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**One Leopard Gecko, Two Warrior Cats, and Three Fiddler Crabs: A
Study of the Science Identity Work of Fifth-Graders Around the
Science Classroom**

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Dedication

I dedicate this dissertation to my boys, Andrew and Michael Mann. I could not have done this without your constant encouragement and support.

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Abstract

One Leopard Gecko, Two Warrior Cats, and Three Fiddler Crabs: A Study of the Science Identity Work of Fifth-Graders Around the Science Classroom

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This research contributes to the understanding of identity by investigating the processes and dynamics of students' science identity work. Specifically, my analysis is concerned with the identity work that students perform as they craft desired and projected identities in and around science topics. I collected data when observing the students, examining and recording their artifacts, interviewing the students (both formally and informally), and interviewing their teachers and parents. I focused on four episodes of identity work of fifth graders. One episode is about a student group I call "the Ringo Keepers." The second episode is about two girls doing imaginary play using books they are reading as their guide. The third episode is about a student working on an identity of being helpful using science content. The final episode is about students developing a process to catch fiddler crabs. One main conclusion from this research is that science identity work happened adjacent to other identity work the students were doing. This way of looking at science identity work—identity work happening as an unexpected result of other work or play done by the students—is unique. Secondly, research on pretend play

happening in fifth-grade students while at school is either limited or does not exist, especially on imaginary play with identity work. One last interesting finding is that identity work can happen collectively, yet at the same time is unique for each individual. While the group is working as one unit, because each individual is an individual with their own unique history, their identity work has a group component and an individual component. From these findings, I would like to further investigate how the organization of a school can support or hinder science identity work in and around the science classroom.

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Chapter 1: Introduction

This dissertation is concerned with science identity work and how this work contributes to fifth-grade students' participation and learning (Brickhouse, Lowery, & Schultz, 2000; Van Horne & Bell, 2017) in and around their science classes. I am specifically looking at the process of identity formation or work done by a student or by the process of others positioning such student. Little research has been done on the work of identity formation especially outside the structured classroom but still around the school environment such as at recess, lunchtime, and field trips. This type of research is very time consuming and difficult to document across various settings over an extended time. I investigated the students' identity work around science in their daily lives, studying them in many different contexts and settings.

My research focuses on fifth-grade students at Manuel Martinez Elementary School, a Title 1 charter school in a large city in the southwest United States. Fifth-grade science classes cover many different topics during the school year. The curriculum includes the broad categories of life science, physical science, and earth science. Students have different experiences outside the classroom and make different connections as they study these topics in the classroom. The students' varied experiences and personal histories make the classroom a rich learning environment with many opportunities for identity work.

To facilitate this discussion of identity, it is important to articulate the various textures and nuances of the term within the context of my research. I am dealing with the

definitions of identity broadly. Gee (2000a) defines identity as an individual being recognized as a certain kind of person in a given context. I expand upon Gee's ideas and argue that identity is shaped by one's position, prestige, power, and context and manifests through activity, which reflexively shapes identity. A change in identity changes an individual's positioning, participation, and opportunities for learning. A person's identity also comprises a collection of stories (Sfard & Prusak, 2005), activity (Brickhouse et al., 2000; Carlone & Johnson, 2007), and being recognized as a certain kind of person in context (Gee, 2000a).

Science identity work builds on an individual's science identity trajectory (movement in relation to science through space and time), which changes based on context and social interactions (Calabrese Barton et al., 2013; Fields, 2010; Jackson & Seiler, 2013). Carlone, Scott, and Lowder (2014) explain that science identity work "involve[s] different performances and take[s] on different meanings depending on the norms, practices, values, and demands of the setting" (p. 838). I focused on students' science identity work and how it highlights the process of authoring oneself in science (Tan & Barton, 2010). To study this, I captured the students' activities and the relationships they formed with others in order to gain insight into how the students positioned themselves as particular kinds of people over time and space (Calabrese Barton et al., 2013). I also listened to the stories told by and about the students. Sfard and Prusak (2005) explain that stories about a person told either by the person or by others about the person are reifying, endorsable, and significant, and provide insight into their identity. Put another way, the stories define identities in the repetitive actions of

storytelling, the positioning of the person, and membership or non-membership among communities. As people are telling their stories to others, they are also telling their stories to themselves (Holland, Lachicotte, Skinner, & Cain, 1998), so they may act to fulfill those stories. By looking at individuals' activity and listening to their stories, I got a detailed view of their identity work.

Identities is plural because every person has multiple identities, such as gender, group, ethnicity, and socioeconomic status, that are apparent in the context of situated activity (Van Horne & Bell, 2017). Individuals act differently in different situations, and these “patterns of social activity affect how we think of ourselves, how others think of us, and how we are in different situations” (Fields, 2010, p. 23). An example from my observations of science identity coalescing with storytelling and classroom and community identity is Inge, a fifth-grader who shared with me about a series of books she was reading (*Warriors*) while we chatted during recess. (All names used in this dissertation were changed to protect the privacy of the individuals.)

I found in my research that students' science identity work happens independent of or adjacent to the curriculum in the classroom. Inge's class was learning about ecology, which made pretending to be Warrior cats more applicable to the curriculum; however, Inge and Luna had been pretending to be Warrior cats for a few months before the class was studying ecology. Their identity building was not dependent on what the class was studying. I discuss Inge and imaginary play around the *Warriors* books in Chapter Five.

My research contributes to the understanding of the process of identity development adding to students' participation and learning (Brickhouse et al., 2000; Van Horne & Bell, 2017) by investigating the processes and dynamics of students' science identity formation. Specifically, my analysis is concerned with the *identity work* that students perform as they craft desired and projected identities (Gee, 2000a) in and around science topics. In this research, I build and expand upon our understanding of science identity work to address the following questions:

1. How is the identity work of fifth-grade students shaped by their participation in school, home, and extracurricular learning opportunities?
2. How do fifth-grade students build a science identity across time and space?
3. How does identity work happen across settings in which students encounter science content and practices?
4. How do students appropriate various resources (objects, material, ideational) available in the environment as they actively work to build desired and projected identities?

The main research purpose of this study is to uncover the process of science identity development and how learning happens through this process. Specifically, I will be looking at the culture and space of the classroom and the science identity work of the students in and around the classroom. The study takes as a basic assumption the idea that individuals are an aggregate of multiple identities (Van Horne & Bell, 2017), and that the interaction of these identities affects individuals' science identity work. To get a comprehensive picture of individual students' science identity work, I gathered

information about students' families and life outside of school. Identity work is identified by close examination of these questions.

Many previous identity studies have been cursory at best (Chang, Eagan, Lin, & Hurtado, 2011; Espinosa, 2011; Hazari, Sadler, & Sonnert, 2013; Hazari, Sonnert, Sadler, & Shanahan, 2010). Said studies fail to delve into the process of identity work, merely recognizing when an identity has developed. By contrast, in this study, I pay particular attention to identity work within and around the context of a classroom, and school activities outside of the classroom.

Furthermore, there has been little research on the contribution of objects acting as support to activate or influence developing identities. Vygotsky (1978) viewed objects in the environment as having a role in a child's development (Daniels, Cole, & Wertsch, 2007). At first, a child plays with an object, for example, a toy broom, by pulling off the straw bristles. As the child ages, she will start to play with the broom by pretending to sweep the floor and later, she will be able to pretend that she is sweeping the floor without the broom. Therefore, while the object has a meaning to the child, that meaning changes as the child develops.

My research also contributes to looking at identity work across various settings. Many studies focus on identity work in a specific setting like an extracurricular club or one specific classroom (Barton & Tan, 2010). I examine the students' identity work during their science classes and other school activities, depicting science identity work of students over time and across settings.

Before explaining how I approach these questions conceptually and methodologically, I will first review the broad literature in this field of study. Following that, I will outline the theoretical framework that guides my research and then explain the research methods.

Chapter 2: Literature Review

2.1 HISTORICAL PERSPECTIVES ON IDENTITY

The term “identity” has many different meanings in the literature with a deep and entrenched history across disciplines. As such, that history necessitates a careful tracing of these historical lines in order to clear the space around my research. To position my understanding of identity within its historical context, I will first present cross-disciplinary perspectives of identity, followed by how my work is situated in the field of identity research.

Identity theories come from many different areas of study, and identity is among the most studied constructs in the social sciences (Cote, 2006). Identity studies have been conducted across a variety of disciplines, including psychology, sociology, anthropology, linguistics, and education (Penuel & Fishman, 2012; Schwartz, Luyckx, & Vignoles, 2011). However, within and across fields, there is variation on how identity is defined and studied, and how its historical roots are traced.

While there is little to no consensus on how identity is defined, and considering that there is even less integration among branches of identity research, this research on identity will be closer to the anthropological or social-cultural perspectives than identity research in psychology and sociology. Nevertheless, for a better understanding of identity, it is necessary to consider how identity is conceptualized across a variety of research fields and traditions. In what follows, I provide an overview of the disjointed ways that psychology, sociology, and anthropology define and study the construct of identity.

Developmental psychology studies on identity go back to the work of Erikson (1950, 1968), who looked at identity development in stages and as a fixed personal attribute

waiting to be discovered by individuals within themselves. Specifically, Erikson (1950, 1968) defined identity as “the ability to experience one’s self as something that has continuity and sameness and to act accordingly” (Erikson, 1950, p. 42). In other words, Erikson believes that we discover who we are and who we are not and that understanding remains relatively stable.

Erikson (1950, 1968) also assumed identity development to be a linear process moving through stages as the ego emerges. He posited that, as an individual progresses to a new stage, there is an internal struggle. This struggle continues until there is a higher number of incidences of positive to negative elements associated with identity. Identity development was thus conceived as a struggle to resolve certain physical, emotional, and psychological conflicts and, once resolved, individuals are committed to that identity. In other words, young people must first experiment with different identities and then commit to their identity (Cook, 2011). Marcia (1966) advanced Erikson’s theory by exploring a person’s awareness of an identity crisis, when old values were being examined and new values were being investigated. He coined the term “diffused identity,” meaning there is no commitment to any one identity (Marcia, 1966).

While Erikson’s followers are primarily working in the developmental psychology field, his writings have also influenced identity research in the field of sociology, especially the work of Weigert (1986; Weigert & Teitge, 1986). Erikson’s writings provided sociologists with the value-neutral term of identity (Côté & Levine, 2014) that inspired the Chicago School of Symbolic Interactionism and Iowa School of Symbolic Interactionism. Sociologists are interested in the role one’s identity plays in the construction and sustaining of social order in societies and how identity influences one’s behavior. A person’s identity influences society through their actions, such as creating organizations, institutions, or networks.

Long before Erikson's work, Mead (1932) developed a framework around mind, self, and society, which was also the name of his seminal work. He never mentioned identity by name, but organized a framework that has been further used for studies on identity. His framework uses three levels of analysis—namely, the personality or mind, the interaction or self, and social structure or society. There are two branches of interpretation of Mead (1932). While the first branch, structural sociology identity, uses the quantitative approach of Stryker (Schwartz et al., 2011), the second branch, interpretive sociology, uses the qualitative approach of Corbin and Strauss (2008).

However, even within sociological research on identity, there is a division between studying identity on the micro level or on the macro level. While on the micro level, the interaction of the interpersonal relationships (Cote, 2006) is examined; on the macro level, research focuses on systems of identity or society and individuals' identity with the interplay between the two (Côté & Levine, 2014). From the sociologist's point of view, identity is not static but dynamic, yet some identities are more dynamic than others. Sociologists also do not think that identity development is linear, but rather assume it to be more of an interaction between the environment and the person; therefore, identity gets somewhat redefined as context changes. This methodology is not applicable to my research, however; I am concerned with the process of identification rather than the end product.

In social-cultural studies, the research also followed Mead's lead (Holland, Lachicotte, Skinner, & Cain, 1998), but they credit the beginning of their field to Vygotsky (1962) and Bakhtin (2010). While these researchers did not work together to develop their ideas, because they were contemporaries in post-revolutionary Russia in the 1920s, they have shared cultural influences. Identity in the social-cultural studies field is defined as a concept that figuratively combines the personal world with cultural forms and social

relations (Holland, 2001). Specifically, Vygotsky and Bakhtin think that identity is developed within the activity of social opportunities and that a person's life is mediated by social interchange among persons; therefore, the activity creates the context. In this context, it is important to also understand the psycho-historical formation of identity, which develops over a lifetime and motivates social life.

This is emphasized in Vygotsky's "genetic" outlook, as he felt that he could not understand a person's behavior without knowing the history of an individual's identity formation (Vygotsky, 1962). Vygotsky differs from Erikson (1950, 1968) personality development studies in that the focus, within the social-cultural studies framework, is on social forces and integration of culture within identity development. Bakhtin (2010) explained this via the concepts of "I-for-myself," i.e., the way a person defines her/himself; "I-for-the-other," i.e., the way others define a person; and "Other-for-me," i.e., how a person internalizes their impression of how others view them, which adds to their personal identity (Erdinast-Vulcan, 2008).

In sum, while developmental psychologists tend to view identities as static, social-culturists tend to think of identities as dynamic, in that individuals author themselves in the moment; furthermore, sociologists tend to assume some identities are static and others are developing.

2.2 SOCIAL-CULTURAL UNDERSTANDINGS OF IDENTITY

I am framing my research on identity through a socio-cultural lens, or as the way people author themselves and others author them (Holland, 2001). The list below serves to establish how I am using identity in this research, as I will demonstrate in this dissertation.

Identity is dynamic and a result of the interaction between the individual and their environment (Wenger, 1998). It includes all historical experiences and how the individual interacted with each context and setting (Fields, 2010).

Identities are shaped by an individual's negotiating position and power, authoring themselves, and world making (Holland, 2001; Holland, Lachicotte, Skinner, & Cain, 1998). Identity is at the nexus of the social and the individual (Holland et al., 1998) "where people neither have the full ability to author themselves nor do others have full ability to position them; identity is iteratively shaped moment by moment over time through negotiations in social interaction" (Fields, 2010, p. 4).

Identity includes "how people come to understand themselves, how they come to 'figure' who they are, through the 'worlds' that they participate in and how they relate to others within and outside these worlds" (Urrieta, 2007, p. 107).

Individuals have multiple identities (Gee, 2000; Sfard & Prusak, 2005) connected to their performances in society and identity sits at "the nexus of the mutually shaping processes of the social, cultural, and individuals with the individual changing over time" (Fields, 2010, p. 4).

In summary, Gee explains that the meaning of identity is:

When any human being acts and interacts in a given context, others recognize that person as acting and interacting as a certain "kind of person" or even several "kinds all at once"... Being recognized as a certain "kind of person" in a given context is what I mean here by "identity" (p. 99).

The combination that makes a person a certain "kind of person" is referred to by Gee as "Discourse with a capital D" (Gee, 2005).

Identities are manifested through activity or performances, which reflexively shape identities (Van Horne & Bell, 2017) and identities can increase agency (Barton & Tan,

2010). Past experiences mediate an identity, but they are not necessarily cumulative. In other words, a person does not obtain or add to an identity when s/he fills up the “science identity basket” with science experiences. Identity is about how a person interprets experiences and how those experiences moderate their current context, or as (Roth & Lee, 2007) write, an identity is a manifestation of the cultural-historical possibilities for a given time and context. Of note, in identity research, one cannot just list experiences as a way to measure a “thickening identity” (Jackson & Seiler, 2013); rather, we should look deeply into how activity, agency, and culture influence the individual and their actions. Therefore, identity is a social construct that is being dynamically negotiated in a temporal context and, as Gee (2000) explains, identity is never fully formed and is always potentially changing.

While Gee explores how outside forces can influence a person or the “kind of person” they become/are, Urrieta emphasizes how a person comes to understand themselves and position themselves through relationships and actions into figured worlds. While these are different points of reference, I accept that identity includes both understandings and will utilize both lenses as I examine identity.

2.3 SCIENCE IDENTITY AND SCIENCE IDENTITY WORK

Like identity in general, science identity is a socially developed dynamic construct, but it is created through interactions with science practice and content (Dien, 2000; Horowitz, 2012; Tan, Calabrese Barton, Kang, & O'Neill, 2013). Science identity work is the process of building a science identity. For example, Carlone, Scott, and Lowder (2014) looked at science identity work in an ethnographic longitudinal research study of students in their fourth- through sixth-grade science classes. Carlone et al. (2014) tracked three social identity performances:

1) the ways that students consistently performed and/or described themselves during science lessons, 2) interviews, and 3) performances across the school year (e.g., being a pleaser, a “good student,” a defender of the underdog). Then, we examined how the *meanings of their consistent social identity work* shifted or remained consistent in the different cultural context of each year in school science. (p. 841)

They looked at individuals’ positioning in the classroom, which celebrated individuals’ relationship with science. By “toggling” between analytical grain size of local structure (classroom norms and practices, individual agency, and celebrated subject positioning) and global structure (figured worlds, race, class, and gender), Carlone et al. (2014) were able to “understand some implicit processes that likely contributed to students’ problematic science trajectories” (Carlone et al., 2014, p. 841). When looking at *science identity work*, rather than identity as a reified achievement (Calabrese Barton et al., 2013; Jackson & Seiler, 2013; A. Johnson, Brown, Carlone, & Cuevas, 2011; D. R. Johnson, 2011), the lens is on the process of identifying, therefore emphasizing that individuals are formed within communities of practice, have agency (limited by norms and practices within the context), and have social identification that occurs within temporal contexts (Archer et al., 2012; Holland, 2001; Holland et al., 1998; Wenger, 1998; Wortham, 2006).

In science identity work, there is a broad interpretation of what is considered learning. I view learning as a cognitive and a social-cultural process (Nasir & Cooks, 2009). Learning and identity work happen as individuals negotiate participation in communities and author themselves within that community (Nasir & Cooks, 2009) shaped by the activity systems within the community (Rubin, 2007). These acts give individuals agency; at the same time, the individuals are developing agency based on how others position them and through this process, the individual is learning. Learning changes who we are (Wenger,

1998) and through the process of learning, identity is constructed (Boaler & Greeno, 2000).

2.4 THE CONTEXT OF SCIENCE CLASSROOMS

My research centers on an elementary science class for fifth graders. I followed the students while they were in science class and also in other activities in and around their school. I was interested in science identity work that was preparing the students to be scientists, rather than the work of being “good science students.” There is the difference between emphasizing learning science rather than summarizing a chapter or choosing the correct answer on a test (Carlone, 2003; Lave & Wenger, 1991; T. Lyons, 2006; Munby, Cunningham, & Lock, 2000; Taconis, de Putter-Smits, Henry, den Brok, & Beijaard, 2010). Good student processes do not build science identity (Brickhouse, Lowery, & Schultz, 2000). Science classrooms should provide the option to use newly acquired knowledge and skills (Bransford, Brown, & Cocking, 1999), which can motivate and support science identity development and build a community of practice centered on science understandings.

Classrooms where the norms encourage students to investigate, cooperate on solving problems, and provide opportunities for feedback with revisions are likely to build a healthy community of practice (Bransford et al., 1999; Lave & Wenger, 1991). The interaction in these classrooms encourages ownership of new ideas and boosts the students’ curiosity about the world. Carlone et al. (2014) contend that being a part of an exemplar science class increases students’ science identity affiliation. In their longitudinal study, Carlone et al. (2014) also found the same students, when in other classes not demanding scientific thinking, had their science identity diminished.

A science classroom that values science discovery can be at odds with the bureaucratic demands of teachers' accountability (Smith & Darfler, 2012). Students are reacting to the emphasis on rushing through the curriculum and always preparing for the next test. In these classrooms, students come to equate this type of instruction with being a scientist. This development is an identity, but an identity based upon rushing through the curriculum. According to Nasir and Cooks (2009), the way students are taught leads to the failure of some students to identify with school or other academic endeavors. Furthermore, Lacasa, Del Castillo, and García-Varela (2005), and Amsterdam and Bruner (2000) report that the nature of science instruction with rigid structure and organization can impede the development of a positive science identity. These rigid structures limit the schools and students' individual identity development. Students might adopt the identity of the institution (as an AP student, a McCallum cheerleader, or a theater geek, but not as a scientist) or, alternatively, not develop an identity during this period.

2.5 IDENTITIES AND LEARNING

Learning and identities are intertwined. Lave and Wenger (1991) discuss how in the process of participation, learning emerges and identities are formed. Lave describes how the Vai and Gola tailors she studied in Liberia must go through, on average, a five-year apprenticeship to become a master tailor. Apprentices first learn to make hats and undergarments and then move on to more formal garments. The apprentices learn first about the finishing work of a garment, then the sewing of it, and then cutting of the material for the garment. Their learning moves them from a peripheral participant to a full participant, changing their identities as they progress through this process. By participating with the master tailor, the apprentices learn and their positioning in the community changes as they learn.

Why is it important to understand identity when studying learning? Learning happens as one participates in a group, which changes an individual or an individual's identity (Wenger, 1998). Learning and identity work have a reciprocal relationship; when learning happens, identities are modified, and through identity work, learning happens. Lave and Wenger (1998) explain that learning is an aspect of identity, and identity is a result of learning. To distinguish between learning and identity in this study, I define learning from a social-cultural perspective as a participation activity where there are "shifts in use of artifacts (both culturally and cognitively) for problem solving, sense making or performance" (Nasir & Cooks, 2009, p. 44). Learning and identity work happen as individuals negotiate participation in groups and author themselves in that community (Nasir & Cooks, 2009). In this research, I examine science identity work and the learning that emerges during that work.

One example of student identity work and learning is when students are socialized into the norms and practices of science (Carlone & Johnson, 2007). The individual work done while learning the norms and practices of science contribute to one's building a science identity (Brown, 2004; Gardner, Kornhaber, & Wake, 1996; Varelas, House, & Wenzel, 2005; Warren, Rosebery, & Conant, 1991; Watson, Callingham, & Kelly, 2007). Brown, Reveles, and Kelly (2005) found that when a student in an elementary class used the correct scientific vernacular during a discussion on classification, the teacher changed the way she treated him. She recognized him as a knowledgeable science student, and later used him as a peer discussion leader. Being recognized by the teacher supported the student's science identity work and changed his positioning among his fellow students. As stated before, through the process of participation, learning emerges and identities are formed.

2.6 IDENTITY WORK AND PROCESSES OF IDENTITY FORMATION

Science identity work is a powerful mechanism that supports a science identity trajectory. A science identity trajectory means that an individual is on a path to building a science identity. However, identities are always being formed and are socially negotiated, which makes them difficult to isolate (Calabrese Barton et al., 2013). Rather than concentrate on having a science identity, which will only reflect an individual's identity in that time and space, I am focusing on identity work. Identity work is "the actions that individuals take and the relationships they form (and the resources they leverage to do so) at any given moment and as constrained by the historically, culturally, and socially legitimized norms, rules, and expectations that operate within the spaces in which such work takes place" (Calabrese Barton et al., 2013, p. 38). Calabrese Barton and others found that the two girls, who were their research subjects, viewed their possible future selves in science through their identity work, especially when their identity work was recognized. If their identity work was supported by important others, their science trajectory was toward a future in science.

2.7 MULTIPLE IDENTITIES

When looking at science identity, one cannot ignore an individual's other identities, such as race, ethnicity, class, sexuality, and gender. To date, research on multiple identities within this context has been secondary to other topics and concerns. Archer, Dewitt, and Osborne (2015) say that identity is mediated by social axes, such as race/ethnicity, social class, and gender. All these identities are tied together and cannot be equitably analyzed in isolation (Archer et al., 2015; Archer & Francis, 2006). All these separate identities come together as the capital, or a reservoir, of the individual (Lyons, Dsouza, & Quigley, 2016). These identities synergistically create the individual. A single identity can only "represent

one aspect, one social role, of being human in social activity” (Tucker-Raymond, Varelas, Pappas, Korzh, & Wentland, 2007, p. 561). The meaning that individuals make from these identities is neither concrete nor similar for everyone.

2.8 INFLUENCE OF AGE ON IDENTITY

In this respect, Carlone et al. (2014) found that when students transitioned to middle school, race, class, and gender exerted a greater influence on students’ science identity work, as compared to the influence of these factors on students throughout elementary school. Other researchers (Archer et al., 2010, 2012; Simpson & Steve Oliver, 1990; Vedder-Weiss & Fortus, 2011, 2012) report a decrease in science interest and engagement related to school in the middle school years; this tendency can be due to an increase of peer influence during middle school. A critical period for students’ interest in science is largely considered to be between the ages of 10 and 14 years old (Lindahl, 2007; Office for Public Management for the Royal Society, 2006; Tai, Liu, Maltese, & Fan, 2006). This underscores the importance of providing students in elementary school with many science experiences (Tai et al., 2006) so as to allow students to participate in science identity work. Lindahl (2007) found that girls’ career goals were being developed by the age of 13 and that engaging them in science after that point was progressively difficult. Identities appear to be more important to the individual in early middle school as children start to focus on fewer interests than they had in elementary school. I am studying students in the fourth and fifth grade before they transition to middle school.

2.9 INFLUENCE OF GENDER ON IDENTITY

Gender studies abound in the domain of science identity research. For instance, Brickhouse et al. (2000) analyzed four African American girls from poor or working-class backgrounds who had a strong interest in science and had science-related hobbies. The authors found that, while gender influenced the girls' attitudes toward science, gender could not be separated from the girls' race, class, and culture. Similarly, in their study on boys and their science trajectories, Carlone, Webb, Archer, and Taylor (2015) found the same pattern. The boys were constrained by their class and ethnic positioning. In both studies, the students' interest and participation in science did not ensure a successful science identity trajectory.

2.10 INFLUENCE OF ETHNICITY ON IDENTITY

Minorities, especially underrepresented minorities, are often the focus of identity studies. Even the way students think of scientists and their impression of the accessibility of the field of science deter some children from pursuing science (Archer et al., 2012; DeWitt, Archer, & Osborne, 2013). In Archer et al. (2012), students did not think they fit the images they had about scientists ("not for me"); even though they were developing a science identity, they still did not consider it a possible career. Chang, Eagan, Lin, and Hurtado (2011) looked at groups of students: those with a strong domain identity and those with medium domain identity and those with low domain identity. The authors found that underrepresented minority students with stronger domain identity were most likely to persist in their biomedical or behavioral majors. However, students who reported low frequencies of negative racial experiences derived a stronger benefit from their domain-specific identities than the students who frequently experienced negative racial experiences.

2.11 CONTINUOUS OR DISCONTINUOUS PATHWAY

Identity work can contribute to an identity trajectory but trajectories are rarely direct paths between two points. Trajectories can also be continuous or discontinuous, meaning that a person can consistently be doing identity work that supports a science identity trajectory or they can make progress and then take a hiatus with their science identity work. Periods of repeated positioning by science identity work can stabilize, or as Wortham (2006) refers to it, “thicken” an identity. Azevedo (2011) argues that initial interest or work must be maintained through lines of practice to support long-term engagement. The context of a situation can encourage continuous participation, which will in turn influence the science identity trajectory.

2.12 METHODOLOGIES FOR STUDYING IDENTITY

Identity studies often use a variety of methods. Some sociocultural identity studies have used personal narratives and self-description such as, “Doing science versus being a scientist: Examining 10/11-year-old school children’s constructions of science through the lens of identity” (Archer et al., 2010). In this study, the researchers asked the children about their attitudes and interest in science. They found that a career in science was “unintelligible for some children... due to its dominant gendered raced and classed configuration” (Archer et al., 2010, p. 637). Tucker-Raymond et al. (2007) also used children’s interviews and self-description for their study on when the children thought they were being scientists. The researchers thought that the self-narratives were an effective way to investigate the children’s present and possible identities. They treated the narratives as examples of the children’s identities, which is similar to Sfard and Prusak (2005), who view identities as a collection of endorsable narratives. Sfard and Prusak (2005) distinguish narrative identities from identity in practice because they say that identity is an interpretive

experience (Fields, 2010). I use student interviews, as interviewing students can yield valuable insights into who the individual perceives themselves to be and how they got there (Nasir, 2002). This technique is best to learn about the individuals' impressions and perceptions.

Along with data gleaned from interviewing the students about their science identity work, how individuals are recognized by others is a part of an individual's identity. Carlone and Johnson (2007), as part of a longitudinal study, followed women of color in the science career pathway from undergraduate through graduate school to careers. The women of color were marginalized in the sciences for their gender, race, and ethnicity. The way others viewed them changed their undergraduate science experiences. In other research by Carlone (2004), she looked at how girls participated in a reform-based physics class. During the research, she interviewed the physics teacher, who described the boys as having raw talent and the girls as hard-working. This gender difference in the teacher's description influenced the positioning of the students in the physics class. Collecting teacher and parent interviews about the students can reveal stories about the students and beliefs and attitudes held by influential people in the students' lives. Using both the students' self-narratives and others' narratives about the students gives a more comprehensive look at the students' identity work than just using self-narratives.

However, narratives provide only part of the story about a student's identity work. Observing the students in practice in or around the classroom provides current examples of identity work and also shows the interactions during their identity work. Some studies use interviews and classroom observations as their methodological approach (Olitsky, Flohr, Gardner, & Billups, 2010). In the research study by Olitsky et al. (2010), the lead researcher attended eighth-grade science classes two or three days a week as a participant researcher recording and taking field notes. During the school year, she also conducted

weekly lunchtime science reviews and interviewed the students. By interviewing the students and recording the students in practice, she was able to understand the interactions in the class and the students' science identity work. Cook (2011), in her dissertation "The Influence of a Classroom Model of Scientific Scholarship on Four Girls' Trajectories of Identification with Science," said that to "understand identity construction, we must do more than identify a list of norms... we must map the relationships between the norms" (p. xv). She further explained that "examining recognitions from three interrelated lenses: self-narratives, other-narratives, and observational accounts of positioning" (p. xv) is valuable to determine those relationships. To get a comprehensive picture of students' identity work, I use self- and other narratives along with observations of the students in and around the science classroom.

Studies that use narratives and observations are often ethnographies (Brickhouse et al., 2000; Brickhouse & Potter, 2001; Carlone, 2004; Olitsky, 2007; Reveles, Cordova, & Kelly, 2004; Tan & Barton, 2008a, 2008b; Tan et al., 2013). Ethnographies examine the culture around the participants, which shows not only individuals' identity work but how it is situated within the culture. These studies interviewed individuals, their teachers, and their parents, and observed students in many different contexts. Ethnographies have the advantage of conveying social interactions, since they provide a more detailed view of the individual (Abdelal, 2009). The stories that are the products of ethnographies are a rich source of data, both communicated to the researcher and observed through the participants' actions.

Carlone and Johnson (2007), among others (B. A. Brown, 2004; B. A. Brown, Reveles, & Kelly, 2005; Kelly, 1985; Nasir, 2002), used the framework of social theories of learning combined with equitable science education (Calabrese Barton, 1998; Gilbert & Yerrick, 2001). In the Carlone and Johnson (2007) study, the authors develop their own

science identity model, which allows them to “maintain a dual focus on both the agency of those striving to build a science identity and the constraints on that process due to the structures within which that identity is being constructed” (Carlone & Johnson, 2007, p. 1211).

Chapter 3: Methodology

Many of the previous studies discussed in the Chapter Two examined added to the understanding of science identity. I wanted to better understand science identity work using a sociocultural lens (Lave & Wenger, 1991). A social culturist views identity as dynamic and contextual dependent (Wenger, 1998).

3.1 THEORETICAL FRAMEWORK

In this study, the classroom is a community where the students learn the norms and values of the space. All children contribute different skills and interests to this space. This study examined the interaction between the children and the classroom community that has developed and how the community supports the process of science identity development.

For my theoretical framework I used a social-cultural approach (Lave & Wenger, 1991). Students negotiate their various identities in their ongoing interaction with peers and community members (Fields, 2010) with identities being context dependent (Van Horne & Bell, 2017). Identity work is seen in the active efforts of the individuals to position him/herself as a certain kind of person and the reflexive process through which the community positions such a person (Gee, 2000).

I view identity not as an accumulation of science experiences that a person has but rather a process over time and contexts. Therefore, I looked at each science experience and how it was framed in the individual's own world, being careful to emphasize experiences that were meaningful to the individual. Science identity work needs to emphasize "the structure/agency dialectic and multi-temporal aspects of identity world" (Carlone et al., 2014, p. 840). In this study, I closely analyzed the following specific performances: 1) the ways students perform and identify themselves in science lessons, interviews, and throughout the school year; 2) how the students position themselves among their peers in

the classroom context and other school-related contexts; 3) how students' science experiences outside of school interact with their school science experiences and contribute to their science identity work; and 4) the influence of objects, materials, and ideas on the process of science identity work. Throughout the research, I considered the framing of race, gender, and class in the students' identity work not as an afterthought but as part of the individual's identity. Since an individual is a combination of many identities, the impact of each of these identities should not be viewed as an individual contribution; rather, the interactions of these identities should be factored in. In this respect, this study will rely on Crenshaw (1991), where the identity of an individual is recognized as an aggregate of all of the individual's identities and their interaction. In order to effectively work within this framework, interviewing and observing not just the individuals, but also their parents and educators, is pivotal (Archer et al., 2012) to understand the various contexts and to have a comprehensive view of the students' identity work.

3.2 METHODS

This is an ethnographic type of study. I collected data by observing the students in and around their science classes, examining and recording their artifacts, interviewing the students (both formally and informally), and interviewing their teachers and parents. I collected 92 hours of video in and around the science classroom. I also wrote 215 pages of field notes and did 18 formal interviews. By using this multi-pronged approach of collecting data, I saw a fuller perspective (Cook, 2011; Fields, 2010), along with nuanced understandings, of the students' science identity work.

I video recorded my research subjects in the classroom and during other activities, but there were times when video recording was disruptive or inappropriate. For instance,

when Inge was telling me about *Warriors* and how she and Luna pretended to be characters in the books, I asked whether I could video record it, but she said she would rather we just talked. During those times, I took field notes and did not video record.

I focused on science identity work in and around the classroom. I found rich cases of identity work being done outside or loosely connected to the classroom at the same time this work affecting the positioning in the classroom. My research will show some novel moments of identity work consequential for science identity construction.

3.3 THE RESEARCHER

I am the only researcher for this study, although there are other research projects being conducted on campus. I am a white, middle-class female in my early fifties. I have extensive science classroom experiences both as an instructor and observer. I have worked as a secondary science teacher, a science coordinator for kindergarten through twelfth grades, and as a science curriculum consultant for elementary and secondary teachers. Over the course of the study, I developed a professional relationship and a personal relationship with the science teacher. She consulted with me about curriculum and parenting advice. During the school day, we had little time to talk or even debrief. However, we often ended up texting or talking in the evenings, especially about the schedule. I also built relationships with the other teachers on the campus, including impromptu conversations with the wellness teacher and the other fourth- and fifth-grade teachers. The teachers and students treated me as a member of the classroom community.

3.4 STUDY SITE

At the time of this study, there were 44 fifth graders at Manuel Martinez Elementary School. All students were invited to participate. The fifth graders had the same science teacher and attended science class daily for 70 minutes. The students also had weekly STEAM and wellness classes, both of which supported the science standards.

Most of the students in the fifth-grade classes had been together at this school since kindergarten. The school demographics at the time of the study were as follows: 63% Hispanic, 20% White, 10% African American, 3% multi-racial, and 2% Asian (2015-2016 Annual Report, _____, 2016). This was a Title 1 school with more than 50% of the students qualifying for free and reduced lunch. Nearly 60% of the students met the criteria for at-risk of dropping out, and 25.95% of the students met the criteria for limited English proficiency. Seven percent of the entire student school population (N=304) were gifted and talented, while 5% had special educational needs. The mission of the 14-year-old school is as follows:

[...] to develop students as lifelong learners through rigorous research-based curriculum, individualized instruction, high expectations and a nurturing environment that includes parental and community involvement. ... To serve as a model of an exemplary educational program for diverse learners. (2015-2016 Annual Report, _____, 2016, p. 2)

To be eligible to attend this school, students must live in the predetermined attendance area. The parents of the students must apply and the students are selected in a lottery. Siblings of current students are given priority in the lottery. The school also maintains a waiting list of students who want to attend. Classes are capped at 22. There is no consideration of the students' demographic or educational special needs in the lottery.

The fifth-grade science teacher, Mrs. Peacock, was a white female in her late twenties who had been teaching at Manuel Martinez Elementary School since she graduated from college in 2012 with an Elementary Education certification. She had taught fifth-grade science and math, fourth- and fifth-grade science classes, and STEAM classes (Pre-K–5th). She also acted as a fifth-grade homeroom teacher, which means that she organized many of the fifth-grade events. She had a good rapport with the students and their parents. She had many of the parents' phone numbers stored in her cellular phone and seemed to be familiar with the children's home lives. She welcomed me into the classroom. Mrs. Peacock determined all the science curriculum and pedagogy following the state standards and district guidelines. My research did not change her curriculum or pedagogy. As part of my objective to observe students' science identity work, I was at the school collecting data from October 2016 until May 2018 and visited the science class as often as three times a week during the school years and accompanied them on seven field trips.

I had the opportunity to accompany the fifth graders on an overnight trip to a Marine Science Institute and a two-night trip to the Outdoor School, along with other science-related field trips. During the school day, I often worked with small groups of students and I accompanied the students to recess and occasionally fifth graders ate lunch with me. As an observer, I video recorded the students while in class, other times during the school day, and on their science-related field trips. I took field notes and collected artifacts.

Watching the children as they are engaged in science and other activities gave me opportunities to observe how they interacted with each other, and used objects. All of these acts position individuals by themselves and allow others to position them (Cook, 2011). In the process of working with the children and being a part of their community, they shared their experiences with me. For instance, Gizelle explained to me during lunch one day that she was a vegetarian because she liked animals and didn't think it was right to eat them,

but that she does eat ethically caught fish. I used all these episodic insights into the students' identity to better understand their science identity work. Since I invested substantial time to be part of their community, the students viewed me as someone in-between a teacher and a friend. This investment of time and the type of relationship is critical for this type of study (Fields, 2010).

3.5 VIDEO RECORDING THE SCIENCE CLASS AND OTHER RELATED ACTIVITIES

Video recording allowed me to examine interactions at a level of detail that is not available with other data collection methods. Because the processes of science identity work are subtle, complex and multidimensional, video recording for this project is necessary.

Every time I was in the classroom, I video recorded the class' culture and routines. I usually set the camera on the tripod focusing on one group of students as they worked together. All videos were logged for content, transcribed when needed, and analyzed qualitatively. The data analysis was iterative. I was looking particularly for examples of science identity work or times when the students talked about how science is part of their experiences. I used the constant-comparative method of analysis (Glaser & Strauss, 1967), in which a researcher reads through the data for emergent themes (coding them along the way), followed by more reading until the themes and codes have been "saturated," a term used to describe when researchers cannot identify any new themes or coding categories and feel the data has been completely represented by the final themes and codes.

3.6 INDIVIDUAL INTERVIEWS

In order to obtain insight into the students' process of developing a science identity, I conducted individual interviews with many of the students. The interviews were brief and

performed at a convenient time for the participants and away from their classmates. I asked each student, “who do you think was a good scientist? Are you a good scientist?” How do they view themselves in terms of their relation to science? Do they play a role (in their perception) as good science students or not and why? How do they think others view them in terms of their relation to science?

Each individual interview was videotaped. The format of an unstructured interview allowed the students to describe their science interests, experiences, and how these related to the science they were studying at school. I looked at the students’ activities both in and out of school, because both in-school and out-of-school activities can support science identity development (Aschbacher, Li, & Roth, 2010).

The interviews were transcribed and coded. After initial sorting and coding of the data by key topic areas, I searched the data for examples of science identity work and how that work was supported in the students’ environment, such as getting a lizard like the lizard at school for a pet or collecting insects and studying each individual species.

Recent identity studies (Archer et al., 2010; Cook, 2011; Fields, 2010; Tucker-Raymond et al., 2007) use personal narrative and self-description to learn about the students’ identity. Tucker-Raymond et al. (2007) argue that the children’s descriptions and narratives are the children’s identities. As mentioned before, I used “formal” unstructured interviews along with informal interviews where conversations emerged in and around the classroom, such as the interaction with Gizelle regarding her vegetarianism. Many conversations emerged by being an observer participant in the classroom.

3.7 RESEARCH PLANS FOR PARENTS OR GUARDIANS AND TEACHERS

Families and teachers significantly influence students’ lives as role models and can affect students’ interests and science identity work (Archer et al., 2012; Aschbacher et al.,

2010; Chang et al., 2011; DeWitt et al., 2013). In this study, I also interviewed some of the students' parents or guardians and their science teacher. Through the interview process, I gained insight into the multiple identities of the participants and how the participants' identities contributed to their science identity work. The people the participants interacted with affected these individuals' science identity and should be explored to better understand the process of science identity development. The purpose of these interviews is to get a complete picture of the participants' multiple identities. Each interview was video recorded. These unstructured interviews allowed me to further investigate their child's science identity work and how this was supported by activities outside of school.

The interview data was transcribed and then analyzed. I was looking for examples of where students engaged in science outside of school either in organized activities or during their free time. After initial sorting and coding of the data by key topic areas, I searched the data for examples of science identity work and how that work is supported.

3.8 FOCAL CASES

Focal cases are the bulk of my data; however, I have data from many other students: 25 fifth graders agreed to participate (25 out of the 44 fifth graders), but focal cases emerged with students involved in the smaller groups, such as the students who were "Ringo Keepers." Because I was in this classroom from October 2016 to May 2018, the students were very comfortable with my presence in the classroom. They often readily volunteered information and comments, which I incorporated into my analysis.

Luna was one of my focal cases. She greeted me the first day I entered the classroom and every time hence. She often tried to include me in the classroom activities. For instance, when I was observing her lab group doing an investigation about landforms created by erosion and deposition, each student in the group was taking turns constructing

the different landforms by shaping the sand and then using a syringe with water (the river) and spraying it on soil to cause the soil to erode and form a valley. She turned to me and asked me if I wanted a turn to “make” a valley. She had assumed the leadership position in the group, guiding the other students about what to do for the lab and determining the order that the students got to use the syringe. When the other students would verbally answer questions, they looked toward Luna for confirmation before they wrote their answer on their lab sheet.

She emerged as a case because she was actively learning science and doing complex identity work in the process. Her positioning of herself as a leader, and by others allowing her that position, supports her and others’ view of Luna as a “science type” person. She had an interest in science, especially the life sciences, evidenced by her actions inside and out of the classroom, and from multiple conversations. She was the leader of the Ringo Keepers, the class lizard. Luna was also one of the girls who “played” *Warriors* during the school day.

She had a twin brother in the other fifth-grade class and a younger brother (a cousin who is being raised as a brother) in fourth grade. Luna was a white girl from a working-class family. Her birth mother was a drug addict, so she and her brother were removed from her mother right after birth and adopted by her aunt and uncle, whom she referred to as her mother and father. She and her brother were very small in stature, which one of the teachers told me was because of their mother’s addiction. Her adoptive parents have since divorced, so she and her brothers spent time with each parent. Her adoptive mother has a second husband with one young child, but they were separated because of some domestic abuse allegations. At the time of this study, Luna and her brothers were living with their father. I share all this background on her since she openly shared it with me and it is an important part of her identity.

Tim was Luna's brother, also in fifth grade. He was the quietest of the trio of siblings. As stated before, he was small for his age and had an actual medical diagnosis pertaining to his small stature. He chose not to engage in team sports during recess, but instead entertained the pre-K students who had recess at the same time in the adjoining playground. Many of his peers identified him as one of the students most interested in Ringo, but he did not interact with Ringo during the school day. At the end of his fifth-grade year, he presented to Mrs. Peacock a new home for Ringo. He had made the home himself out of rocks and plaster of Paris. Later in the dissertation I analyze how his gift was identity work.

Tim has two pet lizards at home. He told me with great pride about his leopard gecko and bearded dragon. He explained that his leopard gecko is much shyer than Ringo but will play when it is quiet. Similar to Luna, he is not afraid to pick up bugs or random organisms. When filming him the day the fifth graders and second graders went to a local park and worked with Keep _____ Beautiful coaches, he was very good about working with his second-grade buddy. He often didn't use words but was able to communicate with his buddy through his actions. He and his buddy were the first group to locate everything on the nature scavenger hunt. During the scavenger hunt, it was obvious that Tim had excellent observational skills and was able to guide his buddy to record the needed objects for the scavenger hunt. My original interest in the siblings as a case emerged independently. Each of the siblings has individual characteristics that make them interesting cases; the fact that they come from the same home environment makes them even more compelling, especially since each child's science identity work manifests itself in unique ways.

Inge is the fifth grader who spoke to me about the *Warriors* books that she was reading. Inge is Latina. She was good friends with Luna and wanted to be a pet store owner when she grew up. She loved animals. She and Luna did a social justice project on

animal abuse for their social studies class. They made brochures on how to identify animal abuse and distributed them to businesses in their city. Inge was not typically a leader in class but was a good solid student. However, she took on a leadership role in the *Warriors* imaginary play with Luna.

Juan, a Latino, became a focal case when he was with Tim and Isaac catching fiddler crabs. Juan tended to be a quiet student in class and at times struggled with the material. He did his assignments but didn't raise his hand to volunteer answering questions. He changed and became more confident during the fiddler crab episode.

Finally, Isaac was a fifth grader and a refugee from Eritrea. Isaac was in the same class as Tim. Isaac was very talkative and working very hard to find his social group among his peers. When Isaac was asked about what he wanted to be when he grew up, he said a scientist for the Army. He explained that he wanted to work for the Army to do good things for America. In Eritrea, his mother was a doctor and his father was a scientist, but in America his father drove a taxi and his mother worked as a medical technician. He had three younger brothers who all attended Manuel Martinez Elementary School. At the time of the study, he had been at Manuel Martinez Elementary School for three years.

The use of individual students as "cases" supports the framing of identity as how one positions him/herself and at the same time how others position the individual, which in turn influences their personal positioning. These cases were emergent but all were doing unique identity work.

3.9 DATA TRIANGULATION

This study was performed using an interpretivist paradigm. I looked for understanding in the context of the classroom and outside of the classroom. As in other interpretivist studies, the researcher is an instrument of the study (Glesne & Peshkin, 1992).

Triangulation from an interpretivist perspective seeks to integrate multiple perspectives (Glesne & Peshkin, 1992). Using multiple data collection methods helps confirm the interpretation (Thomas, 2010). In this research, I use participants' interviews, teacher interviews, parent interviews, and observations. Integrating these multiple perspectives makes the interpretations stronger and more convincing (Yin, 2009).

Chapter 4: Ringo the Amazing Lizard: Identity Work of the Ringo Keepers

Whatever we offer in the classroom becomes an opportunity to pursue a longer-term agenda of identity building; Our primary affective engagement is with this agenda, with becoming who we want to be, not with learning this or that bit of curriculum.

(Lemke, 2000)

4.1 INTRODUCTION

In this chapter, I consider the identity work done by the students of the Ringo Keepers group. The students in the group were constantly negotiating their positions to remain part of the group. They were learning more about leopard geckos, which also helped them reify their position as Ringo Keepers.

Students form groups with similar other students or students they feel are more similar to them than the people outside of the group (Tajfel, Turner, Austin, & Worchel, 1979; Tarrant, MacKenzie, & Hewitt, 2006; Turner, Brown, & Tajfel, 1979). This was the case with the Ringo Keepers: they were more similar to each other than to the other social groups at recess (other groups that were together during recess such as: soccer players, girls who walked and talked together, and fifth graders who played with the second graders). The students in the group all had an interest in Ringo and at the same time were also friends (B. B. Brown, Mory, & Kinney, 1994; Tarrant et al., 2006). I don't know if the friendships started before the group interest in Ringo. Since the majority of the students had been together since Kindergarten (small school with only 48 children in each grade), I would assume that their friendships predate their interest in Ringo. From my observations

over the year (10/16- 5/18) at recess, this group shared an interest in Ringo. Unlike many social groups that form in school, which are often a single gender or ethnicity (Tarrant et al., 2006), this group included three boys and three girls, two white children, three Latinx children, and one African American child.

4.2 BACKGROUND

Ringo was a leopard gecko and the only classroom pet in Mrs. Peacock's room. He lived in a ten-gallon aquarium on the side counter in the classroom close to the window. He had a warming light on a timer, a little house structure that he could hide under or climb on top, along with a water bowl. He ate live crickets. The substrate for his home was sand. He also had a plastic travel carrier for his weekend and holiday trips to students' homes. Ringo had been a part of this classroom for four years at the time of the study. He was not a part of the curriculum, except for the introduction to the class at the beginning of the year. Mrs. Peacock told the student about Ringo during the first day of class. She explained that he is a leopard gecko and he eats crickets. She talked about he can go home for a visit during the weekend or holidays. After this he was never mentioned as part of the curriculum.

Students could ask to hold Ringo or play with Ringo during class time (provided he was not a disruption). Students also had the opportunity to take him home for the weekend and during school breaks. The teacher, Mrs. Peacock, sent a note home at the beginning of the school year, asking parents to send back the signed bottom portion of the note if their child could bring Ringo home for a visit. Then, before each weekend, the teacher drew a name from a jar containing all eligible children. The chosen child would ask permission from his/her parents and on Friday afternoons take Ringo home for the weekend. Many times, students would bring in pictures, drawings, and stories of Ringo's

weekend adventures. Luna's family was the back-up if no one could care for Ringo during a school break. Mrs. Peacock also asked students to bring in crickets to feed Ringo. Some of the students during their interviews talked about when their older siblings had Ringo home over a weekend and stated that they couldn't wait for their turn, demonstrating that it was a memorable experience.

Mrs. Peacock oversaw Ringo's care; however, during the year I observed in the classroom, a group of fifth-grade children took the lead on Ringo's care. I call this group the "Ringo Keepers." There was no official organization to the group, nor did the teacher encourage its creation but over time, the group gained legitimacy within the classroom community and was recognized as responsible for Ringo's care by both Mrs. Peacock and the fifth-grade students.

4.3 RINGO KEEPERS

The group of Ringo keepers initially comprised five members: Luna, Tim, Inge, Austin, and Lindsey. Isaac, whom I will discuss in Chapter 3, joined later. The leader of the group was Luna. As I will show, Luna assumed this leadership position that was both desired by her and granted from her fellow classmates. I observed that she routinely checked on Ringo's cage, changed his water, and, if needed, informed Mrs. Peacock about Ringo or his needs. I heard Mrs. Peacock on at least two different occasions (FN 10/09/2016 and 11/01/2016) ask Luna about how much Ringo had eaten, suggesting that Mrs. Peacock trusted Luna's care of Ringo. Luna was also the one who determined whether students could take Ringo out during recess. She made that determination, according to her, by considering the weather and the student's previous handling of Ringo. One time (FN 10/25/2016), when a fourth grader wanted to take Ringo out during recess, another student informed him that he should ask Luna first. Another time (FN 04/12/2017), Isaac,

a recent addition to the Ringo Keepers, asked Luna if he could take Ringo out for recess and she responded, “no, it’s too cold for Ringo today.” She explained to me that, “since Ringo is cold-blooded, he doesn’t do well when it’s cold.” She further explained, “that is why he has a heat lamp.” This is an example of her knowledge and authority supporting her position as a Ringo keeper (Varelas, Martin, & Kane, 2012).

Tim’s role in the Ringo Keepers was as the knowledge authority on leopard geckos. He had a leopard gecko at home, which he acquired after he met Ringo. Tim was not usually with the group holding Ringo during recess, as he preferred to play with the lower elementary children on the adjacent playground. He would often check on Ringo at the beginning of recess and then go play with the younger children, who gathered around him vying for his attention. However, Tim was the person the fourth and fifth graders would ask questions about Ringo. As a recognition of Tim’s knowledge (FN 10/18/2016), a classmate asked Tim where leopard geckos live in the wild; Tim answered that they live in the desert of India, Iran, and Iraq. He was also asked if Ringo would bite and how old Ringo was. Tim was generally a quiet person but spoke when he had something to add to any given conversation. When I asked the students in their interviews which students were good at science, they often mentioned Tim.

As mentioned before, the Ringo Keepers took Ringo out to recess on warm, sunny days. They included Ringo in their imaginary play and other games like chase, hopscotch, or drawing on the sidewalk. The Ringo Keepers also pet, held, and talked to Ringo. They cared for his cage, changing his water, checking on his eating, and cleaning his cage when needed. This group would gather the things needed for the students to take Ringo home over the weekend. At times, they would hold Ringo during class. Ringo liked to snuggle between the students’ shoulder and neck.

4.4 LUNA, THE RINGO LEADER

Luna identified herself during her interview (014Int 03/24/2017) as the person who liked Ringo the best and also one of the people (along with the teacher) who oversaw his safety, such as keeping him away from the kicked balls at recess. I observed Luna most days when she entered the classroom checking on Ringo (quietly without prompting). During the interview, Ringo was snuggled up around her neck (see Figure 1). She described all of the pets, including lizards, she and her brothers had. Her actions before the interview were very informative. She changed jackets, and when asked why, she said that Ringo gets his talons caught in the jacket she was wearing so she makes sure she wears a denim jacket instead.

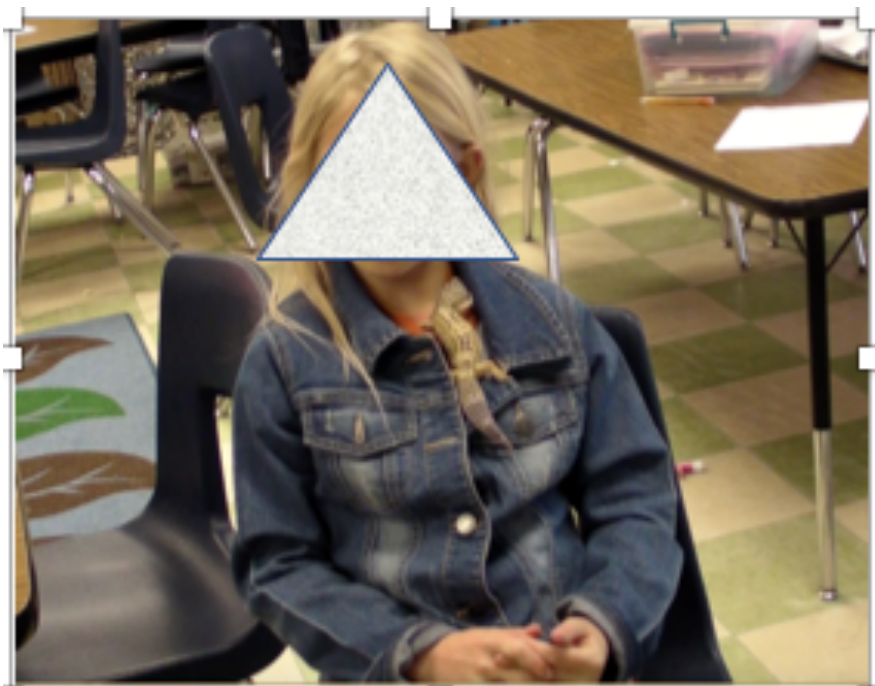


Figure 1: Luna in her denim jacket with Ringo snuggled up close to her neck during her interview.

In this part of the interview, Luna tells me about all her family's pet lizards:

(2:10)

Luna: At my house, I have two bearded dragons. And they're adults but they are like this big and they are very fat. The girl is Geico and the boy is Jasmine. So, we got them well at first, we thought that Geico was a boy and the second and the other one we thought that Jasmine was a girl but when we read in the book that it was actually that Geico was the girl. We read about how to find that out and we found out that Geico was the girl and Jasmine was the boy and then we also have a leopard gecko.

Michele: Is that what Ringo is?

Luna: Yes, Ringo is a leopard gecko. And at our house our leopard gecko has a very small cage but it only about this big and it's not very fat but is actually way lighter than Ringo and she her name is um Liam and she every time the lights are off in the living room, the bearded dragons are asleep she's over on the floor or either on her top of her cave and her eyes her pupils are just wide and it looks like when a puppy is begging and it's really cute.

Michele: When did you get all your lizards?

Luna: We got the bearded dragons at Zookeeper first by Arby's somewhere down there and then we got Liam around I don't remember but it was last year.

Michele: Why did you get Liam?

Luna: Well because Tim, he wanted a leopard gecko and so for Christmas (2015) he, it was on Christmas day we got her actually I think or night and he said he wanted a leopard gecko and we found one.

This is a case where Ringo being in the classroom was a catalyst for Tim getting his own leopard gecko. The family liked lizards (they already had two), but Tim wanted a

leopard gecko specifically because of Ringo. Having lizards at home gave Luna and Tim relevant experience and knowledge that was recognized by their peers and teacher.

Ringo's hurt toe

Carlone et al. (2014) explain that positioning by oneself by people of authority (Mrs. Peacock) and by fellow students is an observable element of science identity work. The episode that follows demonstrates how Mrs. Peacock positioned Luna as knowledgeable about Ringo in direct comparison with two other students, Mateo and Tanya. It also shows how Mateo positioned Luna as an “animal person” because of her actions (touching animals is “nasty!”).

During lunch in the classroom (04/13/2017), Luna brought Ringo to Mrs. Peacock to show her that his foot was hurt. Over the course of the conversation, Luna used a hand lens to make an observation and hypothesized how Ringo's foot could have been injured. Competence in using science equipment is a skill acquired during science identity work (Carlone & Johnson, 2007), an observable element of identity work.

The teacher and Luna talked about what to do for the lizard. Later in the conversation, Mrs. Peacock even adopted Luna's hypothesis (showing that Mrs. Peacock positions Luna as knowledgeable) (Yamakawa, Forman, & Ansell, 2009) about how Ringo's foot was hurt when she was talking with Mateo.

Luna's and Mrs. Peacock's exchange

(016Class 0:06)

Mrs. Peacock: Oh, his tail looks good.

Luna: Yea, cause that is what I saw right there.

Mrs. Peacock: Yeah.

Michele: When is the last time you held him? When you notice his tail?

Luna: The last time you videotaped me [two days prior].

Michele: Oh, OK.

Long silence as Luna is looking at the lizard with the hand lens using science equipment.

Mrs. Peacock: Um yeah, they don't really do check-ups for lizards.

Luna: [Using the hand lens] Would they do one for this one?

Mrs. Peacock: Oh look is he using it?

Luna: No he is holding up ... You can tell... Look.

Mrs. Peacock: What do you think happened to him?

Luna: I don't think... Probably got caught in a shirt or a jacket cause his nails, they hold or get a good grip on shirts and jackets and ripped it up a little, or he probably got caught on something. Cause I heard that crickets actually will start eating the lizard if you leave them in there for a while.

Michele: Where did you hear that?

(1:32)

Mateo and Tanya enter the classroom at this time and are listening to the conversation.

Luna: Well we have two bearded dragons. One leopard gecko and I have a fish. [Uses the hand lens again.] Yeah, he's definitely holding it up. [scratches Ringo under the chin gently.] The leopard gecko we have, it's a lot a little pale. Because she is younger and half the size.

During this conversation, it is understood that Mrs. Peacock respected Luna's opinions about Ringo's injury and listened to her explanations. This shows how she positioned Luna as a knowledgeable and trustworthy person about Ringo's care. Luna

actively took responsibility for caring for Ringo and independently investigated his physical conditions. By using careful tool-mediated observations of Ringo's body, a practice of professional biologists, and hypothesizing on causes, Luna showed powerful knowledge of biology. In this process, she reified to the teacher/gatekeeper her position as worthy of leading Ringo Keepers, maintain her positioning as a leader of the Ringo group.

During the interaction, Luna briefly left the classroom and Mrs. Peacock talked to Mateo and Tanya about what she should do for the lizard. Mateo and Tanya looked at the lizard's foot and told her to take him to the "pet hospital thingy." She further encouraged Mateo and Tanya to come up with other ways to help Ringo; they replied that they don't know what should be done. At this point, the conversation has turned into a critical thinking exercise and less of a conversation. Luna returned to the classroom for the end of this conversation but let Mateo and Tanya try to figure out how to help Ringo. During her conversation with Mateo and Tanya, Mrs. Peacock adopted Luna's hypothesis of how Ringo hurt his toe, reinforcing Luna's knowledgeable position.

(6:26)

Mrs. Peacock, to Mateo and Tanya: You gotta be the animal doctor.

Mateo: No, Luna like(s) playing with animals. Luna like(s) animals. She picks up anything that's nasty.

Michele: Nasty? You don't like animals?

Mateo: No, she touches all the animals

(7:10)

When Mrs. Peacock was talking to Mateo and Tanya, her tone was different than when she was talking to Luna. Mrs. Peacock and Luna were trying to determine the extent of Ringo's injury and whether it needed to be tended. However, with Mateo and Tanya, her attitude was different; she was trying to get Mateo and Tanya to notice the injury and

determine a solution. Mateo and Tanya were in the room listening for part of the conversation with Luna and Mrs. Peacock. They probably understood the positioning of Luna by Mrs. Peacock (the authority). At the very end of the conversation when he says that Luna likes playing with animals, Mateo demonstrates that he positions Luna as an animal person and authority of Ringo's care. Mateo deferred to Luna as the animal person and thought that Mrs. Peacock should ask her what to do for Ringo. Comparing these two parts of the conversations demonstrates how Mrs. Peacock positioned Mateo, Tanya, and Luna.

Touching the animals was a dividing theme for the students in the fifth grade. This idea is also in the episode with the boys catching fiddler crabs at UTMSI (Chapter 4). There are the students who are willing to touch organisms like the worms in health class and those who consider touching those creatures as "nasty" or disgusting. I haven't found any published study on this, but speaking as a former teacher, this is often an issue in a biology class. For example, some students are excited about dissecting a rat (or other animal) while other students are disgusted. Some students exaggerate their disgust during dissecting organisms to team up with their friends who are also disgusted. Rozin and Fallon (1987) found that the idea of disgust was not found in children before age one and was a socially constructed idea. What is disgusting in some cultures was not equally disgusting in other cultures. Luna and Tim were both well known for being willing to pick up various organisms. Luna proudly said on a video (043Class 04/26/2017), recorded when the students were working in the garden that they maintained as part of their health class, that she catches bees with her bare hands. The health teacher in an interview (087PortA 05/04/2017) talked about how Tim and Luna were asked by the other children in class to pick up bugs or worms found during gardening. Touching and closely observing are science skills.

4.5 TIM'S INDEPENDENT LEARNING ABOUT RINGO

Tim was part of the Ringo group, but as explained before, he did not usually participate with the students who took Ringo out during recess. He was a Ringo Keeper and an expert on leopard geckos. These episodes show learning, engagement, interest, and self-sustaining activity around Ringo, which are all types of identity work.

In the fall, Tim walked up to Mrs. Peacock during class to talk to her while the other students were working in groups on a lab (FN 10/12/2016). I overheard Tim tell Mrs. Peacock that “Ringo only catches crickets when on top of his house.” He hypothesized that maybe Ringo didn’t want to also eat sand with his crickets. This was random exchange. However, he was watching Ringo right before he made the comment to Mrs. Peacock. After the comment, he returned to his desk and continued working on the lab. This is one example of how although Ringo is not mentioned in class, the students still watch him and interact with him during class.

Tim was using his science skills to make observations, develop a hypothesis, and find patterns about Ringo’s behavior. This learning about Ringo drove his making a gift for Ringo at the end of the school year. Learning about Ringo and using science skills were all part of Tim’s identity work.

Later in the school year (FN 04/19/2017), I overheard a conversation between three children, Tim, Isaac, and Edgar, about Ringo. They did some computer research about leopard geckos and found that they can get too much sand in their stomachs. This is an example of learning that emanated out of interest in Ringo (Barton & Tan, 2010; Moje, Collazo, Carrillo, & Marx, 2001). The students were reading about leopard geckos and figured out that Ringo needed to avoid eating too much sand and that could be why he caught crickets on top of his house.

The above episode shows that Tim was still thinking about Ringo's eating habits and talked about it with his friends. They followed up and did some research to find out why Ringo hunts crickets on his house. In the first episode on 10/12/2016, he told the teacher, or authority, about what he had observed and in this later episode he told his peers, reinforcing his position as a knowledgeable Ringo Keeper. This shows long-term engagement and also his knowledge about Ringo.

At the end of the year (FN 05/17/2017), many fifth graders brought in gifts for Mrs. Peacock. Mrs. Peacock would open the gift in front of the class at the end of each period, profusely thanking the student who brought the gift. Tim was very excited about the gift he brought, and asked Mrs. Peacock two times during class when she was going to open it. Before she opened the gift, Tim explained that it was actually a gift for Ringo. It was a house for Ringo that Tim had built out of rocks and plaster of Paris. It had a flat top for Ringo to capture crickets. He stood up after the gift was opened—without being prompted, he was typically very quiet—and explained that he designed and built the house this way because Ringo doesn't like to catch crickets that are on the sand. Tim speculated that Ringo would like this house since it had a big roof. Later during recess, Tim brought friends to the classroom to show them what he had built for Ringo. This episode shows the importance of Ringo to Tim. This gift was an act for Tim to reify his position as a Ringo authority.

In this last episode, Tim publicly displayed his knowledge about Ringo and his long-term engagement in his self-devised project. This positioned him as an able Ringo Keeper. His identity work was the public performance of knowledge and the reflexive response of the class that positioned him as a Ringo Keeper. Learning is a part of identity work (Nasir & Cooks, 2009) and these episodes illustrate how much knowledge he had

developed on his own by using the practices of science (observations, hypothesizing, finding patterns) around Ringo.

4.6 CONCLUSION

The identity work done by the Ringo Keepers to reify their positions as Ringo Keepers helped to define them as part of a group or community (Sfard & Prusak, 2005). Luna and Tim identified themselves as Ringo Keepers along with their peers and Mrs. Peacock, but identity is fluid and contextual (Beach, Lundell, & Jung, 2002; Fields, 2010). This means that they must do identity work to reify their positions. By recognizing their learning and documenting their actions over time, their identity work becomes clear. The Ringo Keepers were not learning about leopard geckos to become herpetologists, but instead were learning about Ringo to be a Ringo Keeper.

Luna and Tim were exemplars of identity work, as seen in the student's active efforts to position themselves as certain kinds of people (Gee, 2000b). Their peers and teacher reflexively positioned Luna and Tim as knowledgeable Ringo Keepers. Luna and Tim illustrated the relationship between identity work and learning. Lastly, they show that identity work around practices is sometimes articulated across various settings and contexts (classroom, home, and recess) in which the person circulates.

Chapter 5: Imaginary Play, Ecology Knowledge, and Identity Work

5.1 INTRODUCTION

This chapter is about Luna and Inge's imaginary play, which took place at recess and at home and which afforded identity work. Luna and Inge pretended they were characters from the *Warriors* books during the school day (FN 04/24/2017). *Warriors* is a series of chapter books that follows various clans of anthropomorphic wild cats. Inge and Luna were reading these books independent of school. Inge would first read a *Warriors* book and, when finished, give it to Luna to read. Luna would return the books to Inge after she read them. Inge had read all of the *Warriors* books published, some of them several times (FN 4/24/2017). Both girls chose to read these books during silent reading time at school and at home. Imaginary play can be a space to practice new roles (Bodrova, 2008; Bodrova & Leong, 2006; Leont'ev, 1997; Piaget, 1952; Vygotsky & Cole, 1978; Zaporozhets, Elkonin, Shybut, & Seymore, 1971) and, in this case, a place to practice ecology concepts. This imaginary play for Luna and Inge afforded a context for extended science identity work.

There is extensive research into play with preschoolers, especially around language development and literacy (Dickinson & Tabors, 2001; Neuman & Roskos, 1990; Pellegrini & Galda, 1993; Roskos, 2017). Piaget (1952) and Vygotsky (1967) both wrote about play. Vygotsky saw imaginary play as a way for young children to practice future roles and to gratify impossible desires. Play is "a novel form of behavior in which the child is liberated from situational constraints through his activity in an imaginary situation" (Vygotsky, 1967, p. 9) For instance, children might play hospital and practice such roles as being a doctor or a nurse. Many researchers agree that play is very important for preschoolers to

learn how to engage and interact with the world around them (Bodrova, 2008; Bodrova & Leong, 2006; Leont'ev, 1997; Piaget, 1952; Vygotsky, 1967; Vygotsky & Cole, 1978; Zaporozhets et al., 1971). I will show in this case how fifth graders' imaginary play supported ecology understanding and science identity work.

Vygotsky's view of play emphasizes that children create an imaginary situation, take on roles, and follow a set of rules determined by the context (Vygotsky, 1967). For instance, when children pretend to be kittens, the rules for that play are constrained by normal kitten behavior. A kitten can't eat with a knife and fork, therefore when children are playing the role of a kitten, they don't use knives and forks. Vygotsky used the term "play" to mean specifically imaginary play. He thought of play as a leading source of development in the preschool years (Bodrova, 2008; Leont'ev, 1997; Vygotsky, 1967; Zaporozhets et al., 1971). Vygotsky further explained that play was one of the social contexts for creating children's zone of proximal development (Bodrova, 2008; Vygotsky & Cole, 1978), meaning that children behaved more maturely and acted with greater self-control during play than in their normal everyday situations. Vygotsky never addressed imaginary play in children beyond kindergarten, and he didn't agree with individuals who thought imagination in young children was replaced over time by conforming to reality.

Vygotsky and others (Elkonin, 2005; Vygotsky, 1967; Vygotsky & Cole, 1978; Zaporozhets et al., 1971) explain that (imaginary) play matures over time in children. At first, when children start to play, objects and action are the primary structure of play where the meaning of the play is secondary. But as the child matures, the objects (like toy brooms) become more abstract (maybe just a stick) and actions (physically sweeping the floor with the toy broom) are less needed. The meaning of the play (for example, pretending to be the mother) becomes the driver of the play. Elkonin (2005) and Bodrova and Leong (2006) talk about an advanced stage in play called mature play. This is play in which 1) the child

uses object-substitutes (a stick instead of a play gun) with very little resemblance to the objects they represent or no object at all, 2) the scenarios integrate many themes, and 3) the play might span periods of time like days or even months. Carlson and Zelazo (2009), further expanded on this idea by adding that the children at this stage (mature play) are able to consider more than one aspect of the scenario, weaving different stories together, along with understanding the different stories of the characters in the imaginary play.

Mature imaginary play is a good description of the type of play Luna and Inge did centered on the *Warriors* books. For instance, Luna and Inge explained to me (FN 04/24/2017) that during recess they would often start playing a scene from the book and make changes in the scene as they wanted, having an understanding of how the characters would normally act, integrating things from their real world. For instance, Inge explained to me that if the scenario that they were enacting from the book took place on a sunny day but it was raining in their real world, they would modify their play and the scene would be happening on a rainy day (FN 04/24/2017). Their play did not include the use of any objects (like toy kittens or rubber mice) and spanned their fifth-grade school year. I will explain more about their imaginary play later in this chapter.

While children are playing, they are negotiating culture, language, and behavior and importantly in this case, they were also negotiating ecology concepts. Much of the fictional *Warriors* books deal with territory boundaries, hunting, shelter, and mating, concepts that find their basis in canonical ecology. These books are fictional and at times the cats are anthropomorphic in their actions but there are many accurate ecology concepts within along with reasoning. I will show that, through this imaginary play, Luna and Inge also came to a better understanding of some ecology concepts that they were also studying in class.

5.2 PIVOTS

An essential aspect of Luna and Inge's imaginary play is the concept of pivots. Vygotsky (1967) used the term pivots to describe how a child needed to separate the meaning of an action from the real action, thus requiring a "pivot" of a new action replacing the real action. Therefore, the real action is replaced by the "pivot." For instance, a child listening for a heartbeat while playing hospital might use a jar lid placed over the heart as a "pivot" rather than a stethoscope. This process of action replaced by pivots (in this case, a similar action but using a tool that is a little more abstract) can be repeated until the action is less important than the meaning. For example, the next time the students play hospital they might use a small rock instead of the jar lid, further deemphasizing the objects and action but supporting the meaning. Acting out the actions becomes less important but the meaning of the play remains. This is the process by which, according to Vygotsky (1967), play matures to the point that objects used for actions are no longer needed, but the action is understood.

Another way of thinking about pivots, are pivots being on the boundary of the imaginary world and the real world. For example, if a child is playing an imaginary game of house, the plastic kitchen set might act as a pivot into their imaginary work (Holland, 2001). Sengupta and Shanahan (2017) build on that idea and write that pivots can be boundary objects allowing the individual access between different figured worlds to cross borders. Even short-term entry into these fantasy worlds can affect individuals' identities in their usual worlds (Sengupta & Shanahan, 2017). In other words, pretend or imaginary play can have an effect on an individual's identity during the imaginary play and concurrently their everyday identity. For example, if a child in their imaginary play is battling a monster and wins the battle, this confidence may influence their behavior when confronting a bully in their real world. Sengupta and Shanahan (2017) found using public

computers where people interacted with the code (the pivot) to create a new figured world gave the group of individuals meaning to the nonsensical computer figures (their figured worlds). The participants determined their own meaning for the computer figures, creating a figured world. In one case, they determined that the computer figures were in prison and the actions were how individuals would act in prison overcrowding. Sengupta and Shanahan (2017) found that the act of changing the code changed the individuals' identity from a recipient of computer code to owners of the code in the real world. Thus, the pivot (computer code) created an emergent figured world, simultaneously changing the individuals' normal worlds. In the case of Inge and Luna, I will show that the pivot altered both the girls' shared imaginary world and their own normal worlds.

5.3 WARRIORS BOOKS

The book series is written for an interest level of fourth through eighth graders and at a reading level of third through sixth grade. There are six books in the original series, seven subseries, and some stand-alone "super edition" novels. In other words, there are many books to keep children reading about the adventures of these cats.

The books are in the fantasy fiction or young adult fiction genres and are written by a small group of authors under the name of Erin Hunter. The books have a large following especially in the United States with new releases making the best sellers list for young adult fiction. The *Warriors* series books are around 300 pages while the "super edition" books are more than 500 pages. The books deal with common themes of survival, faith and spirituality, forbidden love, and good and evil; science concepts are not among the themes, but appear organically as part of plot and setting.

The *Warriors* series has taken much creative license regarding ecology concepts. Using medicinal plants to cure illness, monogamous relationships, and cats being diurnal rather than largely nocturnal are all false biological concepts used in the books. Even though the books do not center on ecology concepts and are fantasy fiction, the children I studied found some helpful ecology understanding. Inge said (FN 4/24/2017) that she understood the concepts of food chains and food webs better because of the examples in the books. Inge used some of the ideas when she was working with her lab group on the food chain/food web poster shown later in this chapter. She also understood the abiotic and biotic factors (Inge did not use the specific terms in her explanations) in the environment from her readings, for instance, the need for shelter and animals eating organisms found in their territories. Inge and Luna practiced these concepts during their imaginary play, pretending to go on hunts, eating meals, and feeding kitties. There were battles over resources and space in the books, which Luna and Inge related to real-world scenarios. While there were many inaccurate ecology concepts (mainly around the anthropomorphizing of the cats in the books), Luna and Inge connected the books to the concepts that were related to the ecology lessons they were studying in science class. I have no evidence that they brought into the classroom any incorrect concepts learned in the books. I will further explain this later in this chapter.

The first *Warriors* book, *Into the Wild*, begins when a warrior cat, Graypaw, meets Rusty, a Kittenpet (the series' nomenclature for domesticated cats), in his owner's garden one night. Rusty and Graypaw talk and Rusty decides to leave with Graypaw to pursue a life in the forest with ThunderClan. The first book is about Graypaw and Rusty's adventures as apprentice cats. In the book, ThunderClan battles the ShadowClan with the help of Rusty's fighting prowess, which earns him the warrior title of Fireheart. The books in the series continue with this type of fantasy adventure.

The *Warriors* books use a special warrior cat lexicon. Instead of writing that a character “said” something, the cat character instead meows (or some conjugation of the verb “mew”). The clans refer to humans as “Twoleg,” “glowpoles” are streetlights, “newleaf” is spring, and “sunhigh” is noon. Calling something fox-dung is a harsh insult, while “mouse-brain” is a friendlier insult suggesting that someone is not very smart. These are just a few examples of the series’ extensive lexicon. Luna and Inge used this lexicon when they were in the warrior cat world, continuing to follow the “rules” of their imaginary world. During the girls’ imaginary play they were learning, in addition to ecology concepts, processes such as: socializing, cooperating, reading, play, symbolism, and problem solving.

5.4 READING WARRIORS BOOKS

One day (4/24/17) during recess, I approached Inge sitting alone at a picnic table. I asked her if I could join her. She said that I could. It was a nice day out and the other children were playing in the green space and on the sidewalks around the green space. I asked Inge why she wasn’t playing with her friends. She said that she was sad because Luna wasn’t there during recess; she was at a doctor’s visit. Inge had a book open in front of her and I asked what she was reading. She said she was reading one of the *Warriors* books.

During this conversation, Inge explained how the *Warriors* books were related to what her class was studying in science. In science, they were studying ecology; specifically, standards 3.9(A): observe and describe the physical characteristics of environments and how they support populations and communities within an ecosystem; 5.9(A): observe the way organisms live and survive in their ecosystem by interacting with the living and non-living elements; and 5.9(B): describe how the flow of energy derived

from the sun, used by producers to create their own food, is transferred through a food chain and food web to consumers and decomposers.

She explained (FN 4/24/2017) how the books were organized. She told me that there were four different clans in the books and each clan ate different food depending on their territories. For instance, she explained that the ThunderClan lives in woodlands and eats mice, voles, and squirrels while the RiverClan prefers fish and also eats water voles and shrews. Since the ShadowClan lives in the marshland, they eat many reptiles and amphibians and at times “crowfood,” meaning carrion even though it made them sick sometimes. The last clan she talked about was the WindClan, which lives on the open moors and feeds on hares and rabbits. She said that these books were related to the type of science they were studying in class (ecology), and because she liked the books, she also liked what they were studying in class at that time best.

Inge was very excited to tell me about the books. She was able to explain where the different clans lived and connect it to what they were studying in class. This learning when applied to science class changed her positioning among her peers. At the same time, Inge was also doing identity work linked to friendship development and performed through imaginary play but fortuitously bordering the practice of ecology. Her learning was consequential to classroom learning.

5.5 APPLYING WHAT SHE HAD LEARNED TO CLASS

She further described the predator/prey relationships (such as cats and voles, foxes and cats) in the books and compared them to the ones discussed in class. In teacher-assigned groups in science class, the students were making posters to show examples of food chains and food webs. She was able to provide examples to her lab group from her

readings (rabbit eats grass, cat eats birds, fox eating voles, and fox competing for voles with cats) (FN 04/26/2017). On the lab group's poster, she suggested the rabbit eating grass, wolves eating deer, and a lion eating wolves. Based on my observations throughout the school year, it was rare to see Inge speaking up in the lab group. This was a change in her normal behavior. Even though she had originally suggested cats eating voles and possibly eating a fox, through conversation with the group, her suggestion changed to the lion eating wolves. As a group, the students worked together on the food webs, discussing suggestions and making compromises. In some cases, the group changed ideas because the person drawing the idea couldn't draw certain animals or didn't know what the animal looked like, such as a vole. The group recognized Inge's suggestions and used them on their poster as seen in Figure 2.

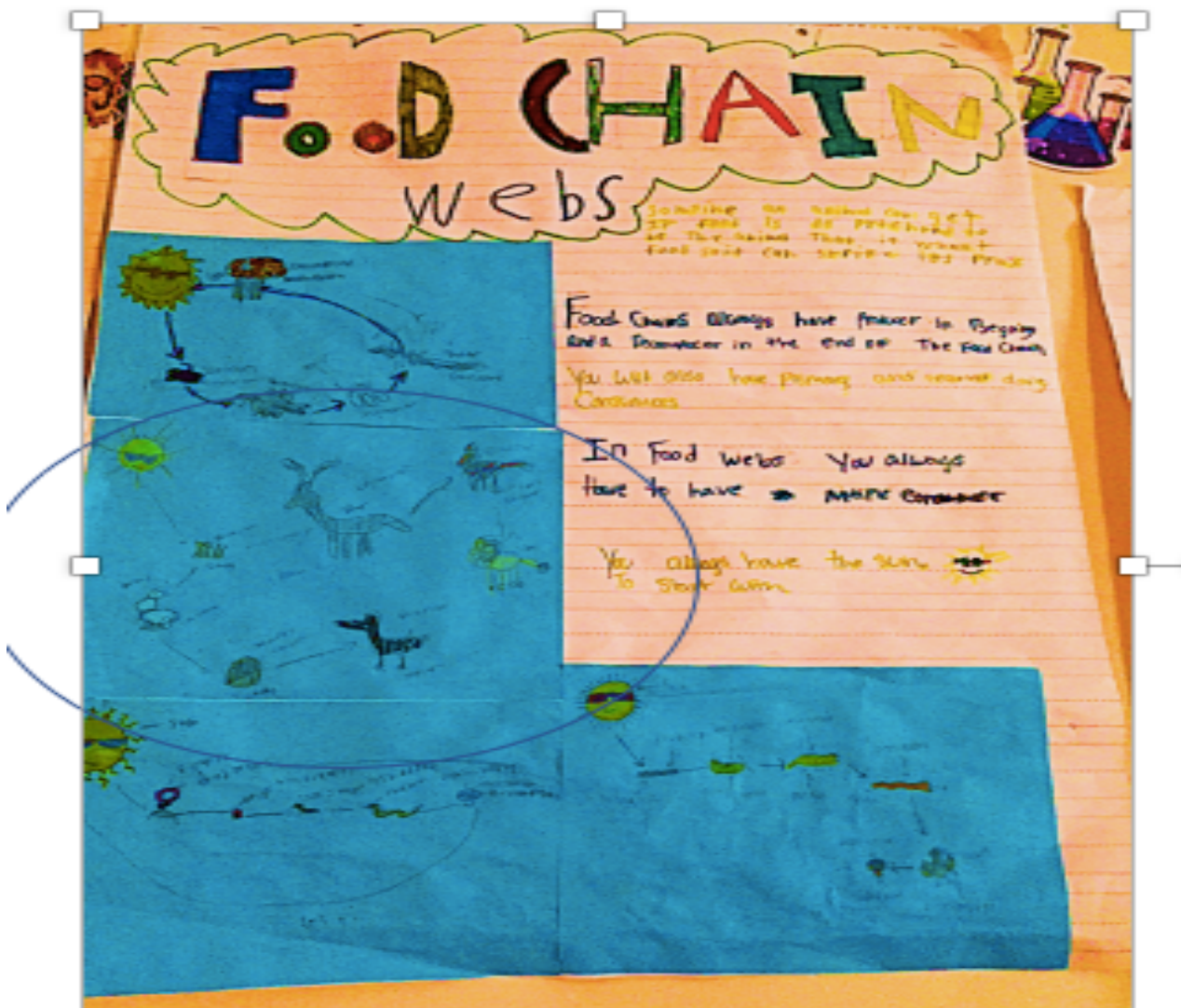


Figure 2: Inge's group final poster explaining food webs and food chains. You can see the web (circled) that shows that lions eat wolves eat deer eat grass. Rabbits also eat grass and fox eats rabbits and wolves eat fox. While this is not an actual food web that happens in nature, the students did show relationships.

Inge was not typically a leader in her lab groups; in fact, she was usually designated as the "drawer" since she could draw well and would draw whatever the other students told

her to draw. I watched her during a land forms lab (FN 04/07/2017) when she often didn't get a turn making the land forms because she was documenting (by drawing) for the group's lab report. In the land forms lab, the students mimicked the process of weathering forming models of different land forms. The students in the lab group wanted a turn at each station, but Inge was the last one to try and twice didn't get a turn before they had to change stations. This new leadership role where she made a suggestion and continued to advocate for the suggestion was a change in her positioning (Calabrese Barton et al., 2013). Her change in positioning was two-fold: she was making suggestion for the poster and the lab group accepted and used her suggestions. She had stated before when I talked to her about the books that she was interested in this type of science because it related to science in the Warriors books. The understanding that she gained from reading the books changed her positioning among her peers, stemming from her identity work (Nasir & Cooks, 2009).

As mentioned before (FN 04/24/2017), Inge and Luna pretended they were characters from the Warriors books during the school day. They even designated some of their fellow students (without their knowledge) as different characters from the books. No one knew that they were "in character" but Inge and Luna.

The following week (FN 05/01/2017), when I told Inge and Luna that I had started reading the first Warriors book, they invited me to participate in their imaginary play and told me my character was Spottedleaf, a medicine cat. After this short conversation, I didn't get another chance before fifth grade ended to talk to them more about the books or their imaginary play. As I observed them during the school year, I had no idea of their imaginary play. Looking back, I remember a few random times when they used strange words but when I asked them about it, they either didn't hear my question or said they said something different. I can only assume now they were talking as cats.

In the above example, Inge was connecting what she was reading in the books with what the students were doing in class. This was also a chance for Inge to practice taking a leadership role, which might result from future and continuous engagement with classroom work. As Vygotsky (1967) explained, imaginary play is a way for children to practice future roles and in this case, Inge was practicing a leadership role. She read the books before Luna and had read many of the books several times. She knew the stories better and when she was telling me about their imaginary play (FN 04/24/2017), she explained that she was the one who decided what stories they were going to play since she knew them better. Practicing a leadership role helped Inge take a leadership position in the group project. Previously, her role was as a compliant group member. Inge was also learning about ecological relationships while playing Warriors. This understanding supported her leadership role during the group project on food chains and webs. Without having an understanding of the ecology concepts, she would not have been afforded the leadership position by her fellow group members. Learning about Warriors contributed to Inge's identity work, affecting both her positioning and participation with her group on the poster.

5.6 THE PIVOT IN WARRIORS PLAY

The girls' imaginary play was a space in which they could practice the stories from the books. They followed the rules of their imaginary world by using the lexicon of the Warriors cats and acting like Warriors cats. The pivot for the girls was the books. These were boundary objects or objects in both their imaginary world and the real world and the objects that allowed the girls to pass into their imaginary play world. These are also the objects that provided the girls with the stories of their imaginary play or at least the beginning of their imaginary play. In their imaginary world, Inge had the lead position. She determined the stories they played. She had read all the books and knew the future stories.

This leadership positioning also boundary crossed into their real world. Their imaginary world not only changed their imaginary world, but also changed their positioning and agency in their real world. In both these worlds, their learning supported identity work.

5.7 SCIENCE IDENTITY WORK

When the girls started playing as Warriors cats during the school day, they were not actively seeking more science knowledge. They were playing, sharing stories by acting them out. This was mature imaginary play where meaning was more emphasized than action. In fact, their action was so minimal that I never saw evidence they were acting as cats during the school day. This imaginary world gave Inge a chance to practice being the leader, being the one who determined the story. This imaginary world provided a space for the girls to practice biological concepts and really understand the direct and indirect forces of nature. The girls were also working on maintaining their friendship. This showed a case where imaginary play and identity work are related to science participation and learning in the classroom along with identity work and friendship relations and classroom learning.

5.8 CONCLUSION

To my knowledge, there is no research on imaginary play during the school day of fifth-grade students. In previous work by narrowing science identity work to classroom and extracurricular environments (Calabrese Barton & Yang, 2000; Carlone et al., 2008; Tan & Barton, 2008b, 2010), we have missed the broader contexts and process through which students might do science identity work. The girls' imaginary play gave them space to try out different roles, positions, and even to better understand ecology of the Warriors world. During their imaginary play, the girls were not directly working on their science identity. They were not playing the imaginary game to learn more about ecology; however, through

reading the books and their play, they were learning about food chains, food webs, and physical characteristics of the cats' environment.

This knowledge also allowed Inge take a leadership role with her lab group when they were working on the poster about food webs and food chains. For her positioning to change, she had to work on changing the position, and her lab group had to let her change her position and her identity as a person who knows science. The play was not conscious science identity work, but as a result of their play, Luna and Inge's identity was altered, much like the participants who changed the computer code (Sengupta & Shanahan, 2017). The girls were also maintaining a friendship as they played these imaginary scenarios. Their imaginary play, maintaining friendships and identity work connected to science class participation is a contribution to the understanding of identity work.

Chapter 6: Isaac: A Boy Searching to Be Helpful

6.1 INTRODUCTION

Isaac was involved in many of the episodes in this dissertation. In this chapter, I argue that Isaac was doing identity work, specifically identity work on helpfulness; in other words, trying to build an identity of being helpful. Isaac talking about wanting to be helpful or being helpful was a way for him to be perceived as important and needed by others (Call, Mortimer, & Shanahan, 1995; Markus, Cross, & Wurf, 1990). In his interview he mentioned how he was helpful to his family members and others. Call et al. (1995) found from data on 1,000 surveys that adolescents performing helpful acts were acting toward the “adult” possible self. They also found that immigrant parents encouraged greater family interdependence, which facilitated helpfulness and doing helpful acts around the house, increasing minority boys’ importance in the family unit (Call et al., 1995). Through his helpful actions and helpful self-descriptions, Isaac demonstrated identity work on being perceived as helpful. I will show that Isaac’s identity work involves gaining science knowledge. He gained science knowledge in order to be helpful to the Ringo Keepers, his future possible self as a scientist for the Army, and to be like Tim.

Isaac was a fifth grader and a refugee from Eritrea, and was enrolled at Manuel Martinez Elementary school from third grade. In third grade, he was an English as a Second Language student and by fifth grade, he had no noticeable difficulty speaking English. Isaac was very talkative and social. He had three younger brothers who all attended Manuel Martinez Elementary School. As a student, Isaac was attentive, enthusiastic, and generally well behaved. He enjoyed school and was a good student. He recognized himself as a

science kind of person. During his interview, Isaac named other students who were good in science and then said he loved science.

Michele: Who would you say are the best science students or most interested in science?

Isaac: Miss Peacock, (yea ok) and also Lindsey, Joe, Nicholas, Austin, Michael and that's it.

Michele: How about you?

Isaac: Yea, I love science.

Michele: Are you a good student?

Isaac: Yes, I am a good student

Another day in May (FN 05/20/2017), he was sitting next to Tim as they were working on their self-descriptive poems, Isaac said to Tim, "We are a lot alike. We understand each other. We both like lizards and science." In each interview, I asked the students which of their fellow students were good in science and he was mentioned by two other classmates (Marcelina and Lindsey) as being good at science. Isaac thinks of himself as a science kind of person (Gee, 2000b)

Isaac was often with Luna, Lindsey, and/or Tim. Isaac, Tim, and Lindsey were in the same class and often worked together during group work or labs. Lindsey, Isaac, Luna, and Inge often ate lunch together and played together at recess. Isaac often talked about his family, his home life, his pets, and his garden.

6.2 TALK ABOUT HELPING OTHERS

Toward the end of fifth grade (FN 05/10/2017), all of the students were asked by their homeroom teacher what college they planned to attend and what they wanted to be when they grew up. The students understood that this information was going to be

displayed along with their picture, name art, and poem during fifth-grade graduation. When Isaac was asked about his future plans, he said he wanted to be a scientist for the Army (FN 05/10/2017), as seen in Figure 3. He explained that he wanted to work for the Army to do good things for America. This view of his possible future self adds to understanding of his motivation supporting his basic needs of competence (Deci & Ryan, 2000). Derived from an individual's past selves are possible future selves, which are individuals who he/she might become or who he/she would like to become in the future (Markus & Nurius, 1986). According to Markus and Nurius (1986) images of possible selves make the end state more likely, facilitating a sense of competence. Isaac's clear goal of being a scientist in the Army motivated him for the future. Being able to help others in America motivated him and supported his goal building (FN 03/22/2017) and his perceived competence. This theme of helping others appeared during his interview (005Int 03/22/2017) during a lunchtime conversation with Luna and Marcelina (FN03/24/2017) on a field trip with the second graders to Fiesta Gardens (FN05/01/2017) and during the picnic outside of the aquarium (FN 05/04/2017). He projected his future self as a scientist for the Army because he imagined the career was helpful to others. His figured world of science actually motivated a future self and career.

University of Texas	Lawyer
UT	Softball
Texas A&M Isaac	Scientist for the Army
University of Texas	Doctor

Figure 3: This is a portion of the form that the teacher completed with all of the students, depicting their future plans for college and what they wanted to be when they grew up. This represents Isaac's future possible self.

When I interviewed Isaac in March 2017 (FN 03/22/2017), he talked about wanting to be an architect, scientist, YouTuber, or soccer player when he grew up. Changing career goals is common among elementary students (Auger, Blackhurst, & Wahl, 2005; Patton & Porfeli, 2007) as they go through different maturity stages. When asked about being a scientist, he said, “I could help people make like medicines or something and help people and find a new germ or something or bacteria and help people” (Isaac, 2017) (FN 03/22/2017). When I asked him about being a YouTuber, he said, “I am into helping people so I just want to post stuff on YouTube like there is a new germ or something or like not make people afraid of wasps or bees because I know bees sting but like they only sting if they are attacked” (FN 03/22/2017). When he gave examples about what he would make videos about, the topics centered on science subjects: germs, bees, and wasps, using his knowledge of science as a vehicle to help people.

Isaac explained that he thought sharing knowledge with others is helpful. Even when he explained what he would like to do on a YouTube clip, he shared his understanding of a food chain. This is also supported in the excerpt below from the interview about helping his younger brothers with homework or ABCs.

Michele: What else do you do after school?

Isaac: umm I do my homework, or when I don't have homework or I finish my homework I read books. Or play outside with my brothers or help my brothers do homework. Or help my brother to do ABCs.

The last time he mentioned being helpful during his interview is in the excerpt below. He is insistent that helping was what he enjoyed doing. It appears that Isaac viewed helping, especially sharing knowledge, as a way for others to view him as helpful and competent.

Isaac: I like helping

Michele: You like helping, who are you helping?

Isaac: Helping my brothers out, helping my friends, helping my Dad and Mom.

Michele: Ok, so you like being a care giver or something to help out.

Isaac: Yes

Much of Isaac's helpfulness was around learning (being a scientist discovering new germs) or passing on his own knowledge about science. For example, performing helpful acts is a way adolescents can practice being an adult, which builds their sense of competence especially if their helpful act was voluntary (Bandura, 1986; Call et al., 1995). Isaac felt that making informational science videos and helping his brothers with school work was helpful.

He was also connecting being a scientist in the Army, where he can be helpful to others but especially to America. There are several identities fused into this future possible self, including being American, a scientist, and being helpful.

6.3 HELPFULNESS AS THE KEY TO BECOMING A RINGO KEEPER

In Chapter 4, I describe the Ringo Keepers and the work of Luna and Tim to maintain their positioning as Ringo Keepers. Isaac had a strong desire to be part of this group and he leveraged his helpfulness by sharing his knowledge of leopard geckos to become part of the Ringo Keepers. I found out that Isaac had some pet leopard geckos when I interviewed him (FN 03/22/2017); he explained that his reason for getting the first leopard gecko was because of Ringo. He said, "I thought leopard geckos were cool."

The following month, I observed Isaac on three different days during recess (FN 4/10/2018, 4/11/2018, and 4/12/2018). On each one of these days, he floated between participating in the soccer game and the group that was playing with Ringo. Each day he

would begin recess as part of the soccer game and then seem to lose interest and leave the game to hang closely around the group with Ringo. He was on the outside of the circle that surrounded the person holding Ringo, but never in the actual circle. On the third day (4/12/2018) of observations I watched from the covered deck about 20 yards from the group and noticed that his soccer time was shortened. When he joined the Ringo group, he was holding Ringo. I had never seen him holding Ringo before. This was a change in his position in the group.

Later that day I asked Luna why Isaac was holding Ringo. She explained that he had shared knowledge that he had acquired about leopard geckos with the group. He asked Luna for permission to hold Ringo, and based on his demonstrated knowledge and the fact that he had a leopard gecko at home, she allowed it. Isaac had physically moved from a person outside of the group to being a part of the group. Prior to this day, there were three students gathered around the lizard and Isaac outside of the circle looking in. The third day, he was part of the circle gathered around Ringo; when he was holding Ringo, he was in the very center of the group with the others gathered around him. Luna, acting as a gatekeeper, acknowledged Isaac's knowledge about leopard geckos therefore letting him within the inner circle and hold Ringo.

In that instance, his positioning changed in part because he gave the group helpful advice. This advice showed that he had gained knowledge and was passing on that knowledge to the Ringo Keeper group. Isaac had worked over time to become a recognized member of the group. He became part of the group because he was able to add to the group's knowledge about leopard geckos, and the group's authority figure, Luna, granted him access into the inner circle.

6.4 CONCLUSION

At first when I examined the many episodes of Isaac talking about or being helpful I was thinking that he was being altruistic, performing acts that are not motivated by self-gain (Underwood & Moore, 1982). I then realized that he was motivated to be helpful in order to be recognized as someone who has scientific knowledge (about germs, bees, wasps, and food chains). He was working on an identity of helpfulness, perhaps even competency, but there is not enough data to support that conclusion. He was trying to show others that he was knowledgeable about science. At times while doing his work he did get recognized by others, such as when Luna accepted him into the Ringo Keepers group and considered him knowledgeable about what leopard geckos should eat. His identity work changed his positioning in the group, his participation with the group, and his knowledge (Brickhouse et al., 2000; Van Horne & Bell, 2017). His stories and actions (Carlone & Johnson, 2007; Sfard & Prusak, 2005) show his identity work over several contexts and over time. He recognized himself as a science kind of person. During his interview, Isaac named other students who were good in science and then said he loved science. Isaac thinks of himself as a science kind of person, he thinks of his future possible self as a scientist and some of his classmates view him as a science person (Gee, 2000b). Isaac's identity work was on being recognized by himself and others as helpful and perhaps competent. He worked on his helpfulness by sharing his knowledge of science-related concepts.

Isaac was trying to become a member of the Ringo Keepers. His recurrent visiting with the group at recess was evidence of his desire. He achieved this his goal as evidenced by his change in position relative to the important resource (Ringo). To change his position relative to the group means Isaac must have done some identity work to convince the group to accept him as a group member. There is evidence that Luna judged Isaac to be knowledgeable about leopard geckos, a quality that she recognized in herself.

Isaac was not working on a science identity directly; however, he was learning science concepts to be able to be helpful and become a part of the Ringo Keepers group. The learning of science and being positioned by his fellow classmates as knowing science (Lindsey, Marcelina, Luna, and other Ringo Keepers) changed his positioning. During this process, he recognized himself as a science person, as he said in his interview and also when he said to Tim, “We are a lot alike...” In the next chapter, there is more about Isaac and his struggle to touch different organisms. His learning to touch organisms was a continuation of his identity work of maintaining his position with the Ringo Keepers.

Chapter 7: Using Science Skills and Changing Positioning

7.1 INTRODUCTION

In this chapter, I will show how Isaac, Tim, and Juan organically form a community while they are catching fiddler crabs. Learning about fiddler crabs' habitat and behavior changed their positioning relative to each other and to their classmates and how they developed a successful process to catch fiddler crabs using scientific processes. During this episode, Isaac continued to work on his identity of helpfulness. This episode also shows how Isaac, Tim, and Juan interacted as a group, but at the same time do their individual identity work.

This episode took place during the fifth graders' field trip (5/4:5/2017) to The University of Texas Marine Science Institute (UTMSI) in Port Aransas, Texas. The first day of the trip, the students left the school around 7:30 am on a charter bus. That day, they visited the Corpus Christi Aquarium and did a beach cleanup. The second day of the trip, each class spent time investigating the wet lands (on campus) and on a boat trip into the Aransas Bay, where they gathered animals to examine. They left UTMSI to return home after lunch on the second day.

The UTMSI complex is a mixed-use campus supporting marine biology research, undergraduate and graduate students, outreach programs, and educational programs. The Wetlands Education Center occupies 3.5 acres of the UTMSI campus, between the Marine Science Education Center and the South Jetty. It is a wetland with an inlet area planted with various seagrasses and appropriate coastal vegetation nourished by water from the Aransas Pass Ship Channel. There was boardwalk for observing migratory waterfowl and

resident marsh birds. The Wetland Education Center on campus provided access for school groups to experience a wetlands area.

7.2 USING SCIENCE SKILLS TO CATCH FIDDLER CRABS

The second day (5/5/2017) of the UTMSI trip, the students were divided into two groups (by their class with 22 students in each group). One class did the boat trip while the other group investigated the wetlands looking for organisms. Before the students investigated the wetlands, they gathered in the pier classroom where Mrs. Peacock told them what to look for and demonstrated what equipment they could take with them to gather samples. They had the choice of specimen bottles, nets, and culture tubes (like test tubes but plastic with lids). I followed Tim, Juan, and Isaac because they were part of my analysis and willing to be filmed. Each group picked their own partners.

While the boys (Tim, Juan and Isaac) were in the wetlands they were doing science to develop a successful method to catch fiddler crabs which connected to their identity work (Angela Calabrese Barton, 1998; Carlone, Haun-Frank, & Webb, 2011). In their group-developed process, each person had a unique job (Fields, 2010; Holland, 2001; Holland et al., 1998; Lave & Wenger, 1998) and the work around that unique job was carried over to their identity with their fellow students. Isaac, Tim, and Juan's identity work was local and tied to the interactions within their group, shifting their positions in the group and later with their peers (Holland et al., 1998; Nasir & Hand, 2006; Nasir & Saxe, 2003). The activity of catching fiddler crabs provided the space where Isaac, Tim, and Juan were working on the identities that were later legitimized by their classmates (Nasir & Hand, 2006).

At the beginning of the activity in the wetland, Mrs. Peacock asked what was making all the little holes in the sand. I explained to her that they are fiddler crabs. She said that she would like to find one. This sparked the boys' interest in trying to find a fiddler crab. Isaac even exclaimed, "Let's dig them up."

For the next 9.5 minutes (video 98PortA), the boys tried various ways to catch a fiddler crab. They first tried tapping the ground, trying to scare the fiddler crabs, thinking they would run out of their hole. When this didn't work, they thought of sticking long pieces of grass into the hole for the fiddler crab to grab with its large claw so they could pull the fiddler crab out of its hole. When that didn't work, they tried to put the specimen jar over the end of the hole and stomping on the ground to scare the fiddler crab out of the hole. The boys were doing science during this time (Archer et al., 2010; Hodson, 2014). They were making inferences and testing the inferences and when they weren't successful, they tried other ideas based on what they had learned and observed. This was all driven by the students without teacher guidance (Mrs. Peacock had left with another group of students before they tried to catch the fiddler crabs).

The boys had ventured beyond the expected behavior of the activity, which was to passively walk around the area, make observations, and possibly bring back something easy to put in their sample bottle (like maybe a shell or exoskeleton). The boys were instead hunting the fiddler crabs. Archer et al. (2010) found in their study with 10- and 11-year-old school children, when students did science outside of the classroom or other structured contexts, the students thought of science as fun, naughty, and risky. During their hunt, I reminded the boys to not dig up the grass and fill in the holes they were digging. I didn't realize how I was filling the role of authority, reminding the boys to return the area to its pre-hunting state until I later watched the video. My nagging them further supported their behavior as risky or naughty.

This type of behavior of children in elementary school (Manning, 2002; Renold, 2004) is associated with masculinity. This idea of masculinity surfaced later when Isaac explained how they caught the fiddler crabs without tools and stated “We are men.” Archer et al. (2010) found that doing science outside of the structured context of school was a type of science identity work but not the same type of science identity work done in the confines of a classroom, which is more closely associated with a feminine idea of being a good science student. The boys were interested in catching fiddler crabs and at the same time they were doing science identity work.

7.3 JUAN’S FORTUITOUS DISCOVERY

Juan observed that where there were tunnels under the ground, there were weak spots in the sand. He started using that information to dig into tunnels, making it easier to find the crabs. This technique was effective and successful. They successfully developed their own technique to catch the fiddler crabs. Juan’s recognition of the weak spots provided him with useful information in the process of finding fiddler crabs, giving him an important position in the group (Calabrese Barton, 1998; Carlone, Kimmel, Lowder, Rockford, & Scott, 2011). Carlone et al. (2014) found that when children were doing inquiry science in the classroom, they built agency and worked on their science identity but when they were learning about science (reading textbooks and answering questions) the students were not working on a science identity. This activity provided the boys with an opportunity to do science identity work, build agency, and change positioning.

(98PortA 06:00)

Juan: just find the weak spots. There is always a weak spot. [Isaac making grunting noises as he digs.]

Juan: Just two more holes

Isaac: Wait, I think they dig what's it called. Tim, when you see it grab it Ok?

Michele: Why does Tim need to grab it?

Isaac: Because he is really fast. Because we are going to dig. Because it's twice as faster it's twice as faster.

Isaac telling Tim to grab it was a way for Isaac to avoid touching the fiddler crabs. I observed Isaac's reluctance to touch organisms on many occasions (FN 05/01/2017 and FN 05/04/2017). He would avoid touching the organisms by asking another person to pick it up or hold it so he can examine it closer. Tim was fast and willing to catch and touch organisms. As mentioned in Chapter One, some students didn't mind touching organisms and some thought it was "nasty" (Rozin & Fallon, 1987). Isaac wanted to be like his fellow Ringo Keepers and remain part of that group. He hid his reluctance to touch organisms by calling over his friends to pick something up. This was in contrast to Mateo's behavior when he was examining Ringo's claw, when he says that touching organisms is nasty. Later in this chapter, I describe how Isaac made some progress in touching the fish and shrimp on the boat trip.

7.4 THE HUNT CONTINUES

(06:46)

Tim: Did you find it?

Juan: No that's a root.

Tim: They probably put the big claw in front to block anything from coming in.

Juan: I am not sure this is a crab oh shoot, it was.

Isaac: Get it, get it, get it.

Juan: Catch it.

Isaac: What the Tim?

Juan: I knew there was one I knewed it, Tim was saying it was a root.

Isaac: Yeah

Michele: You got it.

Tim: There was a root in front of it.

Michele: Guys let's fill in the hole so you don't change the system. Fill it back in.

I coached the boys on how to be good stewards of the ecosystem, reminding them that their behavior was borderline breaking the "rules." I continued in this position by encouraging the students to not catch anymore crabs, further supporting their positioning of breaking the rules.

Isaac: Can we please see? Oh, you want us ok let find more filter crabs.

Michele: Fiddler

Isaac: Huh? Fiddler I said fiddler.

Michele: Let's just go check this one out we can watch it move and stuff.

Isaac: No wait, I want to find one to mate.

Juan: It goes like hand deep.

Michele: How do you know you are going to get a male and a female?

Isaac: Because, like I just want to get him a friend, I just want to see how it interacts with each other. I just want another one to see how they talk to see how they interact with each other. Does it fight? Does it do anything? Does it talk? I don't know.

Isaac was very interested in the crab's behavior and wanted to do experiments on the crab. At this point he was acting scientific, asking testable questions (Carlone et al., 2014).

Juan: I think we just got a female

Michele: How do you know?

Juan: Because I don't think males have a big claw. This one is super slow. [The ones with the big claw are male.]

(8:22)

Juan used a science process supporting his inference about why he thought they caught a female. Was he also associating slowness with being a female? I am not sure if he just thought that females have a large claw and this crab was also slow or if he was suggesting that females have a large claw and are slow.

Tim: Fiddler

Isaac: They eat fiddler? What is fiddler?

Tim: No, it's a fiddler crabs?

Isaac: What do fiddler crabs eat?

Tim: Is that one that dead end?

Michele: I think they eat a lot of detritus. Little things.

Isaac: WE'RE EXPERTS!

(8:53)

Isaac announced that they are experts. This was an un-coached explanation. They had developed a way to catch the crabs and, in the process, learned about the crabs. This development of the process and learning about the crabs made Isaac think they were experts. This act positioned him and Juan and Isaac as experts in catching fiddler crabs. It is interesting to note that Isaac said that "WE'RE" experts not "I" am an expert. Meaning that as a group they developed this process and as a group were successful. This suggests that Isaac valued the group membership and that he couldn't accomplish this as an individual. Later when they showed their classmates the crabs, Isaac tried to show some classmates how to catch a fiddler crabs and called on Tim and Juan for help.

Isaac: With my digging and Juan's digging

Juan: Yeah, but I see the weak spots.

Isaac: Yeah, you see the weak spots and my digging and Tim catchingness. We can get any crab.

Juan and Isaac established the skills each adds to the group, further emphasizing how important each member was to the success of catching fiddler crabs.

The boys continued to hunt fiddler crabs and successfully caught three more crabs. The boys mentioned how the crabs "don't really hurt you," perhaps meaning that they hurt a little but we are able to withstand that hurt and catch them.

(8:55)

Juan: They don't really get you, they don't really hurt you.

Tim: Yeah, they can't. The second one you found. I found a weak one right here.

Juan: You don't know. You don't know what is a weak spot.

Juan's response to Tim in this exchange was his way of defending his position in this group.

(10:00)

Isaac: Juan you say I feel it, I feel it.

Isaac: Wait, Wait. What do fiddler crabs eat?

Michele: I think they...

Isaac: Wait I remember on the filter crabs they get eaten by birds.

Michele: I bet you they do.

Isaac: Oh, food chain, first the sun they the filter crabs eat leaf then,

Isaac was trying to attach his understanding of food chains to the current context, showing that he had an understanding of the system, demonstrating that he could apply what they were learning in class to this activity.

(11:06)

Tim: Oh no, you just killed one I think.

Juan: oh no ohh.

Accidentally killing one (fiddler crab) is another instance of the boys breaking the unwritten rules of the wetland.

(11:55)

Michele: OK, let's not tear up the grass. The grass takes a long time to grow here.

Isaac: Oh, sorry.

When I, as the authority figure, reminded Isaac not to break the rule, I reinforced the notion that their behavior is naughty.

(13:32)

Tim: Yea, there's definitely one in here.

Juan: Where?

Tim: In this hole.

Isaac: Get one.

Juan: Look are you scared to death of one?

Juan showing excitement and mastery (ownership) of the process of catching the crabs.

The boys continued (for 2:40 seconds) to catch the big one that Isaac named Goliath. Once they caught it, I realized that the other students had started to go back to the lab.

(18:41)

Michele: Grab it we don't want to leave stuff out here.

Tim: That was awesome.

Juan: We got three.

Tim: I know but it could have gotten four but...

Isaac: They are so hard to get.

Tim: We are the only ones out here.

Isaac: We did good

Juan: Watch everyone is going to be surprised.

Isaac: Oh gosh, they are trying to get out.

Michele: Put the lid on.

Isaac: Wait, but they can't breathe.

Tim: Yes, they can if it's not all the way on. It's OK.

Tim: sorry... Let's go show them we got three crabs.

Isaac: We caught big Goliath.

7.5 THE HUNTERS RETURN TO THE CLASSROOM

On the walk to the lab, I continued to remind them to “follow the rules,” while at the same time the boys couldn't wait to show others their catch. They were feeling very accomplished that they not only developed a way to catch the fiddler crabs but also had three crabs to show their classmates. As Isaac said, “We did good.” Like before, he was referring to the group as having done well.

(18:05)

Isaac: We caught big Goliath.

Tim: We caught three crabs.

Isaac [to the other children as they passed by]: We caught big Goliath.

Mandy: Where did you get big Goliath?

Tim: They were burrowing.

Tim [to Mrs. Peacock]: We got three crabs.

Mrs. Peacock: You're kidding.

Juan: Nope.

Tim: The fiddler crabs, they are awesome.

Isaac [To the other children gathered around him with the crabs (in specimen jars)]:
We got big Goliath.

Tim [Pointing to a hole]: There is crab in there.

Jim: Dig it up.

Tim: Juan there is one right here.

(18:56)

Mandy: Here I have a net.

Tim: You don't need a net it won't pinch you.

Mandy: That is what those [holes] were for I kept finding them everywhere. (To
Tim) keep digging.

Tim: That's what those crabs are.

Tim: Juan, Juan, Isaac we got crabs

Tim wanted to continue working with Juan and Isaac to catch this crab in front of
his classmates.

(19:11)

Isaac: I am right here.

Tim: Oh

Isaac: I can do the thing.

Tim: We did it with our bare hands

Isaac: With our bare hands

Tim: We didn't use any tools y'all.

Isaac: Yeah, we are men.

Isaac, Juan, and Tim associated their activity of catching fiddler crabs with their hands as a masculine activity (Archer et al., 2010; Manning, 2002; Renold, 2004).

The boys continued to show their fellow classmates for three minutes the process of how they were able to capture the crabs although they were not successful before they were called into the pier classroom.

In the pier lab (classroom area), the students were sharing with each other what they had seen or gathered. The fiddler crabs were very popular with their fellow students (101PortA video). Tim, Juan, and Isaac were at the table with Chris and Mandy. As the students looked on, Tim let the crab crawl on his arm as seen in Figure 4. Chris asked the boys, “Do they bite?” and Tim answered no.



Figure 4: Tim was showing the other students the fiddler crab and Tim, Isaac, and Juan were answering the students' questions. The students had positioned Tim, Juan, and Isaac as knowing about the fiddler crabs that they caught.

After that exchange, Chris asked to hold a crab (101PorA0:30). Mrs. Peacock came over to the group and proclaimed, “Oh my gosh! Dude.” When Mrs. Peacock, the authority figure, recognized the boys, she further supported their positioning as fiddler crab experts (see Figure 5). Students were asking Tim, Isaac, and Juan questions about how they caught them, what do they eat, and will they pinch. They explained their process of catching the crabs and answered all questions. They emphasized how fast the crabs can move.



Figure 5: Mrs. Peacock and another school district chaperone with the school were taking pictures of the crabs. The act of taking pictures emphasizes the importance of catching the crabs.

This was a change of behavior for Juan, who rarely spoke up around the other students. He answered the students' questions about the crabs and showed the other

students how to hold the crabs. The students recognized Juan's change of behavior and positioned him as knowing about fiddler crabs.

7.6 ISAAC TOUCHING FISH AND SHRIMP

Later the same morning, the fifth-grade classes switched places. The boys' class was on the UTMSI boat for a collecting trip in the Port Aransas Bay. In this part of the episode, Isaac worked on touching shrimp and fish. This was important identity work for Isaac. As mentioned before, he was reluctant to pick up or touch organisms; however, his fellow Ringo Keepers readily touched different organisms. He wanted to maintain his positioning as part of the Ringo Keepers.

During the trip, the students collected many different types of samples of organisms. Shrimp were collected and placed in buckets for the students to examine. Isaac watched the shrimp and Mrs. Peacock and Michele (108PortA0:17) started talking to Isaac about the shrimp. At one point in the conversation, he decided he wanted to pick up a shrimp. As he did with the fiddler crabs, Isaac called Tim over to pick up the shrimp for him. Tim didn't hear him, but Marcelina (108PortA 0:56) picked up the shrimp and held it for Isaac to look at closely. Isaac examined the shrimp, counting its legs and telling Mrs. Peacock and Michele other things he noticed. Marcelina handed Isaac the shrimp, which he held, still looking at it closely. Later (108PortA4:45) when Tim and Juan moved over to where Isaac was watching the shrimp, Isaac started to tell Tim and Juan about the shrimp, and hesitantly picked up a shrimp to let Tim and Juan get a closer look. He then handed the shrimp to Tim.

Isaac was continuing on his identity work by telling Tim and Juan what he just learned about the shrimp and to show Tim that he would pick up the shrimp. Earlier that

day, Isaac didn't touch the crabs. He would carry around the crabs in the jar and dig for the crabs but when he got close, he let the other boys catch them. This was a big step for Isaac to pick up the shrimp.

7.7 CONCLUSION

The catching of the fiddler crabs showed how a community or group might emerge for the purpose of a task and how the process of maintaining this community or group entails identity work along with significant learning. When the boys began their walk around the wetlands, they didn't know what organisms were making all of those holes. They had never heard of fiddler crabs. But during the exploration they learned about fiddler crabs, observed them, and invented a way to catch them. Bringing three live crabs back, the most interesting organisms brought back to the lab, positioned them as experts about fiddler crabs among their classmates (Calabrese Barton, 1998). They had previously already positioned themselves as experts (Isaac saying "we are experts" and explaining everyone's job) after they caught the second fiddler crab. This positioning was as a group. The students recognized their work as a group using phrases such as: "They caught Big Goliath" and "Isaac, Tim, and Juan showed us the crabs they caught." Tim having caught the crabs would not have been a surprise to the students, but the students recognizing that the group as a unit caught the crabs caused a change of positioning for Isaac and Juan, further supporting their identity work.

The boys were not intentionally doing science identity work. They were having fun catching fiddler crabs. To invent a way to catch fiddler crabs, they needed to learn more about the crabs, such as how their tunnels were designed. Where were the crabs located in their tunnels? How do you find their tunnels? They learned about the crabs by

experimenting and observing using science skills (Angela Calabrese Barton, 1998; Carlone & Johnson, 2007; Carlone, Kimmel, et al., 2011). This was a group-developed process, which was emphasized when the boys talked about how each person had a specific role in the group (Juan finding the weak spots, Tim catching the crabs, and Isaac digging) and also Isaac said “WE’RE experts,” positioning the group rather than specific individuals as experts. The importance of the group was further supported when Tim showed other classmates how to catch fiddler crabs and called Juan and Isaac over to help (Fields, 2010; Holland, 2001; Holland et al., 1998; Lave & Wenger, 1998). The boys’ identity work was within the group and then part of their class (Holland et al., 1998; Nasir & Hand, 2006; Nasir & Saxe, 2003). The activity of catching fiddler crabs provided a space where Isaac, Tim, and Juan were working on the identities as experts of fiddler crabs, which was legitimized by their classmates (Nasir & Hand, 2006). I argue that the boys were all tacitly working on a science identity with learning science even though that was not their intention in pursuing the activity (Nasir & Cooks, 2009).

The boys associated this out-of-the-classroom science work as a masculine endeavor, skirting the unwritten rules of the wetlands by disturbing the area (digging holes in the path) while having an adventure (Archer et al., 2010; Carlone et al., 2015). The way they positioned themselves caused me to change my position from observer to the voice of authority, reminding them to fill in the holes, pick up their specimen jars, and not to dig up the grass. This was not my intentional role, but one that I was unable to abandon during the fiddler crab adventure.

In this episode, Isaac continued to work on his identity of being helpful and maintaining his position as a Ringo Keeper. He was very excited to tell everyone in the class about their successful capturing of the fiddler crabs and explain what fiddler crabs ate

and where they lived. He was also working on being able to touch organisms (an important skill for Ringo Keepers). He was also able to touch and pick up a shrimp.

This chapter fits well with the other chapters because it shows one more episode where students were doing science identity work but not for the primary reason of learning more science or getting better science grades. Their science identity work occurred during an activity that they were enjoying.

I argue that in the cases of this dissertation that the students were doing identity work while they were doing activities that they found enjoyable. Luna and Inge enjoyed pretending to be cats, Luna enjoyed taking care of Ringo, Tim enjoyed building and designing Ringo a structure for his cage. Isaac enjoyed helping others and telling others about science. I don't think that enjoyment is required for science identity work, but from this data, I noticed that these students did activities over a period of time because they enjoyed the activities not because they were learning science.

Chapter 8: Conclusion

8.1 INTRODUCTION

This ethnographic style of research has provided several answers but at the same time even more questions about identity work in fifth graders. Having spent two school years as a participant researcher at this school, you would think that the answers to my research questions would be clear and decisive. Each individual is unique and science identity work is a product of each unique individual. I attempt to answer each of the research questions as clearly as possible and I also explain some other findings. Even though this research was very time consuming, it scratches the surface of the complexity of science identity work in elementary students. I hope that my work will encourage others to look at identity work happening around the classroom or special program rather than only within the context of direct instruction.

I started this work expecting to find episodes in the classroom of science identity work. I cannot conclude that identity work was not happening in the classroom. I suspect it was happening subtly daily. For my research, I found very rich examples of identity work happening around the classroom that I followed closely but that doesn't mean that there wasn't any identity work being done in the classroom.

8.2 HOW IS THE IDENTITY WORK OF FIFTH-GRADE STUDENTS SHAPED BY THEIR PARTICIPATION IN SCHOOL, HOME, AND EXTRACURRICULAR LEARNING OPPORTUNITIES?

The students' activities in and around school shaped their identity work. For instance, Luna and Tim having pets at home provided them with experience around animals (Archer et al., 2012). This experience was leveraged at school, where it shaped how they

interacted with Ringo. They had knowledge and experience about leopard geckos because they had one as a pet. At home, Tim built Ringo a house to meet Ringo's needs of catching crickets without also eating sand. Their experiences also provided them with skills like catching bugs and being around nature. All of these elements shaped their identity work at home and school.

In another case, Inge and Luna were both reading *Warriors* books on their own time outside of school. Their interest in animals, while supported in school by such activities as doing the social justice project on animal abuse, visiting the aquarium, and visiting UTMSI was nurtured at home. Inge had a pet cat, which was why she began reading the *Warriors* books. Thus, their identity work was shaped by both their home and school activities and interest.

Like Tim, Luna, and Inge, Isaac's rich home life and school life shaped his identity work (Archer et al., 2012). In his interview, Isaac spoke of being helpful to his brothers and parents. He told the Ringo Keepers about what he had learned about feeding his own leopard gecko. All of the students' experiences in and out of school together shape their identity work (Fields, 2010; Jackson & Seiler, 2013; Roth & Lee, 2007).

The students mentioned in my dissertation brought their experiences in and out of the classroom and these experiences shaped their identity work. Each student's identity work was unique to them because of their past experiences (Fields, 2010). Luna and Inge were engaging in *Warriors* imaginary play together. Both Luna and Inge learned ecology concepts, but this imaginary play gave Inge a chance to practice leadership skills. This same episode provided a space for Inge and Luna to do science identity work but their work was different since they are individuals with many different experiences. This is similar to the identity work around catching the fiddler crabs. The catching of the fiddler crabs was credited to Isaac, Juan, and Tim by their classmates, but the actual identity work that each

boy was doing was unique to each boy. Group experiences can provide different identity work spaces to each individual (Jackson & Seiler, 2013).

8.3 HOW DO FIFTH-GRADE STUDENTS BUILD A SCIENCE IDENTITY ACROSS TIME AND SPACE?

Science identity work can take on many forms. I found that science identity work in the fifth-grade cases happened as they were pursuing activities in which they had an interest (DeWitt et al., 2013). Luna, Isaac, and Tim were interested in Ringo and they were doing science identity work around Ringo, learning about and taking care of him.

Tim, Juan, and Isaac were interested in catching fiddler crabs. To be successful, they needed to develop a process or technique to catch fiddler crabs. As Tim, Juan, and Isaac were trying to catch the fiddler crabs, they learned more about them. The successful catching of the fiddler crabs changed their positioning among their classmates (Carlone et al., 2015).

Isaac was interested in helping by spreading science content at the same time he was doing science identity work (Call et al., 1995; Markus et al., 1990). Isaac seemed to not only enjoy learning about science concepts but telling others about those concepts, for instance, why bees are important. His science identity work spanned time and contexts.

Students do some learning and identity work around content that they are not interested in; however, is that work ever sustained across time and space? To maintain sustainable science and identity work, the cases all had an interest (Savickas, 1999).

Students' identity work is not a straightforward trajectory (Fields, 2010). Take, for example, the episode of Isaac at recess. It appeared to be a time when Isaac was trying out being a soccer player and being part of the Ringo Keepers. He would start each recess

playing soccer but then leave the soccer game to join the Ringo Keepers. When he became part of the Ringo Keepers, he no longer joined the soccer game during recess. He played soccer on a team outside of school. I don't know if he continued to participate with the soccer team but this would be an example of his trajectory of identity work changing.

I can only predict that Luna and Inge's imaginary play around Warriors ended along with fifth grade. They did not get together to play outside of school in fifth grade. The girls were going to different middle schools or, in Luna's case, possibly being home schooled. This would change their identity work centered on their imaginary play.

Identity work is context-dependent and in the cases of this dissertation, all the students were changing schools and, except for Tim and Luna, they would not be at a school together. How much this changed the students' trajectories (Fields, 2010) I cannot know, but is something that I would like to further investigate in the future.

8.4 HOW DOES IDENTITY WORK HAPPEN ACROSS SETTINGS IN WHICH STUDENTS ENCOUNTER SCIENCE CONTENT AND PRACTICES?

When I started this research, I focused on students during science class especially when they were doing inquiry labs or having discussions about science topics. I thought I would observe students learning content in science class, which would inspire them to further learn outside of class (Carlone et al., 2014). There was not an episode I observed when students studied something like how canyons are made and then took a trip to the Grand Canyon to look at the evidence of canyon development. That does not mean that the science curriculum was uninspiring and not supportive of science identity work; rather I didn't observe science identity work while the students were studying science content.

What I did observe was how Ringo, the class leopard gecko, affected some students' science identity work, field trip experiences provided the space for science identity work, and students related books and imaginary play to the concepts they were studying in class (not the other way around). I found that students were using science practices and learning science content in many different contexts beyond the classroom (Archer et al., 2010). In the episodes that I wrote about, these contexts were unstructured (or unstructured by the school) but the school environment provided a space for this learning to happen. Students had time and space in school to play imaginary warrior cats, the students had time and space to form a Ringo Keepers group, and the students had time and space to hunt fiddler crabs in wetlands. The episodes included in this dissertation show that there is not just one-way identity work happening across settings. There is not one way that students use science practices or learning content. There are many ways that students do science identity work.

8.5 HOW DO STUDENTS APPROPRIATE VARIOUS RESOURCES (OBJECTS, MATERIAL, IDEATIONAL) AVAILABLE IN THE ENVIRONMENT AS THEY ACTIVELY WORK TO BUILD DESIRED AND PROJECTED IDENTITIES?

Objects, materials, and ideas are supporters of identity work. For example, Ringo was the object or, more accurately, the organism at the center of the Ringo Keepers. The group was recognized by the students and the teacher as people interested in Ringo. It is difficult to predict, but I think if Ringo was not a part of the classroom, the group would have organized around something else.

Group relationships and even partner relationships (Inge and Luna around secret imaginary play) was an impetus for identity work, like students dividing themselves into groups of "I am a person who touches animals" or "I am a person who thinks touching

animals is nasty.” People are constantly doing identity work and part of the work is determining which type of person they are (Gee, 2000b). These relationships, or, put more simply, group memberships are part of ever-developing identity work (Barton & Tan, 2010; Brickhouse et al., 2000; Sfard & Prusak, 2005; Tan et al., 2013). The materials, objects, and ideas around those groups are appropriated to support the individuals’ identity work.

8.6 UNIQUE RESULTS

The answers to these questions are not straightforward. This is to be expected in ethnographic research. There are some other interesting results from this research. I found that science identity work happened tacitly to other identity work the students were doing. For example, the girls were not working specifically on their science identity work while playing *Warriors*. Isaac, Juan, and Tim were not intentionally changing their positions among their classmates when they were developing a way to catch fiddler crabs. This way of looking at science identity work—identity work happening as an unexpected result or other work or play done by the students—is unique.

To my knowledge, research on imaginary play, friendship, and identity work has not been done. This is a contribution to the field of identity research. I think that there is probably much more imaginary play happening with students at that age than we adults realize. This is an area that should be further researched. Imaginary play, especially where two children are participating, is a space for identity work.

The last unique finding is that identity work can happen as a group collectively, yet be different for each individual. This makes sense but hasn’t been reported on in the literature. While the group is working as one unit, because each individual is an individual

with their own unique history, their identity work has a group component and an individual component.

In my research, I found identity work happening around the science classroom and students leveraging that work in the classroom. Much of the identity research shows work happening in the classroom being leverage either outside the classroom or in future classrooms (Barton & Tan, 2010; Angela Calabrese Barton, 1998; Angela Calabrese Barton et al., 2013; Carlone & Johnson, 2007; Carlone et al., 2014; Carlone et al., 2015; Tan et al., 2013). This is an interesting finding that I will continue to research.

8.7 FUTURE RESEARCH

I plan to do further work looking at identity work happening beyond the classroom and/or extracurricular organized programs. How can that work be supported by teachers or parents? Can that type of science identity work be sustainable? What is the effect of that type of science identity work over a longer period of time? These are all areas that need further research.

I plan to also further explore the contributions of imaginary play on identity work in older elementary students. This is difficult and time-consuming work because the older students need to trust you enough to open up about their imaginary worlds, but I think there is a need to better understand how identity work and imaginary play can be beneficial to children.

I also would like to further investigate how the organization of a school can support or hinder science identity work. If there was not recess time at Manual Martinez Elementary school, my work would have been very different. Think about the opportunities

that would have been lost if the school had no field trips. Were the opportunities different because the students had been together as student group since kindergarten?

I would like to examine science identity and gendered interactions, in my cases the girls were caring for pets and bringing in science through literature and the boys were catching fiddler crabs in the wetlands. Was science identity work gendered or did I just recognize the gendered science identity work? Are girls and boys limited to science identity work associated with their gender? These are all questions that will guide my future research.

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