think are the important features of effective science instruction?”

John: “Something that’s hands-on, inquiry-based, engages the students something that builds confidence in them through participating, something that’s definitely concrete and abstract concepts.”

Researcher: “Can you tell me a little more about what you would consider concrete science and what you would consider abstract science?”

John: “Concrete, let’s see something with dealing with their (pause). Do you want a specific example?”

Researcher: “Yes, it would probably be easier if you just tell me about a lesson when you did something concrete and when you did something abstract.”

John: “I would say with the rocks and minerals where they had to do scratch tests, and they use a nail and they scratch to see the toughness of the mineral. The abstract I would say would be writing the report about the follow-up with that about what they’re findings were.

Researcher: “What have you found, is more difficult for them to do? The writing or the lab?”

John: “Definitely the lab in third grade. Uh, no, no, I mean the writing the report, the follow-up. Just, they have the information. It’s just in third grade, it’s with (pause), the putting it into sentences and how to say it.”

Researcher: "Okay, and then what experiences are necessary for students to become successful in learning science?"

John: "They definitely have to follow directions, written and verbal directions, able to take notes. They have to have a I think a little bit of a background in math. Also, they definitely have to have a background in reading and be able to work well with others in groups."

Researcher: "So some social skills?"

John: "Oh, definitely."

Researcher: "So, that was about science. What do you think about reading? So you were talking about reading and writing, what do you think they (students) need to be successful readers when they are reading about science or they're writing about science?"

John: "They definitely have to have comprehension skills, a good reading fluency. They have to be able to, I think, ask questions as they are reading, ask questions to themselves, not just the ones that are in the book that they have to answer. They need to be thinking of questions ahead."

Researcher: "Okay then, any strategies when teaching science that helps students? Or maybe some of your students that need extra practice in reading? Anything that seems to help them?"

John: "Hands-on things, graphic organizers, definitely visual clues, maybe word wall or thinking maps."

Researcher: "Then are their arrangements when you place kids in partners or groups, or do some kids work by themselves?"

John: “Yes, sometimes it’s good to pair up two brighter students so they push each other. Sometimes, it’s better to pair up a brighter student maybe with a student that is struggling so that they can teach them some way differently than I am teaching them or explain it different.”

Researcher: “So there’s an intersection there you talked about with writing and science, what are your thoughts about that?

John: “I think they go hand in hand, you can’t have science without knowing how to read. Definitely, I think it’s a crossover there and I think it’s a great thing when you transfer some of things you do in reading to science and the same thing is that you bring in science into the reading lesson.”

Researcher: “Do you ever collaborate with the reading teacher or remember things from when you taught reading that you use in science that you know are third grade skills that they need to have?”

John: “That I don’t. The reading, they have their curriculum and they kind of stick to it.”

Researcher: “Do you find that you tie in more math and science because you’re the teacher of both.”

John: “Oh, definitely.”

Researcher: “Because you know what they’re learning right now.”

John: “Yes. And I know what they are capable of doing in science. So if something asks a specific measurement or something like that in science, I make sure I cover that in math class before we get to the science part.”

Researcher: “Do you find that it’s helpful because remember it more because they are doing it in both classes?”

John: “Yes, yes, it’s definitely a cross-over, they transfer that information and becomes hands-on. We do some hands-on things in math, but when they see it also happening in a different subject, I definitely think that enhances the skill.”

Researcher: “And you know what they’re doing in both because you’re teaching it.”

John: “Exactly. And it’s may be a lot easier because the words that I use to teach it, I know how I said it to them, also that can transfer to science.”

Researcher: “What are your thoughts on integrating science and literacy. Do you have in your current science program books that accompany it?”

John: “The students have workbooks.”

Researcher: “To clarify, there’s no books besides the textbook?”

John: “Just the textbook.”

Researcher: “I know you talked about bringing in some activities you do and some real-life applications like talking about fishing when discussing fish. Do you ever bring a book to read to them or anything from the library?”

John: “I used to with the rocks and minerals with the old ASSET kit that we used to have. I am new to this so is my first go-round so and I haven’t been trained on it so to be honest trying this one lesson at a time and get through the lessons that they have there. I am hoping to become more creative as the time goes on but no I haven’t been able to bring any books in with it.”

Researcher: “And this is year one, just getting started and getting things organized and what the content is after being out of it for a couple of years can be challenging.”

Teacher #1: “Yes.”

Researcher: “Thank you very much. This is the end of the interview.”

Appendix E.6.2 Interview #1 with Rose-Before the Lessons Start

Researcher: "This is interview one for the preinterview. Today is January 10th, 2020. How are you doing?"

Rose: "I'm good."

Researcher: "Good. How many years have you been teaching?"

Rose: "About 13."

Researcher: "Has it all been in third grade?"

Rose: "I taught fourth grade for two years and then the rest has been third grade."

Researcher: "And when you were in fourth grade was it departmentalized?"

Rose: "No."

Researcher: "So, you taught all the subjects?"

Rose: "Yes."

Researcher: "Then for third grade, how many years have you taught science? [Probe] When you first started you probably taught multi-subjects?"

Rose: "(pause) I'm trying to think how long we've been departmentalized. I want to say, maybe like nine or so years."

Researcher: "So the whole time (career) you've always taught science?"

Rose: "Yes."

Researcher: "Okay, just to clarify. And all your teaching has been in elementary school?"

Rose: "Yes, in third and fourth."

Researcher: "Same building?"

Rose: "Yes."

Researcher: "What do you think are the features of effective science instruction?"

Rose: “I definitely think it should be hands-on, student-centered, engaging, not reading from a book the entire time, just the hands-on experiments and labs for sure. Students need to be engaged.”

Researcher: “What experiences are necessary for students to feel successful in learning science? [Probe] What does it look like in your room”

Rose: “The first thing is it should be connected to their real, to their own lives in some sort of way. Especially in my class, the make-up of my home room I have so many ESL students, and they don’t come with a lot of background knowledge on certain subjects, kind of like we were talking about yesterday with the frogs. What does a frog need to live? Well, they don’t know. Trying to make some connections to their own life. They need a lot of extra background knowledge in certain things, certain topics.”

Researcher: “What do you think effective science instruction looks like to make students be successful readers?

Rose: “Well, I use some of the same strategies and they kind of overlap. Like with vocabulary words for example, I always introduce them whether it’s ELA or science. And then, we do these picture boxes. I just they’re really beneficial for the ESL kids, special ed. kids.

Researcher: “Can you tell me what a picture box is?”

Rose: “They write the word and then they draw the picture of that word. So it’s really to understand what it is. And then, they put the definition in their own words. So it just helps them get a visual. So like the word ‘atmosphere’, so it can be a little tricky to explain it but once we draw a picture of the Earth, and then they show the atmosphere as a blanket that wraps around it, they get a better understanding of the word.”

Researcher: "I know we had ASSET and now we have a Pearson textbook, have you with either brought in any of your own materials?"

Rose: "Oh, yes."

Researcher: "What kind of things did you bring in with ASSET?"

Rose: "Well, I feel like we went from one extreme to the other. With ASSET having no text at all to look at to Pearson which is all text. The labs are crummy. I was just trying to always pull resources like reading material. We were studying rocks and minerals. I would try to get books from Scholastic on rocks and minerals."

Researcher: "Then with Pearson, you have a text. Do you find that the text is sufficient or do you bring in books with that too?"

Rose: "The text is very dull. So, I don't use it that much to be honest. The lab is dull. The text is dull. It doesn't put the vocabulary in student-friendly terms. So, I just go off of it and do my own thing."

Researcher: "So the kids like that? Do they seem more receptive about science when you do just the textbook or when you add some extra things?"

Rose: "Definitely when I add some extra things."

Researcher: "And they seem to learn that (science content) better?"

Rose: "Yes, and I've been redoing all the labs because the labs are pitiful in the Pearson series."

Researcher: "Have you done them the way the books says and done them your way? Or you just knew when you looked at it and said, I need to do this?"

Rose: "Last year, I did the labs the way they were in the book and it was our first year of having the curriculum and they were, they just did not work, they were not relative to what we were learning. They (students) did not get anything out of the labs. This year I'm just going step by step and I'm just trying to plan the labs that's related to what they're supposed to be learning."

Researcher: "How do you know if it's working or not working? Is that based on a test grade or is that based on kids talking about science and you know they mastered this skill because they came up with this science idea?"

Rose: "Just talking with them, I'm not just basing it on the test, and just seeing what they come up with from these labs."

Researcher: "Do you like the test they gave you? Or do you add to the test?"

Rose: "I do add to the test, like a couple extra pages."

Researcher: "Since you teach ELA and science, do you think that science, you should just be teaching science or ELA or are you able to use, I know they are learning this in ELA or I know they need help in this so when I do science?"

Rose: "Just definitely be interconnected."

Researcher: "How do you do that? What do you do that's not in the textbook that you said I know this in ELA and I know they're going to need this when they go to science?"

Rose: "Probably the biggest thing is with their writing because their writing is always a struggle in third grade. Even just writing complete sentences if they're doing a lab sheet and we're reflecting on something, they need to tell me in a good, solid paragraph what was you know the result what did they see and write it in a paragraph. Where I don't know if other science teachers that don't teach ELA and they might just have them write a couple notes, but I make them write a paragraph."

Researcher: "Since you have them for both, do you see any benefits when you go back to reading class when you say, okay we did something in science and now that we're reading, it's helping them? [Probe] I know you said reading is helping science is science helping reading at all?"

Rose: "Well, (pause) when we are reading something non-fiction, yes, definitely. So, just making that connection like remember when we were talking about this in science class, so this article we are reading is just making that connection for them."

Researcher: "Is that what you meant before when you were saying background knowledge and giving them that extra information?"

Rose: "Right, right, correct, exactly."

Researcher: "Thank you so much. That is the end of the interview."

Appendix E.6.3 Interview #2 with John-After the Coral Reef Lessons

Researcher: "Good afternoon."

John: "Good afternoon."

Researcher: "Today is Tuesday, January 31, 2020, and this is interview #2. I wanted to ask you how the Coral Reefs Website Lesson (1) went. I know you have two different classes. I did not know if there was anything different between them (classes), or anything particular that worked well, or any suggestions you had?"

John: "I think the second class went better of course because it was the second time I was teaching it. Both classes really enjoyed it. They enjoyed working together with an IPad. They enjoying teaming up, writing down all of the different kinds of fish and really enjoyed the videos and the colorful pictures of the fish."

Researcher: "Is that similar to what you did in ASSET (Science) before the last time you taught science? Did they have things similar to that in ASSET, or was it more lab-based or websites to go on?"

John: "I kind of liked this a little bit better. We used some technology which the kids are familiar with. The kids were more excited."

Researcher: "Do you think it was because the new-ness of the technology in their hands, or being able to watch videos, or just doing it (lesson) in more than one way?"

John: "The use of technology, the kids definitely enjoyed. I think dealing with animals too was a factor in that was the ASSET was hands-on but was kind of a dry hands-on thing. I thought this (new lesson) with videos and pictures was better."

Researcher: "How did lesson 2 on feeding strategies go?"

John: "It was awesome. Again, with the hands-on using the little fish (manipulatives) and the pictures, the kids…lots of excitement in the classroom. The kids touching the little fish and figuring it out. By the end, students were able to pick (feeding strategies) and they did a lot better than I thought they were going to do."

Researcher: "They were able to give a concrete reason why instead of saying 'I think so'?"

John: "Yes. When we had to write a sentence, usually the students complain and it's like pulling teeth, but it was very easy this time. In fact, I allowed them to talk in the classroom because the excitement was still there saying 'I'm going to write about this' or saying "I'm going to write about that'."

Researcher: "Did any go past the sentence (writing more than a sentence)?"

John: "Many. They did, close to half the class wrote more."

Researcher: "Do you think your fishing experience and talking about that kind of piqued their interest in fish? Or was it more about the colors and the fish types?"

John: "Yes, because I didn't bring much at all about me fishing or anything like that. It was on what videos they've seen and the pictures. Just the lesson and general."

Researcher: "Thank you. This concludes interview #2."

Appendix E.6.4 Interview #2 with Rose-After the Coral Reef Lessons

Researcher: "Good morning."

Rose: "Good morning."

Researcher: "It is Friday, January 17, 2020. Today is interview two. I just had a couple questions. I know you've been doing Coral Reefs this week and I just wanted to know how the websites visits went and how the feeding strategies went. I know you just started feeding strategies yesterday and you're going to continue that today (with class 2). Basically, we can start with websites, what went well, what you liked?"

Rose: "The first time I did it with my own homeroom, I introduced biomes, what a coral reef biome is I kind of just let them, showed them how to get on the websites with the bookmarked tabs and they just went to town. They started exploring. And there were a lot of kids that came up with questions like, 'Well how do I find the plants? How do I find this or that?' So I made a note for next time that I will with class 2 before I even pass out the IPads, I'm going to show them on my screen (projector screen) and how to navigate each page and go through the tabs on that."

Researcher: "Was there a particular website the kids liked the best?"

Rose: “They liked the reef guide with all the pictures. They enjoyed it, they loved it, and then we came back together and looked at the map website and we were talking about what the places with the coral reefs have in common and then we finally came to the conclusion that coral reefs are along the equator where it is hot and so they came to that conclusion so that was good.”

Researcher: “In third grade, you do continents?”

Rose: “In social studies.”

Researcher: “Have they done them already?”

Rose: “Yes, in the beginning of the year.”

Researcher: “Do you think it helped at all with understanding where the coral reefs were and looking at the map versus if this lesson had been done before they learned that (the continents)?”

Rose: “Yes, I would definitely do that. They were able to find Florida and it is hot and there were certain places they could point out and they knew it was hot there. So it was good. They loved it.”

Researcher: “I know you just started feeding strategies yesterday with the first group. How did that go?”

Rose: “It went well. I put them around the room and gave them their little packet (fish manipulatives) and introduced the three feeding strategies (pointed to flip chart of the strategies that she made with the students) so we got into that. We did some highlighting in the passage that we did that you gave us. I wanted to make sure they really understood what those three words were (referring to generalized carnivore, specialized carnivore, and herbivore) before I let them loose. Then, they went around (pointed to colored fish posters around the room) and it took a while with their clipboards and looking at pictures and came up with pretty good inferences.”

Researcher: “Did they write in complete sentences?”

Rose: “Yes.”

Researcher: “Did you have to remind them much?”

Rose: “At the beginning of class like I always do, but, it went well. And they really wanted to know the answers at the end so, I went one by one and showed them the answers and they were like ‘Yes!’ or ‘Hurray’ or “Oh’.”

Researcher: “And they were surprised?”

Rose: “Yes. There were some that I know I was surprised by and I told them, I would have guessed this. So today, I’m supposed to do this lesson again so with the second class. Well, I definitely had to adapt this packet because the second class includes special ed. students. So, I wrote the reasons and they just have to circle them instead of writing them.”

Researcher: “Did you have all of your students write the same way as they do in ELA?”

Rose: “Yes, they had to write ‘I think it is this type of fish because blank.”

Researcher: “Do you think it helped because you are their ELA teacher because you knew what each kid was capable of doing?”

Rose: “Yes, I tell them all the time that just because it’s science class, we can’t forget everything we’ve done in ELA. I tell them that all the time.”

Researcher: “This concludes interview #2.”

Appendix E.6.5 Interview 3 with John-After the Bird Beaks Lessons

Researcher: Good morning.

John: Good morning.

Researcher: I wanted to ask you about how bird beaks went. We can start with the first section, the lab.

John: The lab, the kids really enjoyed it. It was very hands-on. I thought the kids got more out of it. In fact, the day after when we didn't do the lab, the kids were disappointed that we weren't doing it again. I thought it went really well. I thought it was really realistic and set them up for pretending to be a bird. They got to feel and see how that went.

Researcher: How well did they do at picking out the tools and matching them to the birds?

John: Some of them were a little more difficult than the first one I set up where they had to get the water out for the hummingbird. That one was tough because they kept wanting to dip the chopsticks in and turn the bottle to the side. But, they can't. And they thought that the chopsticks working because they were able to dip them in the nectar. I later explained that yes, they were able to touch the water but would it be enough food for the bird to survive on it.

Researcher: The next day went into the pictures and the students' picking the bird diets.

John: It was the same birds as the lab and the light went off then. The students said, "Oh, yes," and they started using the pictures. They were able to associate the bird with the diet.

Researcher: How did they do at identifying the birds?

John: They were able to identify almost all of them. I prompted them to think back to the different stations saying, "What bird do you think would belong to that station? What type of beak was your tool?" They did pretty well with that.

Researcher: Were they familiar with any of the types of bird beaks before?

John: The hummingbird of course they knew, and the cardinal. They knew those but I bet if I would have asked them to draw me their beak, they couldn't have. And if I would have asked them what do they eat, they would have had no idea.

Researcher: The book and the interactive videos, how did that go?

John: It was great and the book was really nice. The kids really enjoyed going on to the DK Find Out Website. I had them take the quiz as a pretest and then research the birds. After they looked at each bird, I had them take the quiz again. Almost every single student had a ten out of ten the second time.

Researcher: What are your thoughts on the pacing and order of the Bird Beaks lessons?

John: I did the like order. It was good that they did the hands-on lab first. I am not sure if they would have taken the lab as seriously if they had the bird pictures first. Usually when I'm giving them information, I'm giving them the answers to what they're supposed to be getting from the lab. Whereas the lab came first so, they got their true answers from inquiry rather than me telling them.

Researcher: Thank you. This is the end of the interview.

Appendix E.6.6 Interview #3 with Rose-After the Bird Beaks Lessons

Researcher: Good Morning.

Rose: Good Morning. It is Thursday January 23rd.

Researcher: I wanted to talk about Bird Beaks Lessons today and what happened when you did the lab.

Rose: The stations, they loved them. Yes, they had a blast doing them and they just went through them. I made station cards that they could know what each station was. Station one was nectar with the flower just so they could have a little background on what each one represented.

Researcher: How did they respond to the lab?

Rose: They loved it. It took a longer time than I thought. It took sixty minutes for them to do it, know why they were doing it, and actually doing it.

Researcher: Did you label the food at each station?

Rose: The food, and then they had to guess the bird.

Researcher: The next day, you had the packet with the pictures of the birds and they had to pick their diet. How did they do with that?

Rose: It was good because they were able to use what they learned from the stations and apply it, for some of them not all, for guessing the diet. For example, they remembered the toucan was the fruit-eating one because they were picking the berries off the tree. And they remembered it for the next one, that it was a frugivorous bird. It was nice seeing them apply that knowledge.

Researcher: The last one was the DK Find Out website with the quiz and Bird Beaks book. How did that go?

Rose: It was good. We did that on the third day, read the book and then went to that site, DK Find Out. We read a little bit and took the quiz. They were really excited about the quiz. I let them explore on that site because there was a lot of information about birds and so many topics they could look up.

Researcher: Thank you, this is the end of the interview.

Appendix E.6.7 Interview #4 with John-After the Wetlands Lessons

Researcher: Good morning.

John: Good morning.

Researcher: Please tell me about the Wetlands Lessons: both the book and the Wetlands Food Web Task.

John: The kids enjoyed it. Because it's something different for me to read to them since I'm their math teacher. With ASSET Science, we never had a book to read to them. So, it's been a long time since I read to them. They enjoy listening to me and we get to come up to the front carpet and it's something different. It gets them out of their seats and they enjoy it.

Researcher: How did the Wetlands Food Web Task go?

John: That went pretty well. I had it on the front board and then we put the first set of guide cards up there. From that point, I had different students come up and they put up the cards without me giving them any guidance. I said, "Go ahead, you put the orange cards where you think that they belong. We turned it into a game. I asked them, "Is everything correct up here? What do you think?" Most of it was correct, we had had to adjust a few cards. Then, we went to the picture cards using the same process. I taped them to the board and had students come up. I said, "Go ahead and put them where you think they belong." They placed them. Then I asked, "Does anyone disagree with them?" The kids had a lot of fun with that because it was interactive where they were all working together as a class. They were saying, "No, that's not right. No, put it back." So then, there was a lot of discussion that went along with it. I said, "Why don't you think it belongs there? What do you think belongs there?" There was a lot of discussion and I think the kids enjoyed it.

Researcher: Did you push them along if they were going the wrong direction?

John: I did that only when the entire class was totally wrong about it. Then I would say, "Do you really think this one fits here?" I would try to push it that way. But as long as there was someone else that was trying to adjust it, I let them go.

Researcher: This is the end of the interview.

Appendix E.6.8 Interview #4 with Rose-After the Wetlands Lessons

Researcher: Good Morning.

Rose: Good Morning. It is Thursday, February 13th.

Researcher: I wanted to talk to today about how the Wetlands Lessons went.

Rose: I put the orange cards first on the swamp mat. Then, I hung up the yellow cards on the chalkboard and the white cards on the white board so they could see all of them spread out. The class before, I went over what all the vocabulary words meant like decomposer and primary consumer to give them a little background knowledge. They were able to pick them right out and place them in the right spots. It was good. The only thing I suggested to you was for everyone to have a recording sheet so that as we went, they would have something to record the information on. This would help them focus on the lesson.

Researcher: I know I made that edit. Because of your suggestion, I made a recording sheet and put it in the study guide and as a tested part of the unit test. Now prior to this lesson, you made picture boxes for the vocabulary in this lesson?

Rose: The class before this lesson, they did a little research on wetlands to get a little knowledge about the plants and animals that live there. They learned about Everglades in social studies before the lesson. So when they came into science class, it expanded on the knowledge they already had. I told them that wetlands are not just in Florida in the Everglades. They are actually all over the world. Then, we did the vocabulary sheet which was the picture boxes. I did this before because there were a lot of words they never heard of before that I wanted to give them a little background on.

Researcher: This is the end of the interview.

Appendix E.6.9 Interview #5 with John-After the Frog Habitat Lessons

Researcher: Good morning.

John: Good morning.

Researcher: Today, I am going to ask you about the Frog Habitat Lessons. How did that go starting with the frog book you read to them?

John: The kids enjoyed it. I told them it was a lead up to them making a frog habitat. I told them to pay attention to the book and they were really excited about the habitat. When it came to reading about the frogs, I pointed it several things to make sure they were paying attention. They were really excited both about the frog habitat and the reading of the book too.

Researcher: How did they like the videos of the frogs?

John: They liked it. I had them use the Chromebooks and watch the videos online in pairs. They were having different reactions as I was walking around the classroom because they were at different points in the videos. They enjoyed them.

Researcher: How did the building of the frog habitat lesson go?

John: They went great. They were so much more creative than I thought. I told them to use the shoeboxes. I had a bunch of kids that asked to not use the box and make a 3-D habitat. I was expecting the kids to have it pasted down flat on their paper and so making of them were making trees that were standing up. They were making frogs, waterfalls, and caves. They were rolling up paper to make trees or logs that had fallen down. Then, they were putting the frog on top of the log or underneath. There were rocks that they were putting frogs under. It has been great.

Researcher: This is the end of the interview.

Appendix E.6.10 Interview #5 with Rose-After the Frog Habitat Lessons

Researcher: Good morning.

Rose: Good morning.

Researcher: If you could talk to me about how the frog book and websites lesson went. Then, you can tell me how the building a frog habitat lesson went.

Rose: The first day, we look at the frog website and I told them that as they watch the videos, pay close attention to what you see in the frog habitat. Then, they had to record what they saw on the videos on a recording sheet. When all the videos were done, we came together and I showed them the frog book. We brainstormed together all of the things that they saw in the frog's habitat book and also the websites. We made a big list and they went back to the recording sheet we had made and sketched out what they wanted their frog habitat to look like. It put them in the right mindset to make the habitat. The next day, we made the habitat with all of the materials you provided. They loved it. They had so much fun. They were so excited they got to keep their plastic frog, you would have thought I handed each of them a million dollars.

Researcher: This is the end of the interview.

Appendix E.6.11 Interview 6 with John-After All of the Lessons

Researcher: Hello, John.

John: Hello.

Researcher: What do you consider to be the features of effective science instruction?

John: Students are able to summarize and ask questions on their own. The teacher has a hands-off approach and lets the students get their answers based on the information in front of them.

Researcher: What experiences are necessary for students to become successful in learning science?

John: They have to have a good reading fluency and comprehension. They of course have to have math. They have to be able to ask questions and summarize.

Researcher: What do you think would be effective instruction and what experiences are necessary for students to become successful readers?

John: They need to be able to summarize what they are reading and have good comprehension skills. They need to have a good vocabulary.

Researcher: What do you think are the most effective strategies for teaching science to students?

John: I use a hands-on approach. We read together. Then, I talk about what they are supposed to learn from this lesson. They need to demonstrate what they learn during their experiments.

Researcher: What are your thoughts about integrating science and literacy instruction?

John: They definitely need to be together. You find stories based on the science lessons. You can integrate the stories into the science lessons.

Researcher: Was there a specific [integrated science literacy] lesson that you felt was particularly challenging, that your students may have misunderstood?

John: The Wetlands Lessons were the most challenging. The students understood it but it would have been better if I had them work in pairs or groups since they wanted to shout out the answers. Some of the other students needed more think time. I would have liked to give groups of students their own cards and mats to work with.

Researcher: Was there a specific [integrated science literacy] lesson that you felt was particularly successful, that your students really understood?

John: My favorite lesson was the Bird Beaks Lessons. I liked the different stations where they acted like birds. It was hands-on and the kids realized how the size of the birds' beaks played a role in what they could eat.

Researcher: This ends the interview.

Appendix E.6.12 Interview #6 with Rose-After All of the Lessons

Researcher: Good morning.

Rose: Good morning.

Researcher: This is the final interview. What do you consider to be the features of effective science instruction?

Rose: Hands-on instruction is important for science. When students are engage, it becomes more meaningful to them.

Researcher: What experiences are necessary for students to become successful in learning science?

Rose: If you base it on what they already know, it's very helpful. Such as with some of the lessons, building that background and letting them look on websites was helpful. For instance, it helped to do this if they had no knowledge of a wetland or a frog habitat and build some background knowledge. It also gives them a visual picture.

Researcher: What is effective instruction and what experiences are necessary for students to become successful readers?

Rose: As far as my instruction goes, we do whole group, small group, and differentiated instruction. But also, I expose them to a lot of different types of texts. I think something to think about for the next time I do this unit is to pull in some non-fiction articles where you did the bird diets and put them in kid-friendly terms. I could bring in even more non-fiction such as what is the different between frogs and toads.

Researcher: What are your thoughts on integrating science and literacy instruction.

Rose: It is very beneficial. They should definitely be interconnected. When students are exposed to non-fiction text in science class, they get a better understanding of the science concepts. It goes hand-in-hand and helps them to become better readers too.

Researcher: Was there a specific [integrated science literacy] lesson that you felt was particularly challenging?

Rose: The most difficult lessons for them was the Wetlands Food Web one because there was so much heavy vocabulary. I introduced all of the vocabulary words first but, I think some of them missed some of the concepts. I could have gone over the vocabulary a little more beforehand and maybe have more examples for each vocabulary word. It is something to think about.

Researcher: Was there a lesson that went particularly well or was your favorite?

Rose: I like the Bird Beaks Labs the best. I know the kids just loved it and had so much fun. All the lessons were great. I loved this unit. It was really fun, hands-on, the kids loved it, and I think they learned a lot.

Researcher: This is the end of the interview.

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