ANALYZING STORIES TOLD BY AN ELEMENTARY SCIENCE TEACHER IN A FIFTH-GRADE CLASSROOM

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A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

EDUCATIONAL PSYCHOLOGY & EDUCATIONAL TECHNOLOGY

2012

ABSTRACT

ANALYZING STORIES TOLD BY AN ELEMENTARY SCIENCE TEACHER IN A FIFTH-GRADE CLASSROOM

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The purpose of this qualitative study was to analyze and interpret the stories told by one teacher, Ms. M, in a fifth grade science classroom. In this study, stories are defined as teacher utterances that are used in first person or third person narrative view, and are related to an experience that occurred outside the classroom. This research answers questions concerning: (a) what types of stories Ms. M tells during science instruction; (b) when these stories occur in the classroom; and (c) what pedagogical functions do these stories serve in the classroom. Utilizing theories on the social construction of knowledge and narrative cognition, stories told may be formed through multiple paths that follow no logical expression to make sense of the context and to connect to the audience. Therefore, this study provides insight into how Ms. M made sense of science with her stories and the ways in which they worked with her students.

Data collection included video recordings of Ms. M as she taught the Web-Inquiry Science Environment (WISE) curriculum in two of her classrooms. The aim of the curriculum was to teach students inherited and acquired traits of plants and animals. At the time of data collection, Ms. M taught science for six years. Her classroom was inclusive since there were students with diverse educational needs. She taught the curriculum two to three times per week, and there was either a whole class discussion using a projector, or students working on laptops, or observing the growth of their Fast Plants®. Software was employed to conduct a first-pass transcription of the video recordings. Identification of the stories Ms. M told was paramount to answering the three research questions.

Once stories were reliably identified by two coders, these 16 stories were analyzed for their type, occurrence and pedagogical function. Coding schemes were created and verified for each of the research questions by two coders. Once the codes were clarified to categorize or interpret what was found in the discourse, the coders commenced final coding. Cohen's Kappa was used to increase reliability and 0.9, 0.87 and 0.88 were reached for each of the three research questions respectively. The types of stories found were autobiographical, biographical, fictional, or based on current events. These stories occurred when the teacher initiated the discussion by bringing forth a definition, a question or reinforcing a concept. However, the stories were triggered by students to a greater degree with their questions, concerns, observations or their own stories or explanations.

Pedagogical functions of stories were identified hitherto because research asserted that they can promote engagement or attention of students, build community, clarify concepts or vocabulary, or activate and build background knowledge. On a more social level, stories have been found to reveal the roles teacher take, and the voice they carry when telling the story. In this study, all the functions were found in Ms. M stories. She used her stories mostly to clarify concepts or vocabulary. When there was a clear connection between the story and the scientific concept being taught, students were able to appropriate the knowledge themselves to apply the concept. Ms. M stories exemplified her sense-making of science and connections to her own life and eventually, her students were able to make sense themselves. Stories in which role and personal voice were identified, occurred the least, but they allowed her students to relate with her in ways besides teacher. Finally, stories that activated and built background knowledge, and built community, were most successful because students were able to recognize features in her story that were apparent in their lives, which permitted all to understand science personally.

DEDICATION

This dissertation is firstly to God, the Almighty Father.

Secondly, it is dedicated to my parents, Gem M. Lindsay Trotman and Mark T. Trotman who taught me the power of love and sacrifice.

Finally, it is dedicated to my students of Unit C in the Children's Center in Brooklyn, New York in 2005. They taught me the power of living and pursuing a dream.

ACKNOWLEDGEMENTS

> "For he himself is our peace, who has made the two one and has destroyed the barrier, the dividing wall of hostility, by abolishing in his flesh the law with its commandments and regulations. His purpose was to create in himself one new man out of two, thus making peace, and in this one body to reconcile both of them to God through the cross, by which he put to death their hostility. He came and preached peace to you who were far away and peace to those who were near. For through him we both have access to the Father by one Spirit," Ephesians 2, 14-18

Though I faced many trials and tribulations, God was with me through it all and I need to thank Him for always keeping me at peace, and for the following persons:

1. The four faculty members who brought me to this point:
    a. Dr Michelle Williams (my mentor), for her unwavering faith in my abilities, and her tutelage in making science education meticulous and evident in my study.
    b. Dr. Matthew Koehler (my advisor) for his astute guidance in writing clearly and succinctly, staying close to the objective, and firm belief in my capabilities to do better.
    c. Dr. Ralph Putnam for his detailed editing and ensuring that I explained my psychological terms accurately.
    d. Dr. Troy Mariage for his expert direction in special education and discourse analysis.
2. The three faculty members who became my mentors at my undergraduate institution, Pace University: Dr. Janice Jackson (1943-2010), Dr. Kathryn DeLawter and Dr. Richard Kline and Dr. Richard Velayo.
3. My editors, gurus and counselors (in no particular order): Dr. Susan Peters, (Dr.) Barbara Thelamour, (Dr.) Chiharu Kato, Dr. Viola Manokore, Connie and Dr. Jim Detjen, Dr. John Metzler, Sally McClintock (1938-2011), Dr. Eric Williams (1911-1981), (Dr.)

Valencia Moses, Dr. Joi Merritt, Phil Sheratov, Scott Luntz, Sherridon Poyer, Raya Sam-Matos, Isaiah Matos, Dr. Shiho Saito, (Dr.) Laura Ann Oliver, (Dr.) Patrick Norris Leahy, (Dr.) Maryl Randel, Tonjala Eaton, Candice Collins, (Dr.) Camille Comas, Giselle Yearwood, Kirk Millette, Nyron Rolingson, Oneka Streete, Adanna Lett, Dominique Didier, (Dr.) Kaliamma Ponnan, Greta McHaney-Trice, Oumatie Marajh, Dr. Fumiko Sakashita, Akiko Miyamoto, Dr. Aroutis Foster, (Dr.) Nai-Cheng Kuo, (Dr.) Akesha Horton, Violeta Yurita, Dr. Xuechun Zhou, Dr. Audrey Brutus, Marcello Ritondo and Annabelle Murillo.

4. The members of the following groups: LATTICE (Linking ALL Types of Teachers to International and Cross-Cultural Education) and GS4 (Graduate Students Seeking Support and Sanctuary.
5. My family with special mention to my mother and father, my grandmother, Ena Trotman, my sisters, Gillian Trotman, Tessa Trotman and nieces, Abby Pope, Alexa Andrews and the rest of my family Dr. Sue-Ann Barratt, Lester Barratt, Letetia Barratt, Keisha Lindsay, Kendal Lindsay, Dr. Keston Lindsay, Gregory Lindsay, Harriette Arthurton, Sarah Arthurton, Gabrielle Arthurton, John Arthurton, Wendy Cruickshank, Jay Cruickshank, Douglas Clayton and Jameel Donawa.
6. And last but not least, Ms. M (and her students). Thank you so much!

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KEY TO SYMBOLS OR ABBREVIATIONS

AAAS: American Association for the Advancement of Science

IEP: Individualized Education Programs

NRC: National Research Council

CHAPTER 1

INTRODUCTION

The Trends in International Mathematics and Science Study (TIMSS) 2003 International Science Report indicates that the majority of fourth grade students sampled in the United States were successful in recognizing some basic facts from the life and physical sciences; however, these students were unable to grasp abstract science ideas and apply knowledge of the various science domains (Mullis, Martin, Gonzalez, & Chrostowski, 2004). In addition, there is some concern that students' attitudes towards science appear to be unfavorable since they shy away from choosing science for high school and beyond (Osborne, Simon & Collins, 2003). In order to prepare students to integrate the ideas they learn in science class for life-long learning, students need opportunities to connect science ideas to personally relevant problems (Linn & Hsi, 2000).

Making connections between science ideas and personally relevant problems is one of the hallmarks of the kind of scientific literacy that will assist students in making long-standing contributions to issues related to science, mathematics and technology, as well as their appraisal of global phenomena such as climate change (AAAS, 2010; McNeill & Krajcik, 2009; NRC, 1996). Yet, scholars have critiqued how scientific literacy has been implemented because there has been little attention given to how students (and teachers) make sense of science in their own lives (Eisenhart, Finkel & Marion, 1996; Lemke, 2001; Roth & Désautels, 2002). Research demonstrates that stories are one vehicle that may address the gap between how teachers may talk about science in their classrooms and outside of school, thereby having the potential to improve the relevance of science to learners (Avraamidou & Osborne, 2009; Carter, 1993; Ah Nee-Benham & Dudley, 1997).

For example, consider the following statement made by Ms. M during her teaching of heredity in her fifth grade classroom:

> And offspring refers to children. So I am the parent… my husband and I are the parents of these offspring. So these are my children, okay? And if you... look at them carefully you can see that they have some of the same traits that I do. Okay? They both have dark brown eyes just like me (04/27).

Here, Ms. M develops a story derived from her experience to animate science (Egan, 1986). She is also formulating a narrative as she communicates how she is making sense of science with a life event. In this study, story is the discourse that suggests an illustration of one's experiences, whereas narrative consists of elements (e.g. life events, discourse markers) that can be found within and among stories. Specifically, narrative may also serve as a "unifying sequence" that helps tie together diverse events, happenings, and actions thematically into a goal process (Polkinghorne, 1995). Ms. M's story about being a parent to her offspring provides an opportunity to showcase science as a lived experience that may be relevant to learners (Upadhyay, 2005). In addition, narrative as a methodology offers the potential to interpret the complexities of classroom events through the teacher voice (Carter, 1993).

Despite the potential impact that they can have, little is known about the kinds of stories that teachers tell and the purposes that these stories serve in science classrooms (Norris, Guilbert, Smith, Hakimelahi & Phillips, 2004). A study of these stories "in action" can help reveal how teachers attempt to translate connections between their personal life experience and school science. Teachers often struggle with these connections because the identities of teachers, students and schools integrate in culturally reproductive ways that resist change (Goldston & Nichols, 2009; Patchen & Cox-Petersen, 2008). Also, teachers are said to have unflinching views

of being efficient, direct knowledge transmission, staying close to the intended curriculum and student test preparation (Goldston & Nichols, 2009).

Purpose Statement and Research Questions

The purpose of this dissertation is to interpret what kinds of stories teachers use in their classrooms, the circumstances under which teachers tell these stories, and the pedagogical purposes these stories serve in the classroom. For the purposes of this study, story refers to a teacher utterance derived from experience that is drawn from outside the classroom. I draw on an interpretivist stance to understand how the effects of teachers' stories can illustrate the ways in which they are structured, organized and used in certain learning environments, (Aavramidou & Osborne, 2009, p. 1703).

There are many possible reasons why teachers tell these types of stories in science classrooms. Some research (Solomon, 2002) has claimed that narrative (and thereby stories) may improve student motivation and enjoyment, and may transform isolated ideas in science into a coherent interrelated theme that is meaningful. Teachers may be using stories to introduce new topics and revisit previous topics (Kubli, 2005). These stories can be parts of a plot that unfold at different points in time when human action is expressed linguistically and extemporaneously (Polkinghore, 1995; Shirley, 2005). Finally, teachers may also use stories to position themselves as storyteller, motivator, diagnostician, mentor (Crawford, 2000). These possibilities for why teachers tell stories in science classrooms are explored by focusing on the stories told by Ms. M, an elementary school teacher in a fifth grade classroom with students with diverse educational needs.

The analysis of the science stories told by Ms. M is guided by the following research questions:

1. What stories does one elementary teacher tell during science instruction?
2. When do these stories occur in the classroom?
3. What pedagogical functions do these stories serve in the classroom?

Answering these questions will help to address the concern of what teachers' stories do in science classrooms. It is likely they may function in ways unanticipated because a particular version of the story is being told in and for the occasion of telling (Edwards, 2005). As a result, new understandings of how teachers manage their psychological stance in their constructions and use of the story may be revealed. Their stories, or the narratives of their experience, may need to be told to in order to understand their personal experiences and involvement with science education. Researchers have lamented on the paucity of research which explores the teacher's discursive practices in tandem with their personal stances in classrooms (Kovolainen & Kumpulainen, 2005), especially in science education research (Scruggs, Mastropieri & Okolo, 2008; McGinnis, 2002). This study is an attempt to fill the void in this research by investigating how one teacher's stories interacted with the science curriculum in her classroom.

CHAPTER 2

LITERATURE REVIEW

This chapter outlines the conceptual framework that brings stories into focus. It begins with a brief overview of the social construction of knowledge in classrooms. The definitions of narrative are provided along with the structure of narratives that are driven by narrative cognition. This chapter closes with a review of stories in terms of their form and function in being tied to the curriculum context, and those that are apart from the context that brings teachers' roles to the forefront.

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Social Construction of Knowledge

In classrooms, students try to make sense of various events such as text on screens, paragraphs from a textbook, and teacher's verbal messages. The cognitive management of these multiple events suggests that sense-making processes do not take place only in the individual's mind but develops through participation in activities (Kumpulainen & Wray, 2002). This marked the paradigm of social constructivism, whereby inner speech materializes through language and is constructed through social interactions (Bahktin, 1981; Vygotsky 1978). Thus every speech act illustrates a construction that is active, filled with specific artifacts and emotional expression (Bruner, 1987; Egan, 1986). The intent of the teacher in the science classroom is to use language that builds upon students' current state of knowledge, or to construct the channels between their actual development and their Zones of Proximal Development (ZPD) (Vygotsky, 1978). The teacher's task is to take students' responses and enrich them with two functions: 1) sense making and 2) connections between the students' responses and new knowledge, which is commonly referred to as scaffolding (Kubli, 2005).

This social construction of knowledge processes achieved between teacher and students using language serves to enculturate students into a community, not only as classroom members, but also as students of the discipline of science (Kovalainen & Kumpalainen 2005; Marx, Blumenfeld, Krajcik & Soloway, 1997). Students can appropriate this knowledge (language and practices), learned through the discourse employed by the teacher (Driver et al., 1994; Rogoff, 1993), and begin making sense of science for themselves. One way in which a teacher's discourse can both engage the richness of students' personal experiences as well as communicate scientific elements is through the use of narrative (Egan, 1986).

Narrative is the type of "discourse composition that draws together diverse events, happenings, and actions of human lives into thematically unified goal-directed processes," (Polkinghorne, 1995, para. 7). It is the way humans experience the world and their stories are depictions or verbal constructions of their world (Connelly & Clandinin, 1990; Ochs, 1997). Often, it is said that people lead storied lives and tell stories of these lives (Bruner, 1987; Carter, 1993). These lives are formed using narrative cognition and paradigmatic cognition (Bruner, 1987). The latter refers to thoughts that often lead to unitary or precise outcomes. They are influenced by logical expression, rules, and laws often attributed to rigorous scientific formulation (Bruner, 1987). Bruner (1987) maintains that narrative cognition in contrast takes multiple paths to explain the action taken. Meanings are found in the actions of classroom practice that operate on multiple levels such as intrapersonally, interpersonally and institutionally (Lundqvist, Almqvist & Östman, 2009; Rogoff, 1993). Therefore, the outcomes are often ambiguous or inconsistent. Meaning-making or sense-making is strived for when a story is told because the purpose of the story should be apparent at the very least to the listener.

Narratives hold a general structure that can be identified in stories. Since narratives carry emotive effect, there is often a sequence of events that suggest some form of conflict, predicament, or link to a larger purpose that explains why they are being told (Carter, 1993). There is a protagonist that is engaging in the events and there is some consummation to the event sequence that indicates that the purpose has been achieved, the plot has come to an end, or that the conflict resolved (Norris et al., 2004; Polkinghorne, 1995). Thus, stories usually not only indicate how the narrator is involved with events but how he/she interacted with other elements (e.g. objects, materials) to fulfill a purpose suited to the context (Roth, McGinn, Woszczyna & Boutonné, 1999; Smith & Sparkes, 2008). The events are patterned around a theme or figure significant to the culture being portrayed (Connelly & Clandinin, 1990).

Functions of Stories

In the culture of classroom teaching, teachers try to make sense of what is happening and their stories reflect retelling and reconstructing once they gain more expertise teaching in their classrooms (Osborne, 1998). The habitual or novel actions that teachers employ are possibly reflections of their personal lives combined with their experiential knowledge of teaching (Carter, 1993). Thus, teachers' stories can have many functions depending on the goal they set out to achieve given the context. Scholarship has shown that teachers use stories as instructional tools (Clough, 2011; Egan, 1986; Isabelle, 2007; Klassen 2007; Osborne, 1998) and this may be the vehicle to demonstrate how teachers' stories represent science. In addition, they have used stories as reflections of their teaching (Ah Nee-Benham & Dudley, 1997; Jupp & Slattery, 2010; Moore, 2008; Seiler, 2009) in science education, which may help to illustrate how they make sense of their relationships with their students, and their own personal identification with such

stories. Stories as instructional tools have often been told within the curriculum context to understand how they shape teaching and learning. Stories as reflections have been told beyond the curriculum context to encompass teachers' life histories. Furthermore, these reflections may be cast as legitimation to the teacher's role in sharing knowledge distinct from the dominant discourse of science.

Without stories having context and a personal connection, students may struggle to integrate scientific knowledge into their ways of knowing (Stinner, 1996; Metz, Klassen, McMillan, Clough & Olson, 2007). Kubli (2005) cites Vygotsky, stating that stories mediate the thought processes between scientific concepts which materialize deliberately, and spontaneous concepts that are practical and contextual in character. The spontaneity of these concepts seems to differ though depending on the teacher's intent in telling the story. Teachers do not always tell these stories as part of planned events in their lesson plans (Shirley, 2005). Instead, they may aim to enhance students' knowledge or clarify vocabulary with stories located in contexts of their own experiences (autobiographical), other's experiences (biographical), or fictional experiences (Shirley, 2005). Stories based on biographies or fictions tend to stem from current events, discovery or a historical situation where the context of scientific theory is evident (Kubli, 2005). However, the author affirms that these contexts contrast with the stories that teachers tell that outline their personal involvement.

Scholars have studied the structure and function of these stories. Specifically, they have spoken about how stories may elicit student background knowledge, clarify unclear concepts, promote engagement and attention, and build community. These functions will be detailed in the following sections.

Activating and Building Background Knowledge

Research literature that looks at how stories can be used to build student background knowledge stipulate that the story must be situated in a context and connect to students' personal experiences (Stinner, 1996). Stories that are linked to the context of a history of science are aptly named historical narrative. These stories are matched up with the features of narrative which have chronological sequence and plot (Metz et al., 2007). Utilizing history to portray science content contextually provides for greater authenticity and meaningfulness for students (Clough, 2011; Klassen, 2009; Stinner, 1995).

Connecting to students' personal experiences is an acknowledgement that students do come into the classroom with some content knowledge. As a result, the stories that are told must contain some details that connect to students' backgrounds. Additionally Metz et al. (2007) assert that teachers incorporate imaginative and manipulative events in their stories. In so doing, they employ strategies to stimulate students' background knowledge. The strategies they recommend are providing opportunities for students to ask (a) predictive, inferential, and open-ended questions, (b) employ compare and contrast procedures to link students' ideas with historical ones, (c) conduct demonstrations and projects for cross-curricular integration, and (d) incorporate writing (e.g. journal) and guided reading strategies.

The possible drawback in this research is the lack of attention given to how students may interpret the contextual character of stories of historical narrative in their personal lives. Kubli (2005) stated that many of his students reported that it was important for them to understand how the teacher's experience was made salient in the story because science became more humanistic. Teacher involvement in the story (whether telling their own story or someone else's) seems to also be crucial for younger students because it introduces social elements that have moral and

ethical implications (Shirley, 2005). As students are trying to make sense of these stories, they are also learning particular norms of language use and actions that imply how scientists may be socialized, (Aikenhead & Jegede, 1999; Lemke, 2001, Lundqvist et al., 2009). Milne (1998) affirms

> interpretation is a complex interactive process, and often the readers can become captives of the text because the text is believed to be the expert and the reader the novice. Because students in particular are deemed, or believe themselves, to lack situated knowledge, they are more likely to accept science stories as truth and to accept uncritically the values and meanings that underpin the story. (Milne, 1998, p. 179)

Historical science stories usually have a scientist as the protagonist in the story. Even though students may recognize the actions of the scientist, they may feel that the social role the scientist had in their respective life differs from their own personal role. This distance is augmented by the possibility of an "architecture of myth" being employed when constructing these scientists and their lives (Allchin, 2003). Allchin refers to this architecture as a glamorization of scientists and their craft through portraits of them working alone with no obstacles. History is distorted as their deeds are cast out of proportion and exacerbated by the use of rhetorical devices such as 'a eureka moment' and tragic irony (Allchin, 2003). Metz et al. (2007) acknowledge that this possibility is inherent in telling historical science stories. Therefore, they argue that there is a difference between using rhetorical devices to conjure affect and using the stories honestly so that they include strategies to deconstruct them in order to uncover ambiguities or hidden agendas. Many researchers state that the social lives of scientists differ from the social roles students and teachers currently inhabit in terms of age, race, socio-

economic status, ability, gender, sexuality and ethnicity (Bianchini, Cavazos & Helms, 2000; Carter, 2004; Carlone & Johnson, 2007; Ryan, 2008; van Dijk & Atienza, 2011).

Consequently, historical science stories may not solely function to elicit students' background knowledge on cognitive levels but also on social levels. It seems that even though stories can elicit students' knowledge, the intention for students to learn from them is speculative because the stories can have implications for their current lives. Milne (1998) reaffirms this by citing Martin and Grouwer in their 1991 paper that

> the elevated status of scientific knowledge leads students to imagine that they cannot achieve that level of understanding. Therefore, a focus on the struggles of scientists as well as on their successes might help students who have struggles in their own lives to identify more closely with the great scientists. (Milne, 1998, p. 184)

This is why it is crucial to analyze what stories may do in other contexts, like stories told spontaneously in classrooms, because it is possible that teachers' stories may create new practices or norms for science learning and/or socialization for students.

Clarifying Unclear Concepts or Vocabulary

From the research reviewed, there are very few empirical articles that examine how stories can help students revise their misunderstandings of scientific vocabulary. However, stories helping to clarify scientific concepts have been documented in theoretical and empirical ways regarding the nature of science. The 'nature of science' was an expression coined by Norman Lederman to examine the underlying assumptions of scientific knowledge and progress (Liu & Lederman, 2007). These assumptions he claimed can be revealed when distinguishing

between the language that teachers use to communicate science and the subsequent understandings students obtain for the nature of science (Zeidler & Lederman, 1989). The authors found that the language that teachers use contain implicit references to how students interpret concepts. Without a context or "without qualifications" students may understand science in a Realist tradition which conveys empirical truths that objectively represent and describe phenomena (Zeidler & Lederman, 1989, p. 772). Thus it seems that stories can provide contexts that may not only activate student background knowledge but also clarify concepts that engage their own subjective understandings. In other words, stories may invoke the Instrumentalist tradition which offers products of human investigation and creativity that utilize inferences and models to explain phenomena.

Students' clarification of concepts with teachers' stories appear to also be influenced by their interpretation of the contexts. This is because the story form may not only contribute to students' understanding of the concept but also its commitment to their long term memories (Klassen, 2007). Klassen (2007) wrote a theoretical article using the story form as an analogy to understand the processes of learning science through conceptual change. He asserted that the story form contains temporal elements that may reveal mental processes of how concepts in one state can transform to another state. For instance, the temporal elements are structurally organized with a "beginning state, through a middle event, to an end state," (Klassen, 2007, p. 307). The end state follows the beginning state and bears a relation that suggests that the plot has come to an end (Egan, 1986; Gerrig & Egidi, 2003; Norris et al, 2005; Sacks & Jefferson, 1992). Klassen (2007) categorizes these relations as described by researchers in terms of binary opposites like happy and unhappy, and in science, hot and cold. However, the author argues that these opposites are too extreme to describe stories that have a beginning state that is refined and

elaborated at the end. For example, Ms. M can provide a story where she begins speaking about her daughter having blue eyes, but both her parents have brown eyes. She ends the story with the daughter's grandfather having blue eyes which speaks to the trait of blue eyes skipping a generation. Students can retain the concept of children only inheriting traits from their parents, but Ms. M's story communicates that traits are passed on through generations which further refines their understanding of trait inheritance.

Klassen (2007) affirms that the story structure model of beginning and end state can provide a heuristic to explain the learning process of how new concepts can add to, refine, or change concepts stored in long-term memory. These new concepts are retained under two conditions: (1) the concepts need to be understood and (2) the concepts need to be remembered. Therefore, the end state 'makes sense' once the middle event contains or produces some change derived from the beginning event.

In Ms. M's story, the quandary that emerges upon hearing the middle event is "How did the daughter have blue eyes in the first place?" Once the student hears the end of the story, they may further understand the concept of trait inheritance where a trait appears in one generation and not the other. However, would students commit this concept to long-term memory? Would they remember it? Klassen (2007) concludes then that remembering these concepts from stories also relies on students anticipating the end result. The stories told need to build curiosity and the emotion incited builds adequate momentum to tie the concepts to students' long-term memories.

Tao (2003) found that if students grasp at concepts in stories that fit neatly in their memories, it is likely that they will accept theses scientific concepts as they are and not critique them. In his study, secondary school students were provided with stories as they worked in peer collaboration. Peer collaboration was a strategy designed to encourage students to work together

on a task. As they read the stories, they had to make and justify their ideas publicly for critique and clarification of concepts pulled from stories. Tao's (2003) aim was to identify the processes by which students came to understand these concepts through stories. These stories had explicit references to science being used to improve lives and understand nature, and described experiments that tested hypotheses to explain phenomena that did not necessarily represent reality. These references were in concert with the criteria for the nature of science.

Tao (2003) discovered that the majority of students held on to their views of scientific theory being facts proved by experiments. Even though students claimed to enjoy the stories, they did not learn the concepts from the stories as intended because their assumptions of what science was were steadfast. The author pointed out that interpretation of the contexts of these stories came into play where "Students' peer interactions showed that most of them were not fully aware of the overall theme of the stories; instead, they attended to certain aspects that appealed to them and appeared to confirm and reinforce their inadequate views," (Tao, 2003, p. 167). As a result, students selected features of the story that confirmed their own understandings of the concepts stored in their memories. These stories were not told in such a way, or contained adequate details, to heighten students' emotions to the point where they were encouraged to question the concepts being taught.

It seems that when concepts grasped from stories fit neatly into students' memories, they re-enact an ending of the story for themselves that makes sense for them. However, the concepts they retain may be incorrect or may fail to explain the phenomenon that was represented in the story (Klassen, 2007). Also, caution is noted where the clarification of concepts by stories is never smooth. There are many end states that can be accomplished by the teacher and students through story. Furthermore, the ways in which students and teachers make meaning are made

relevant through their personal and cultural contexts and histories (Witherell & Noddings, 1991). However, this review highlights two aspects of how stories can help clarify concepts. Firstly, stories need to contain adequate details so students' interest is sustained to incorporate the new concepts learned with their own knowledge. If too many details are given in the story, students' interest might wane since they are not provided with opportunities to anticipate the end result. If too few details are given, students may find it difficult to make the connections themselves and may accept the concepts as told by the teacher (Milne, 1998). Secondly, and more importantly, how the story is told matters. If the stories are told by the teacher in a Realist tradition, students may further think that these concepts have already been discovered and cannot be interrogated. It may help if teachers are skilled in storytelling because then the end result they provide are not those anticipated by students. The teacher scaffolds the concepts with stories in such a way that disequilibrium is achieved whereby students' initial conceptions are disrupted (Klassen, 2007, Tao, 2003). Students' emotions are intensified to the extent that they query the concepts told in the stories and reflect on what was taught.

Promoting Engagement and Attention

Many studies that include stories in their analysis claim that stories can heighten attention or improve students' engagement with science (Clough, 2011; Egan, 1986; Kubli, 2005; Metz et al., 2007; Stinner, 1996). Kubli (2005) referred to students' attention being prompted in the 'addressivity' of telling the story. Citing Bakhtinian theory, the teacher in making contact with her students makes every effort to welcome them as listeners. Teachers need to become aware of students' inner speech in order to produce intellectual and emotional responses that students can follow and understand. Students who are striking mutual understandings with their teachers are

often those whose attention can be roused. Kubli (2005) though affirmed that teachers may struggle to tell riveting stories because they may find it difficult to connect to students and thus are unsure of students' expectations.

Teachers may overcome the obstacle of identifying with their students by either telling stories that contain other people's voices or discourses, or stories that contain the teacher's own experiences (Egan, 1986; Kubli, 2005; Metz et al., 2007; Stinner, 1996). Students were said to find these stories the most engaging in their college classrooms, after they were interviewed by Kubli (2005). When students recognized discourses from their own social environments in their teachers' stories, they became more engaged because there was an emotional impact. These familiar features sparked affective engagement among the students (Klassen, 2007). On the other hand, students were engrossed when teachers spoke about themselves, portraying their humanness. Students also stated that they were able to organize the line of argumentation for scientific concepts with teachers' personal stories, and that these were most memorable. They cautioned however, that teachers need to be sensitive about the appropriate time to tell these stories because the stories need to fit the context, in terms of connecting with the concepts taught, and students' train of thought; they cannot be only anecdotal in a science classroom.

Shrigley & Koballa (1989) report that anecdotes are 'unpublished' short versions of stories which are told for the element of surprise; they often contain descriptive content of phenomena that is uncommon to the everyday listener. The events appear to be connected arbitrarily so they motivate the listener to seek answers thus inciting affective arousal or attention (Klassen, 2007). Norris et al. (2005) express this element of surprise as narrative effect. Besides this effect being said to promote greater comprehension, it is also said to stimulate attention because the content as narrative is familiar. The authors state that "There is an appeal to the view

that narratives are easier to comprehend, because the most basic elements of narratives are germane aspects of all human experience," (Norris et al., 2005, p. 554). This effect can be compounded by the fact that a norm exists for reading for understanding in classrooms which is taught with the genre of narrative and infrequently with other genres like expository and argumentative text.

Even though stories may have these anecdotal elements or narrative effects to promote student engagement, they run the risk of subduing student learning. Given the degree of the content that is familiar, the likelihood that the story has plausibility and persuasiveness increases (Shrigley & Koballa, 1989). It is this very act that can encourage listeners to take inferential leaps and not questions the validity of the story. Shrigley & Koballa (1989) cite Gordon Allport who speaks to this phenomenon as overgeneralization whereby "People are slow to deduce particular instances from a general truth, but are remarkably quick to infer general truth from a vivid instance," (p. 296). Thus the teachers who tell stories with a high degree of narrative effect can inadvertently teach students that their example is true for all instances and likely holds a low risk of error. Thus students may not learn about alternative outcomes to the 'truth' presented.

Teachers, however, can use these anecdotal stories as teachable moments because they exemplify the danger of jumping to conclusions in science education (Shrigley & Koballa, 1989). Teachers can also capitalize on the vividness of imagery inherent in their stories to engage students to come to expository and argumentative science texts which are noted to have denser vocabulary and complex propositions (Scruggs et al., 2008; McGinnis, 2002). Even so, concrete claims cannot be made about the superiority of stories to promote student engagement and attention because there have been little research comparing narrative texts to other types of texts

(Norris et al., 2005). There has been even less research looking at teachers' spoken discourse (Oliveira, 2010).

Given the finding that there is little research focusing on how teachers' talk actually engage students, Oliveira (2010) attempted to describe the oral strategies that actually engage students. These strategies are discourse markers that can be identified in teachers' stories. He found that when teachers use figures of speech such as metaphors, metonymy[1], synecdoche[2], irony or exaggeration, they can increase student engagement. However Oliveira (2010) admitted that he did not evaluate how students' participated in response to these discourse markers which may have strengthened his claims. In this case, Turner & Patrick (2004) point to the discourse patterns that can facilitate student engagement, and encourage shy students who may not be highly competitive. They claim that teachers' discourse need to be consistent with attending to students' needs by avoiding differential expectations and calling patterns. Consequently, the personal goals of the students must match the instructional behaviors that teachers choose to perform. This is in a cognitive frame, which highlights that teachers' stories need to include cultural and/or familiar aspects of students' lives.

Building Community

There is more literature available on how teacher discourse can help to build a community of learners, but little focusing specifically on a type of discourse like stories.

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[1] Metonymy is described as word substitution whereby an object, being or idea is referred to not by its actual name but by the naming of something near or closely related (Oliveira, 2010).
[2] Synedoche is a form of metonymy whereby a part of an object, being or idea is used to refer to its whole (Oliveira, 2010).

Research findings directed to how teacher discourse may build communities in the context of connecting to students, may inform how stories may function in the science classroom.

Rex, Steadman & Graciano (2006) conducted a literature review on classroom interactions and found seven perspectives: process-product, ethnographic, cognitive, socio-cognitive, discourse analysis, critical and teacher research. The perspectives denote the purpose of the study, conceptual framework, research questions and methodology. Of particular interest to this study are the socio-cognitive and discourse analytic perspectives.

The literature that draws on the socio-cognitive perspective for classroom interactions denotes that communities are constructed through members' conceptions of, and engagement with, activity structures. Thus the learning that takes place within these communities emerges from the socially situated interactions with the objects and materials within the context. Varelas, Luster & Wenzel (1999) looked at how a teacher, Barbara, strived to build a community of learners. She was successful in negotiating the social-organizational dimension of the community whereby the environment is nurtured and built through interactions that foster trust, respect and shared values. The participatory framework created enables students and teacher to switch the roles of expert and novice (Herman, 2003). However, Barbara however was less successful with the intellectual-thematic dimension. This dimension refers to the ability to transform student participation into scientific practice (Varelas et al., 1999). Teachers are able to introduce how phenomena (in some cases data) connect to scientific theory. They can explore and discuss these connections with students by making it meaningful through stories, models and experimentation. Since the teacher was primarily focused on negotiating supportive interactions among students, she missed the opportunities to connect students' responses to scientific theory and assist students in elaborating their points. If students took more time to elaborate their explanations,

she may have noticed their misunderstandings, or that they were speaking about the phenomena in divergent ways (Varelas et al., 1999).

The fact that the intellectual-thematic dimension was secondary to the social-organizational dimension may have stemmed from the way the community was formed. The teacher brought about an actual community of students from her and her colleague's classes that met outside of class time every day. Thus the teacher and the students may have come to the group with different goals, beliefs, values, and purposes. If these are not similar among teachers and students, the outcome may be very different, from what was intended such as science learning being interrupted (Ballenger, 1992; Siry & Lang, 2010). For example, the teacher's primary goal was to transform the group of students into a community of learners where students voiced their thoughts and challenged each other in an attempt to make meaning. The students, however, were not familiar with the style of participation in their own science classrooms and this may have posed new ways of thinking in terms of what they can say and what role they could play. So if teachers do incorporate stories in their talk in an effort to build a community of learners, can their stories both connect to students and facilitate their science learning?

The literature that draws from the discourse analytical perspective on classroom interactions suggest that teacher discourse can take on both functions. Firstly, a participatory framework can be employed for analysis because it looks at the multiple layers (cultural, linguistic, social) that utterances can take as teachers navigate their discourse in the classroom. This framework can outline the utterances that may have been used to identify with students (e.g. in terms of revoicing) and/or to teach concepts (e.g. direct instruction or extending students' contributions). Secondly, Enyedy & Goldberg (2004) suggest that the object of the science lesson must be clear and that flexible roles and rules granted between teacher and students. The

object of the science lesson requires transitions between activities and a rationale for why the activity that followed stemmed from the previous one (Puntambekar, Stylianou & Goldstein, 2007). If the community's activity is framed around a story told by the teacher, "it can establish an object that orients the community toward genuine inquiry and creates conditions for conceptual learning," (Enyedy & Goldberg, 2004, p. 925). In addition, the story needs elements that students are familiar with outside of the classroom (Kubli, 2005).

The flexibility given to the roles and rules between students and teacher is similarly aligned to the social-organizational dimension of the classroom community. The caveat, though, is that teachers may also need to provide opportunities for students to interrogate the story and build upon it (Enyedy & Goldberg, 2004). The teacher becomes both learner and student in an activity of science. Moreover, teachers who resist avoidance behaviors like sarcasm and isolating one student with respect to another while negotiating the discourse can build community (Turner & Patrick, 2004). If the teacher disagrees with a response made from her story, she can make the instance a learning opportunity where students can continue to test their inferences until they reach a conclusion (Enyedy & Goldberg, 2004). In so doing, a community of learners with story may be supported.

Beyond the purposes strictly related to the science curriculum, teachers may tell stories related to their personal roles or their professional roles. The functions that are illustrated in the following section are how teachers' stories may legitimize their voice in the dominant discourse of science, and uncover the roles or positions that they occupy.

Teacher Voice

When individuals attempt to make sense, their discourse may not only contain aspects of their personal experiences but 'common sense.' Taylor (2009) cites society's understandings as 'society's common sense' which refers to "aggregated ideas and theories about how the world is and should be, and the associated practices or ways of doing things which make up our shared cultural environment," (p. 5). Gee (1991), a sociolinguist, puts a critical slant to 'society's common sense' by referring to it as dominant discourses. Individuals or groups, whose intentions usually are to obtain social goods, or acquire social status for their own benefit, use dominant discourses (Gee, 1991). These groups do not only create dominant discourses, but also standards or norms by which to measure non-dominant groups (Lemke, 1990). Thus, students' knowledge of key scientific concepts reflects the assessments put forth by standards created by dominant discourses. This outcome is often used as the sole and fixed measure of success, because it supports political goals of a knowledge-based economy (Kelly & Sezen, 2010; Shaw & Greenhalgh, 2008). These goals may be used as resources by teachers socially and politically. They may believe that their roles as teachers and their possession of science knowledge as it exists cannot be questioned, in order for students to learn the key concepts (Brickhouse, 1990; Hanrahan, 2006). An apparent consequence is that there is little acknowledgement of how these dominant discourses and norms are hindering teachers' voices in making sense of science, and possibly may be influencing their interactions with students with diverse educational needs.

Teachers' voices are evident in the stories told by Osborne (1998) about herself and Ah Nee-Benham (1997) about Jacquilyn Dudley. Osborne (1998) examined how she made sense of science and found that if she gave students similar opportunities, the discourse that was produced was unexpected. Her goal was to have a writing workshop where students would research and

write stories about dinosaurs. Her classroom students included a majority of English language learners. She began the unit telling stories about dinosaurs from various resources. She wanted students to identify whether any of the concepts were fact, theory, or fiction in the spirit of creating a lens that critiqued what scientific knowledge was and how it was produced. In so doing, students will grasp some concepts to write a story and defend its construction with their peers and teacher, thus engaging in authentic science activity. However, the outcome was that students directed the progression of the workshop by articulating questions about concepts taken from the stories, and reflecting on their fundamental assumptions of science. Osborne (1998) did not expect this turn of events but she allowed it to continue as she recognized that verbalizing her view about how science was constructed through story encouraged students to think about their own views. The decisions students made to include some concepts and not others came from implicit assumptions or subjective understandings that were tied strongly to their respective cultures and were revealed in their discussions. These revelations led Osborne (1998) to reflect upon her own values and uncover the assumptions that she made with her original pedagogical choices, which culturally made sense to her. In a classroom working with students with different cultures and abilities, stories provided Osborne (1998) with a context to examine her voice through expression of her tacit values and reconstruction of the logic behind those values. The stories also encouraged students to articulate their voices which gave Osborne (1998) the opportunity to study by seeing how students learn from their standpoint (Witherell & Noddings, 1991).

Jacquilyn Dudley told many stories to Ah Nee-Benham (1997) as she chronicled her experiences as a daughter and student to those of becoming a science teacher. Her stories disclosed the complex interconnections between her cultural, social, and ethnic background and

how these influence her perceptions about self and school (Carter, 1993). Ah Nee-Benham had extensive interactions with Dudley using interviews, classroom artifacts, a reflective journal, personal writings and poetry, and a pedagogical biography which was a product of a college course. As a result, Ah Nee-Benham was able to provide a thick description of the narrative that emerged from Dudley's stories that revealed the nuances of oppression through her inertia and combat in dealing with difference. As an African-American, Dudley recognized how her ethnicity was devalued in curricula and by some key people in her life. Also, since she did not grow up in an African American neighborhood, she was ostracized by some people of her own ethnicity because she was seen as not being fully conscious of the Black experience. As a result, Dudley turned to her teachers and herself for support. Also, the social consciousness and collective responsibility that developed from the civil rights movement and other events in the 1960's gave her the courage to express her voice through poetry and share her beliefs of understanding and unity through teaching (Ah Nee-Benham & Dudley, 1997, p. 70). As a result, Dudley shared stories with her students that emphasized the values of care and respect and provided structure with clear objectives which highlighted the tensions that existed between the two. It was a reflection of her own experiences that was an interweaving of her personal and professional self (Moore, 2008).

Witherell & Noddings (1991) contend that "stories can join the worlds of thought and feeling, and they give special voice to the feminine side of human experience – to the power of emotion, intuition, and relationships in human lives," (p. 4). It seems that stories can expose teachers' voices (and those of their students) to show how social and cultural dimensions can have powerful influences of how teachers teach and students learn in the classroom (Ah Nee-Benham & Dudley, 1997; Osborne, 1998).

Roles or Positions of the Teacher

As teachers tell their stories, what are they doing? Are their narratives having any affect in the classroom? As teachers narrate their experiences, they may choose certain positions in comparison to others. Their choices may be determined by their role in the classroom, thus they may occupy a 'safe' or 'risky' position. A 'safe' position may refer to some teachers who maintain the rules because it confirms the differences they perceive, which may reinforce the stereotypes associated with the dominant structures in science (Brand & Glasson, 2004). The 'risky' position may refer to Lemke's (2000) description of some teachers who may break the rules or norms in order to create alternative outcomes for their students that are not deemed successful. Therefore, the positions teachers may take as they tell their stories may be their response to the context as they attempt to make sense of science meaningfully.

The knowledge utilized when teachers assert particular positions are part of the value-judgments they make in order to make sense of past experiences, commitments, beliefs and their subject matter knowledge in perceived contexts (Salloum & Abd-El-Khalick, 2010). Salloum & Abd-El-Khalick (2010) state that teachers making sense of their own practice requires further exploration because past research has not utilized interpretative frameworks that position teachers as sentient beings that utilize more than just logical/rational knowledge. They continue that the use of practical-moral knowledge implies that knowing about the world may fall into two categories: paradigmatic cognition and narrative cognition. This study focuses on narrative cognition because individuals take action based on the interaction of several variables in their lives that do not follow prescribed patterns (Bruner, 1987). Thus individuals who use narratives are positioning themselves as taking action bolstered by memories connected to emotional and

motivational meanings (Polkinghorne, 1995). Furthermore, these positions derived from their personal meanings form identities (Moore, 2008).

Researchers have examined how teachers' positions or positionality and identity are inextricably linked. They found that the identity derived from teachers' personal histories can shape their positionality when interacting in the classroom (Goldston & Nichols, 2009; Moore, 2008). For example, Moore (2008), in challenging professional development research, argues that teachers' identities emanating from their personal lives can influence their social positions. Her study found that African American science teachers used their identities as resources for privilege and obligation in high school contexts that were predominantly African American. Their unique personal histories provided narratives that revealed gender and racial oppression. However, their experience of the interlocking aspects of oppression, power, and privilege enabled them to occupy positions that shaped their knowledge of science, pedagogy and themselves, which similarly influenced their interactions. They communicated experiences that both represented their sense-making processes, and constructed their entry into a context that seemed at times, welcoming or intimidating.

Consequently, teachers' stories are not only constructions but representations of one's life (Bruner, 1987). Bruner (1987) asserts that the narrators are committing a reflexive act when they are both privileging their stories in response to the context, and disrupting their stories despite their rendition. The reflexivity emerges when scholars indicate that teachers may both (1) occupy particular positions in relation to their students and (2) select particular experiences, when telling their stories (Hanrahan, 2006; Moore, 2008; Upadhyay, 2005). Hanrahan (2006) states that a teacher who assumes a hybrid identity is one that occupies a variety of positions, and

communicates rich, everyday experiences that provide opportunities for students of all backgrounds to access science.

Conclusion

In conclusion, there are two ways in which stories function: (a) improving science, and (b) establishing relationships with students. In some cases, both functions are strived for but the construction of stories is mediated by the roles of the teachers and the students. In terms of the affordances of teachers' stories, they can demonstrate how science is lived. Students can hear the experiences of teachers making sense of science in their own lives which are current and authentic. Upon hearing these stories, students' knowledge can be elicited, concepts can be refined, their engagement stimulated, and they may feel that they are indeed members of a classroom community. Students see their teacher occupy various positions to teach science, and the teachers' stories in particular may show that they can learn science amid difficulties they might face.

The constraints of stories though seem to rest mostly upon the role that the teacher chooses to take in order to teach science, thus conveying the opportunities that she provides for her students to learn science. If looking at two extremes, a teacher who views her role as teaching science in one way may not use stories at all. On the her other hand, a teacher who views her role as teaching science in multiple ways may tell stories and use many other strategies to the extent that there is little coherence and students are lost in the process of learning science. It seems that a balance needs to be sought where a teacher uses stories to convey her personal experiences with science. In so doing, students can see science as currently lived. Additionally, the teacher allows her students to interrogate and question her story. The result might be that she is able to correct misunderstandings and clarify concepts that students might demonstrate as they vocalize their thoughts. Furthermore, she is informed of whether her students are following the correct line of thinking as the story becomes the object of science activity. Finally, the teacher

recognizes that all students need to participate in learning so even though they may not question her story, she might use an alternative strategy of allowing students to write their story. As such, students are involved in the sense making process of science, thereby engendering a community of learners.

Consequently, teachers' stories help to build the narrative that they adopt in the classroom in terms of their utterances and their management of student discourse. They are using their voice to make available their experiences with science, but also allowing students to participate in that process. Scholars have shown that when teachers include students' experiences or their funds of knowledge in their science teaching, science becomes more meaningful for students and its impact can reach persons beyond the classroom like parents and community members (Calabrese Barton & Tan, 2009; Upadhyay, 2005). Upadhyay (2005) also indicated that teachers who share their own experiences create an environment that is relevant to students' lived experiences and their responses are given equal merit. In Brickhouse's (1990) study, one of the teachers did speak of experiences but they were not his; instead, he described the livelihoods of scientists.

Even though the studies conducted by Brickhouse (1990) and Upadhyay (2005) delineate the connections between teachers' discourse practices and knowledge they do not systematically indicate how the teacher's stories of their experiences functioned (Norris et al., 2005). Carter (1993) may have described their interpretations as lacking genuineness because their plot structuring served to satisfy dominant paradigmatic interests for finding "best practices" instead of documenting what teachers actually may be doing with their stories as they are told spontaneously. The functions of the stories appear to be at conceptual levels in terms of representing science, relational levels in terms of relating to students and identification levels in

terms of the roles they might adopt. There is a need to identify how teachers use stories to understand if they operate in productive or unproductive ways. This dissertation will attempt to address these issues to determine how teachers' stories function to help students make sense of science.

CHAPTER 3

METHOD

This chapter begins with a brief overview of the research approach that is used to interpret the data. I then elaborate on my role as a researcher, the participants, and the context. Lastly, I discuss the steps taken for data collection and analysis.

This dissertation is an interpretative case study that examines how one teacher, Ms. M, uses stories in an elementary science classroom. It lends itself to a qualitative approach because it takes place in a natural setting, uses interpretative methods, and is emergent (Creswell, 2009). The context is a fifth grade classroom and the procedures employed are to interpret the teacher's stories. Patterns of understanding will materialize through interpreting a series of Ms. M's stories (Creswell, 2009). These patterns arise from a recursive movement between the data and the categories that emerge from the classification process of stories for their similarities (Polkinghorne, 1995). Analyzing these patterns will be accomplished with a basic form of content analysis (Neuendorf, 2002). Afterward, the combination of stories will be interpreted and discussed to illustrate a narrative of her experiences related to teaching as she works toward helping her students make sense of science. This type of narrative analysis is called narratives as practice in social interaction, where the focus is on how stories operate in society (Peräkylä & Ruusuvuori, 2011). In this case, it is Ms. M's classroom and how her stories are constructed and organized in the given context.

This case entails an in-depth inquiry into a setting bounded by the participants' activities and time (Creswell, 2009). This case study also possesses features that are particular to the teacher's classroom context: descriptive, to richly explain the teacher's use of stories, and heuristic, to add to a reader's understanding of the stories told in a science classroom (Merriam,

2009). The case for this study, Ms. M, was selected because it was a purposeful sample (Bloomberg & Volpe, 2008). While spending time in fifth grade classrooms collecting data on how teachers used the technology-based science curriculum, I was intrigued by Ms. M's use of story compared to other fifth grade teachers. Her case was not based on a snowball effect where her colleagues recommended her as a 'story-telling' teacher (Shirley, 2005). Instead, her case was opportunistic, or presented the opportunity to illustrate how she used stories in her classroom (Patton, 1990). Ms. M was chosen because she initiated activities and spoke of experiences external to the curriculum with students that had diverse educational needs. In addition, she was in her second year of teaching the curriculum which was seen as ideal because she could possibly speak outside of the intended curriculum discourse, integrating her subjective understandings of science (Keys & Bryan, 2001; Williams, 2008).

Role of the Researcher

My participation in the research process revolved around designing the online curriculum unit and the lesson plans. During the project run, I was present at most of the classroom sessions when the WISE curriculum was being implemented in the classroom. When I was in the classroom, I helped the teacher with classroom management and pedagogy since I was very familiar with the curriculum. Therefore, I was not only occupying a position as a researcher in the classroom but also as a mentor (Slotta, 2004).

As the researcher of this qualitative study, I hope to depict a holistic picture that is both descriptive and interpretative for Ms. M's narrative. Thus, the process is both inductive and deductive as I navigate between the codes and interpretations. As a result, I have to be very clear of the interpretations that are drawn in order to reveal my intuitive or reflexive moves (Carter,

1993). Reflexivity is said to be an introspection and acknowledgement of my biases, values and interests (Creswell, 2012) which is a vital part of the representational validity taken in qualitative research (Baxter, 1993).

Research Participants and Context

The data reported in this dissertation was part of a larger project that investigated how elementary and middle school students developed coherent understandings of heredity and related concepts across grade spans. A web-based science inquiry curriculum called WISE (Web Inquiry Science Environment) and offline laboratory materials were utilized. For this case study, I analyzed and interpreted the discourse of one 5th grade teacher called Ms. M. Pseudonyms were used to protect the identities of the study participants.

Study Context

This study was implemented in two fifth-grade classrooms taught by Ms. M. The two classes, Zeta and Gamma both consisted of 28 students. The students attended an elementary school in grades five through six in a Midwestern suburban school district. The school was well resourced technologically with Internet access, a Smart Board, multimedia projector, and two computers in every classroom, as well as a computer lab with approximately 32 computers. The principal and science teaching staff were dedicated to ensuring the best learning opportunities and had successfully secured a grant to obtain additional laptops for students. As a result, Ms. M's students used the laptops in the classroom while they worked with the WISE Heredity curriculum materials. Figure 1 depicts a layout of Ms. M's classroom.

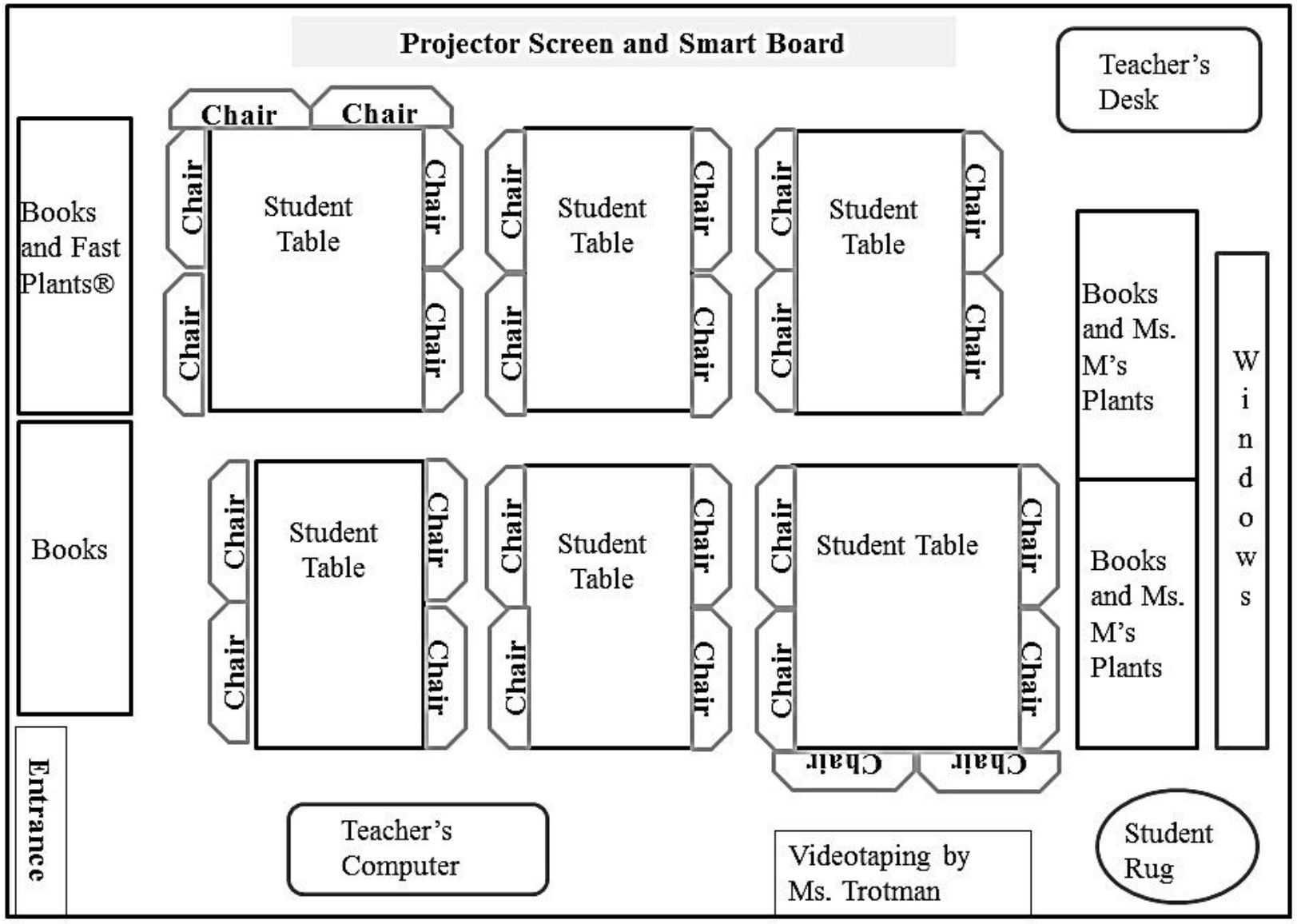

Figure 1. Typical layout of Ms. M's classroom

Background on Ms. M

Ms. M is a Caucasian female teacher who majored in English, and also held a Master's degree with a special emphasis in Early Childhood Education. At the time data was collected, she had accumulated six years of teaching science at the 5th grade level. Before implementing the heredity project, Ms. M completed a demographic background questionnaire. She indicated that she was somewhat confident in teaching science and moderately confident using educational technology.

Ms. M agreed to teach the core science topic of heredity and integrate technology into her instructional practices with the WISE curriculum. She was provided with the 5th grade WISE curriculum and all necessary laboratory materials (e.g. Wisconsin Fast Plants™). She taught the curriculum at least four days per week for a total of six weeks. The author was present to video-tape the classroom science instruction three days a week on average. Students were learning science using computers for the first time and Ms. M was teaching with WISE for the second time. The students worked with laptops in the classroom for science and were grouped in dyads. The teacher purposely paired the students based on how well they socially worked together.

When Ms. M worked with the WISE curriculum, she generally began by showing an activity step from the curriculum with the projector. She used the Smart Board at the front of the classroom to navigate through the WISE steps in the unit. Sometimes, the Smart Board did not work so she asked either a student or I to assist with navigation on the computer at the back of the classroom. She usually read through the information or evidence on the Smart Board screen. Afterward, she would ask students questions about what she read. When was finished lecturing or discussing with the students which took up approximately half of class time, she would give the laptops to students so they could work in paired groups on the WISE curriculum unit. During

this time, she would facilitate individual group discussions with different pairs. If the students were not working on the computers, they were working with the Fast Plants® in paired groups and writing their observations about plant traits in their offline journal. At this time, Ms. M would also sit with different pairs to discuss the traits they observed in their plants.

Background on Students

The total student enrollment for grades 5-6 in the period 2009-10 was approximately 361 students. There were 180 male and 181 female students.

For fifth grade alone, 30% of the students qualified for free or reduced lunch. The ethnicity of students was as follows: 20% African American, 11% Asian, 61% Caucasian, 6% Latino and 2% Other. 10% of the student population was enrolled for special educational services and 5% were English Language Learners.

Ms. M taught two classrooms for science which were Zeta and Gamma. Desks were arranged into six tables or stations in the classroom as shown in Figure 1. There were approximately four to six students sitting at each station. Stations were either heterogeneous or homogeneous by gender since Ms. M changed the configuration approximately every three weeks. Most of the students were suited to general education. Students who did receive special educational services had a paraprofessional in the classroom to assist them with classroom duties. There were some students however who were protected under Section 504[3].

[3] Section 504 under the Vocational Rehabilitation Act of 1973 protects students who may have any condition that substantially limits their ability to learn in school. However, these students do not meet the eligibility criteria for special educational services. As a result, general educational personnel need to make every effort to take steps necessary to provide the highest quality education and eliminate discrimination of these students (Friend & Bursuck, 2012).

There were 57 students registered in both of Ms. M's classes. 15% of these students qualified for free and reduced lunch. 12% of the students had Individualized Education Programs (IEPs) and 2% were English Language Learners. At the time of data collection however, Classroom Zeta had 16 boys and 12 girls and Classroom Gamma had 11 girls and 17 boys. There were approximately 8 students and 5 students in classrooms Zeta and Gamma respectively that either had IEPs or were protected under Section 504.

Implementing the WISE Curriculum Unit

The Web-Inquiry Science Environment (WISE) curriculum unit for fifth grade was called "The Case of Audrey – Inherited and Acquired Traits". It was designed by a partnership that included teachers, researchers, programmers, and scientists. During the design process, the partnership worked with the main and related concepts of inherited and acquired traits by establishing criteria, testing ideas, re-conceptualizing tasks, and designing new approaches (Linn, Shear, Bell & Slotta, 1999; Linn & Eylon, 2006). Ms. M, along with other fifth through seventh grade teachers in the district, took part in a professional development workshop coordinated by the research project team. This workshop took place in the summer before implementation and provided teachers with opportunities to engage with the WISE platform and the heredity curriculum. Discussions developed around the knowledge integration instructional framework connected to the WISE curriculum, technical issues associated with the implementation, and lesson planning. Ms. M also met with the researcher in two after-school meetings (one during and one after implementation) to reflect on curriculum implementation.

WISE offers content that has relevance to students' lives, has many practical, hands-on opportunities, and allows students to work together (Mastropieri et al., 1998). WISE is a technology platform whose design is guided by the Knowledge Integration (KI) framework. This

framework acknowledges the repertoire of ideas that students have in order to build coherent understandings by using evidence to add new ideas (Gerard, Varma, Corliss & Linn, 2011). In addition, teaching with WISE can provide insight into the interactions that support classroom learning communities (Cobb, Confrey, diSessa, Lehrer & Schauble, 2003; Cohen & Ball, 1999). The participatory framework from Kovalainen and Kumpulainen (2005) can assist in outlining interactions between students and teachers in which teachers may tell stories and other types of discourses that occur in the classroom.

The WISE curricular materials integrated inquiry and technological scaffolds as multiple activity structures to move students towards a deeper understanding of heredity. These structures guide students to interact with dynamic visualizations, reflect and write explanations, make predictions, and collaborate through discussions (Lee, Linn, Varma & Liu, 2010). To begin their learning with the curriculum, students were alerted to the driving question, "Why do plants and animals have similar and different features?" This focused students on how traits are inherited and acquired by plants and animals. Besides interacting with the WISE tools, students were immersed in authentic experiences of growing their own plants and working with *Audrey's Garden*. Students grew Fast Plants® which were hybrid brassica plants bred to complete a life cycle within 40 days. Students worked in pairs and each pair grew two Fast Plants® with a different phenotypic trait of height (short and tall). However, students were not aware of this difference until they discovered that their plants were growing differently and they had to determine why plants may have similar and different features.

Audrey's Garden was a simulation that featured a 5th grader, Audrey, growing tomato plants in three gardens. These gardens were situated between her house and a flowing river, and the gardens were five, ten, and fifteen meters away respectively from her house, with the last

garden being closest to the river. Audrey obtained the seeds which were the offspring of tomato plants that belonged to Jeff which grew perfectly in a greenhouse. However, when Audrey began growing her plants in her garden, she saw that the plants closest to the house and closest to the river were not looking as healthy as Jeff's plants. The 5th grade students were then appointed to assist Audrey in solving this mystery. They participated in the inquiry process of investigating why the traits of Audrey's plants were similar and different from Jeff's plants.

In addition to Ms. M teaching students about inherited and acquired traits of animals and plants, she also taught them about animal and plant cells, plant reproduction, and traits for survival. By the end of the curriculum unit, Ms. M determined if her students understood trait inheritance for plants and animals and particular traits being acquired depending on the organism's environment. Table 1 summarizes the nine WISE activities in the 5th grade unit. Each of the activities consisted of a series of steps that consisted of evidence or informational pages, discussion forums, reflection notes, assessments, simulations, or interactive tasks. It is important to note these individual activities and steps since they illustrate what Ms. M was teaching at different temporal points in the curriculum unit. For example, Activity 1 included one informational page, five evidence pages, and one reflection note.

Table 1

Summary of activities in WISE 5th grade curriculum unit

Activity	Title	Description
1	*Introducing WISE…*	Introduction to the biological inheritance unit and the driving question, "Why do organisms have similar and different features?"
2	*The Case of Audrey and Learning about your Fast Plants*	Inquiry investigation of characteristics that students can observe among themselves.

Table 1 (cont'd)

3	*Similarities and Differences among Organisms*	Introduction to inherited and acquired traits of animals, and trait variation. Students explore similarities and differences among themselves using a trait survey. Also, they investigate examples of how traits can be influenced by the environment through engaging in online discussions about acquired traits among a set of twins living in different geographical locations (based on the classic movie *Parent Trap*).
4	*Cell Growth and Reproduction*	Investigation of cell structure and plant reproduction. Students learn similarities and differences between plant and animal cells. They learn how reproduction occurs through the process of fertilization in plants. Students are asked to connect these experiences to their Fast Plants investigations.
5	*Plant Traits*	Investigation of inherited and acquired traits of plants by observing short and tall Fast Plants. This is an example of plant diversity that can help students observe phenotypic characteristics.
6	*Audrey's Garden*	Introduction to Audrey's Garden gaming environment. Students interact with a virtual garden to understand how environmental factors can impact plant traits.
7	*Traits for Survival*	Investigation of how traits evolve over time as a result of organisms interacting with the environment.
8	*Solving the Case of Audrey*	Application of concepts learned to determine whether plants traits, including both Fast Plants and Audrey's tomato plants, are inherited or acquired.
9	*5th grade Glossary and Resources*	Provision of an online dictionary and external resources connected to the unit.

Data Collection

An interpretative approach was used in this case study that centered on classroom discourse, with a special focus on Ms. M's stories. A basic form of content analysis was used to fulfill the purpose of identifying what these stories were, when they occurred, and their pedagogical functions. Afterwards, the patterns that emerged from the classifications were interpreted to understand Ms. M's rationale for using stories to make sense of science with her

students. Ms. M's stories were the units of analysis, which formed part of "naturally occurring" data (Peräkylä & Ruusuvuori, 2011, p. 529).

The data sources for this study included video recordings of the classroom discourse in two of Ms. M's science classrooms (Class Zeta and Class Gamma) and a demographic questionnaire for the teacher, Ms. M. I was present in both of Ms. M's classrooms every week while she taught the unit and the video recordings documented the time spent in both classrooms. Her discursive practices were recorded as she interacted with her students in a Web-based Inquiry Science Environment (WISE). Ms. M's interactions with her students differed based on the temporal point she reached in the WISE curriculum. For example, if the WISE step entailed providing evidence of the science content, Ms. M usually initiated a whole class presentation and/or discussion. On the other hand, if students were primarily engaged with observing their Fast Plants® or entering their responses into the WISE curriculum, Ms. M circulated the classroom interacting with groups of three or four students as they worked on their laptops.

Ms. M was observed for two classes per day for two to three times per week in the spring of 2010. These classes are named Zeta and Gamma respectively. Ms. M was the main teacher for class Zeta; class Gamma was taught primarily by another teacher. Each class episode lasted for approximately 49 minutes, totaling an estimated 18 total hours of video over five weeks. Table 2 depicts the class episodes that contain the time and description of the activity in the WISE curriculum being taught by Ms. M. Ms. M held the microphone which meant that her discourse was heard to a greater extent compared to her students. In addition, she had the ability to turn the microphone off. When the microphone was turned off, the video was also switched off. When the sound and video was turned back on, the class continued to be videotaped. As a result, there

was more than one video for one class period. For example, on May 4th for Class Zeta, there were two videos totaling 61 minutes.

Each of the video tapes was initially and automatically transcribed by Dragon software for first-pass data analysis. Once stories were identified within the 18 hours of data, those segments containing stories (along with five minutes before and after the story) were transcribed in full detail by the researcher. The conventions used to transcribe the data were Jefferson's Transcription Notation shown in Appendix D.

Table 2

Ms. M's Class Episodes for the Web Inquiry Science Environment (WISE) Curriculum

Date	Description	Class Zeta	Class Gamma
04/27	*Activity 2* Discussion of traits		(1, 44)[a]
04/28	*Activity 2* Completing trait survey	(1, 60)	(1, 52)
05/04	*Activity 3* Students work on laptops	(2, 61)	(1, 43)
05/06	*Activity 4* Discussion of inherited and acquired traits and cells	(3, 56)	(1, 53)
05/10	*Activity 4 and Fast Plants* Students observe and measure their plants; discussion on plant life cycle	(4, 78)	(1, 18)
05/12	*Activity 4* Discussion of plant traits and reproduction	(2, 60)	(1, 56)
05/13	*Activity 5* Discussion of plant roots, traits and reproduction	(1, 58)	(1, 45)

Table 2 (cont'd)

05/18	*Activity 5* While some students complete the online work, others work on instructional posters	(1, 64)	(1, 53)
05/20	*Activity 6* Students work on laptops and record results from tomato plant growth	(2, 32)	(1, 54)
05/24	Activity 6 and 7 Discussion on Audrey's plants and animal adaptations	(2, 24)	(2, 15)
05/27	Activity 8 Students chart growth of Fast Plants and discussion of plant traits	(2, 49)	(1, 49)

Note. [a](number of videos, number of minutes)

Another source of data for this study was a teacher demographic questionnaire which is provided in Appendix A. The questionnaire contains 11 questions asking about gender, ethnicity, educational background, years teaching science, and level of confidence teaching science and working with educational technology. It was adapted from questionnaires used for the National Assessment of Educational Progress (NAEP) and Mentored and On-line Development for Educational Leaders in Science (MODELS) (Spitulnik, Higgins & Corliss, 2008).

Data Analysis

Before data coding and analysis were conducted specific to the research questions (what stories are told, when they are told, and what purposes they serve), significant work was needed to reliably identify stories from the videotaped classroom discourse.

Identifying Teacher Stories in the Videotapes

Prior to identifying what stories Ms. M tells in her two classrooms, a working definition of a story was needed. For the purposes of this study, and for coding, stories:

- Are teacher utterances;
- Use the first person or third person narrative view;
- Relate an experience that occurred outside the classroom.

Analyzing the data for occurrences of these stories then was a systematic search through the videotapes for utterances with the above characteristics. Once a story was found, several features of the story were coded as outlined in Table 3.

Table 3

Coding Scheme for Occurrence of Stories in Classroom

Category	Description	Codes
(a) Curriculum Sequence	Codes the activity number, step number, and describes the part in the WISE curriculum in which the story emerges	Activity #, Step #
(b) Story Start Time	Codes in minutes and seconds where the story emerges temporally in the class	(mm:ss)
(c) Story End Time	Codes in minutes and seconds where the story ends temporally in the class	(mm:ss)
(d) Full Text of Story	Describes events that occurred during the time the story was told	Full text transcript
(e) Antecedent Events	Full text of 5 min before the story start time	Full text transcript
(f) Subsequent Events	Full text of 5 min after the story end time	Full text transcript

To increase reliability in this study, two reviewers were used for data coding. To determine if two raters agreed on whether or not they had identified the same story, the following procedure was used. Following training (described later), each rater independently viewed the full set of videotapes looking for occurrences of stories that fit the provided definition (above). For each story a rater found, they recorded (a)-(c) (Table 3). Once both reviewers had independently created their lists of stories for the entire corpus of tapes, they compared their lists. Comparing items across the two lists resulted in the following scenarios:

1. An item from reviewer A's list that overlaps in start and end time (for the same Curriculum Sequence) with an item from Reviewer B's list will count as one agreement.
2. An item from either reviewer A's list that does not overlap in start and end time (for the same curriculum sequence) with any item from Reviewer B's list will count as one disagreement.

Disagreements were resolved by consensus. Moreover, codes (d) to (f) were automatically coded (since it was not open to interpretation) with codes generated from the data for type of story, antecedent and subsequent events for each story identified (mutually agreed upon).

What Types of Stories does one Elementary Teacher tell during Science Instruction?

The data coded in Table 3 provided one answer to the first research question: What stories does Ms. M tell during science instruction? The full collection of stories was transcribed and is reported. However, a paradigmatic analysis was needed to summarize these stories into

categories to identify types of stories. These categories were not mutually exclusive since stories can be of more than one type. This categorization (g) was added as a coding decision.

Early passes through the data helped inform an initial coding scheme to further analyze these stories according to type and are represented in Table 4. These types also corresponded with some of the types that Shirley (2005) identified in his research when he interpreted the discourse of three teachers who were experienced storytellers. Although these categories were used to guide analyses, additional categories may emerge during the coding of the data.

Table 4

Coding Scheme for Types of Stories Told in the Classroom

Category	Description	Codes	Analysis	Example
(g) Type of story	A categorization of the type of story told	Auto	Autobiographical – first person narrative whereby teacher personally speaks about herself and is the primary character	"I planted some roses in my garden and they are now beginning to bear. They are red roses and those are my daughter's favorite."
		Bio	Biographical – third person narrative whereby teacher personally speaks about someone else and may be a secondary character	"When I was little, my father used to pull up those weeds – dandelions. I helped him but it felt like a tug of war as we struggled to pull those large roots up."
		C_Event	Current Event – the characters in the teacher's story are recognizable as individuals in current news	"My friend's son is autistic and there is a current debate among scientists about whether autism is caused strictly by genetics or the environment."

Table 4 (cont'd)

	Hist	Historical – teacher tells a story about a science figure in the past of which she bears no personal relation	"Gregor Mendel born in Austria was the first to describe how pea plants inherit traits."
	Fict	Fictional – teacher tells a story where the characters appear to be fictional or made up	"One night Sally went to bed and she dreamt about green peas. She got up the next morning and her hair was green!"
	Other	Teacher tells a story that has other attributes	The teacher tells a story that has other attributes.

When do these Stories occur in the Classroom?

The second research question was: When do stories occur in the classroom? These were answered based upon what happened in the classroom just prior to the story being told. Each of the utterances that were told either by the student or the teacher which triggered the telling of the story were interpreted and assigned a code. Open coding was used and the codes discovered in the data are reported in the Results chapter of this study.

What Pedagogical Functions do these Stories serve in the Classroom?

The final research question which elucidated the pedagogical function of Ms. M's stories was answered using the functions that stories have been purported to have (as stated in the literature review). Categories (d) to (f) from Table 3 were interpreted to gauge whether these functions were evident in the discourse. Firstly, category (e) contained the full text transcript which has the antecedent events or events happening approximately five minutes before the story started. This was the response to my research question two whereby I interpreted the transcript to determine the codes for each utterance. Secondly, category (f) contained the full text transcript

which has the subsequent events - those occurring approximately five minutes after the story ended. Finally, category (d) contained the full transcript of the story. I looked at the full text transcripts of the antecedent events, story, and subsequent events to determine the codes that described the functions that emerged from the data. These functions are disclosed in Chapter 4 of this study.

Two reviewers were also used for data coding for the antecedent events and functions to increase reliability in this study. However, this case differed from story identification because the codes were already generated from the data. Following training (described later), each coder independently viewed the full text transcripts of categories (d) to (f) for all stories. Once they read through the transcripts, they checked for at most three codes for (i) antecedent events and described the attributes for the events and (ii) functions and described the discourse markers that indicated the function.

It was possible that other functions besides those illustrated in Table 5 may be evident. As a result, the codebook for this categorization (h) also included a section called 'Other' where the rater described the marker that prompted these other functions.

Table 5

Coding Scheme for Pedagogical Functions of Stories

Category	Description	Codes	Analysis	Discourse Marker
(h) Pedagogical Function	A categorization of the pedagogical function	Act_Build	Activating and building background knowledge	Student introduces a concepts and the teacher builds on the student's response with a story or the teacher uses a story to bring a concept to students
		Clarify_Concept	Clarify concepts and vocabulary	Student poses a question and teacher responds with a story to answer or clarify
		Engage	Promoting engagement and attention	When story is being told, students appear to be listening to the story (e.g. their eyes are turned to her; little behavioral distractions)
		Build_Comm	Building community	Students ask questions about the story or contribute stories of their own
		Voice	Teacher voice	Teacher brings her personal experience to the formal discourse of the classroom
		Role	Roles or Positions of the teacher	Teacher appears to set aside her role as teacher and brings other roles familiar to her (e.g. mother) to the forefront
		Other	Other characteristics to describe the function of the story	

Procedures for Coder Training

A codebook was generated that contained coding schemes illustrated in Tables 3 through 5. This codebook and a coding form were provided to two raters. The coding form was a blank document that contained space for the rater to record the codes identified with the stories. A coding form is provided in Appendix B and the code book is Appendix C.

The raters first accomplished the goal of identifying stories. They independently viewed the full collection of videotapes. Afterward, they compared their lists of stories to decide whether there was agreement of when a story temporally occurred. Following the identification of the stories, raters were asked to report and describe the attributes of the stories and their events. The following were the goals that were pursued:

1. Select the type of story (using Table 4) from viewing the full text of stories. In addition, include attributes of the story that indicate the type.
2. Identify when stories occurred from reading the transcripts of antecedent event and story, and coding for the antecedent events.
3. Select the function of story (using Table 5) from reading the full text transcripts of antecedent event, story, and subsequent events. For each function, include attributes of the discourse marker.

A first pass of reading the transcripts and using the codebook were completed by two raters until they were comfortable with the coding scheme. Therefore, I provided the opportunity to include any other codes that were not present in the initial coding schemes. This pilot coding was completed and consensus was built on the schemes. Final coding for story function commenced using transcripts of story type, antecedent events (when the story occurred), and subsequent events. Comparing codes for each transcript resulted in the following consequences:

1. Two or three codes from coder A's list matching two or three codes from coder B's list signified one full agreement.
2. Two out of three codes from coder A's list matching two out of three codes from coder B's list signified ⅔ agreement.
3. One out of three codes from coder A's list matching one out of three codes from coder B's list signified ⅓ agreement.
4. One out of two codes from coder A's list matching one out of two codes from coder B's list signified ½ agreement.
5. All two or three codes from coder A's list not matching any of the codes from coder B's list signified one disagreement.

Disagreements were resolved by re-explaining the codes, adding new codes, clarifying the context and/or verifying the story start and end times. Once that was completed, at most two more rounds were taken to read through the transcripts and check the codes for antecedent events and function. Attributes were used to assist interpretation of antecedent events and discourse markers were used to aid interpretation for function. For example, a discourse marker can be the teacher shifting from speaking strictly about science content to her personal experiences which may indicate her effort to bring her voice into the formal discourse of the classroom. The results of the final round taken are reported in the results section including the procedures employed to compute inter-rater reliability with the coding forms.

Computing Inter-rater Reliability

Inter-rater reliability needed to be achieved to ascertain agreement among two or more raters so the procedures utilized can produce similar results in repeated trials (Neuendorf, 2002). Pilot reliability was conducted to assess whether the codes chosen by the two raters reliably represented the content.

Cohen's Kappa was used to compute inter-rater reliability for the type of story, occurrence of story and the story's functions (Neuendorf, 2002). This coefficient was utilized because it accounted for aspects of chance with weights to measure the levels of difference between codes. For example, for function of story, if one rater assessed the story's function as autobiographical and biographical, and the other rater assessed it as only autobiographical, this disagreement might be weighted 0.5 since one out of two functions was similar between the two raters.

Cohen's Kappa was used to calculate the level of agreement between coders for type of story, when the story occurred and its function PA_O refers to the percentage of agreements observed and PA_E refers to the percentage of agreements expected.

$$\text{Cohen's Kappa} = \frac{PA_O - PA_E}{1 - PA_E} \qquad \text{where } PA_E = (1/n^2)\,(\Sigma\, pm_i) \qquad (1)$$

n = number of units coded in common by coders

pm_i = each product of marginals

CHAPTER 4

RESULTS

The data analysis addresses three specific research questions: (a) what stories does one elementary teacher tell during science instruction; (b) when do those stories occur in the classroom; and (c) what pedagogical functions do these stories serve in the classroom? The identification of the individual stories that Ms. M tells provided the foundation for answering these questions.

What Stories Were Told

As discussed in Chapter 3 (Methods), the videos for the two classes (Gamma and Zeta) were analyzed in order to identify the stories that Ms. M told. A coding sheet, as shown in Appendix B, was developed to determine the start and end times for each of the stories identified. Initially, the two coders jointly identified 18 stories, spanning across observations of seven different videos - all of these stories occurred in Activities 2, 3 or 4, and were employed mostly during the Gamma class. In the end, there was 100% agreement regarding the videos on which the stories were identified. However, there were 12 out of 18, or 67% agreement, on the specific stories selected from the videos.

Disagreements were resolved by consensus. Table 6 illustrates the final identification of stories reached by consensus between the coder and the researcher.

Table 6

Final Identification of 16 Stories told by Ms. M

Story #	Transcript
1	Probably you've heard the word inheritance!... maybe in a story one of the main characters has a rich uncle who dies and the main character inherits his mansion! Okay!
2	So:: I am the parent... okay my husband and I are the parents of these offspring. Kay? So these are my children kay? A::nd if you... look at them carefully you can see that they have some of the same traits that ^ I do. Okay? They both have dark brown eyes just like me. …… But! Look at his hair! It's not grey yet but it's curly like my hair so these are traits that he has inherited from me! Okay? And there are traits that he's inherited from his dad as well as has Melanie my daughter okay?
3	Okay alright so that would've... that would've made a difference in our presentation. Okay and I think if you were to survey the entire world, you would find out that most people in the world are right-handed. Now it doesn't mean there aren't a lot of great people in the world that are left handed. For instance... Student: Obama The President of the United States is left-handed and its... its not only this President but also President Clinton I believe was left... is left handed. I'm sorry. I could not hear your question Hayden.
4	Okay that is kinda surprising isn't it? Ahm... I can... I can think back to when I was your age, I don't think people considered testing children to see if they needed glasses and very few people wore glasses when I was your age at school so, maybe people were becoming more aware and they had better ways of helping people or recognizing that younger people need glasses too so you're right. That is kinda interesting that we're se... that's very close. Okay? Anything else? Yep!
5	Okay. (Some students comment on the getting freckles). Okay it's true! People that have freckles during the summer if they're out in the sun and don't use sunscreen, they're likely to get more freckles okay. And then in shhhhhhh... and then in wintertime^ their freckles kind of fade away. Yeah! Kay? Okay shhhhhh....

Table 6 (cont'd)

6	Okay. Alright. When I was... again here is ancient history. When I was a student... when I was learning how to write ahm... people that were left handed... the teachers would often force them to write with their right hand. They wouldn't allow them to write with their left hand. They told them they have to learn to write with their right hand.
7	Okay so these are my offspring. Okay? So they have inherited traits from me and my husband. Right? Okay. So for instance, both of my children have brown eyes. My husband has hazel colored eyes so they inherited their brown eyes from... oh no! That's not true! This... my son has brown eyes so he inherited his brown eyes from me. My father has brown eyes so I probably inherited my brown eyes from my father and then my son inherited my brown eyes from me. Because my father... his grandfather also had brown eyes. Okay now! My daughter has blue eyes but! I have brown eyes and my husband has hazel eyes. But his... her grandmother... my father's mother has blue eyes.
8	Well neither of Melanie's parents have blue eyes either but her grandmother has blue eyes. Okay? So... that's how she probably ended up with blue eyes. Alright? Okay. Hear how that works? Okay. It's not what your uncle has, it's not what your aunt has or your cousin has? It's what you inherited through your parents, and their parents and their parents. Alright?
9	Okay. And that does happen sometimes. When I was a student... when I was a child many many teachers would not let anyone write with their left hand. They made people write with their right hand because they just didn't think that it was the proper thing for people to use their left hand. (Students ask why.) I have a sister that's left handed and it really was very confusing for her because she thought she was doing something wro:::ng by bring left handed and it really had nothing to do with her other than she inherited that trait. Okay. Elsie?
10	For instance I was born with bl... blonde hair and as I got older my hair turned brown almost black and now it's turning gray. And truly I never changed it. Kay? And the same thing happened to Kyle! He was born... I... ooh look! I can even... I think I even have... Student: Woah! See her pictures! (Students comment and make noises.) Okay. I guess I don't have one that far back here. But he... he had blonde hair when he was born. And then as he got older it turned brown and curly like mine. And now it's still brown and curly because he's not... (Ms. M shows them the picture again of her son.) And he'll probably have gray hair when he gets older.

Table 6 (cont'd)

11	Okay because he puts them on alright... they are not part of his actual face okay? Do you know Latoya? (giggles with students) At the high school a few years ago, the kids tried to break a Guinness book of world records and they filled the gym with all the students and all of them put on those masks (giggles)... So everybody in the gym had on one of those masks . You would have just been lost completely.
12	I decided I was going to have pierced ears. I wasn't born with pierced ears. My mother doesn't have pierced ears. My father doesn't have pierced ears. Neither of my grand... none of my grandparents had pierced ears. I decided at a ripe bold age that I was going to have pierced ears so I made that choice and I had someone give me pierced ears. Okay?
13	Ahm... for instance I was... as I told you at the beginning of the year I was in a little car accident. And I now have a dark blue spot on my knee where I got a bruise and my doctor told me the other day I'm probably gonna have it forever because I got such a big bump that it's kinda... He called it a tattoo alright? It's not a cool picture trust me okay. (Ms. M chuckles).
14	For instance hair color. Hair color okay. A lot of people who are my age that had hair this color naturally okay would be in the beauty shop instantly and having it changed to a different color that isn't gray.
15	Ahm I just finished reading a great book... the evolution of... have you read that book? You've read that book Daisy? The evolution of ahm... a girl. Oliver: American teenager? Okay. Anyway she... she goes to ahm with her grandfather and they put some pond water under a microscope and she sees ahm all these one celled organisms and feel... and felt exactly the same way. Okay.
16	I have one of These in my atrium at home and the plant is kind of walking All over the Bottom of the Garden. It Has Moved from One Spot to the Other As These little Plants... Take Root and Grow and then the big Plant Dies.

Another way of determining what stories Ms. M told in her classroom was to consider the *type* of stories that were told. The second rater was trained to use the codes from Table 4 and the transcripts of category (d) for each story to determine the type of story. For the first round of coding, the level of agreement between the rater and the researcher was 63%. Consequently, the two raters sought to improve the level of reliability. First, there was a clarification of the times

when stories ended for stories 6 and 8. Secondly, we rewrote the coding instructions to clarify the codes Bio (biographical) and C_Event (current event). As a result of these changes, and the re-categorization of the data, Table 7 shows the final codes used to categorize type of story.

Table 7

Type of Story for the 16 Stories

Codes	Description	Story	Frequency	%
Auto	Autobiographical – first person narrative whereby teacher personally speaks about herself and is the primary character	2, 7, 10, 12, 13, 14, 15, 16	8	50
Bio	Biographical – third person narrative whereby teacher personally speaks about someone else as the primary character (subject)	4, 6, 8, 9	4	25
C_Event	Current Event – the characters in the teacher's story are portrayed as individuals in current or local news or everyday life situations	3, 5, 11	3	19
Hist	Historical – teacher tells a story about a science figure in the past of which she bears no personal relation		0	0
Fict	Fictional – teacher tells a story where the characters appear to be fictional or made up	1	1	6
Other	Teacher tells a story that has other attributes		0	0

For type of story, Cohen's Kappa was used to compute the level of agreement, which was found to be 0.90. As indicated in Table 7, autobiographical stories were most prevalent and fictional stories emerged the least. The number of stories that were biographical or based on current events were close to a quarter of the 16 total stories Ms. M told for the duration of the curriculum implementation. Concluding, when Ms. M chose to tell her stories, they were mostly autobiographical or events in which she was the main character in the story.

When Stories Occurred

An analysis was conducted to determine when Ms. M told stories in the classroom by categorizing the antecedent events. The initial six codes emerged during analysis of the 16 total stories. Then the second rater was trained to use the developed coding scheme, and the transcripts of the antecedent events for each story, in order to decide when the story occurred. During the first round of coding, the level of agreement was 31%. Thus, the two raters aimed to improve the reliability measure. Firstly, the context for each story was provided to give a visual description of what students were doing in the classroom. Since the other coder only read transcripts and listened to audio, but did not view the videos, she asked the researcher to give a description of what the classroom looked like for each story. Secondly, we decided a seventh code category would be added to assess the antecedent events. Based on these refinements, Table 8 depicts the final codes that explain the events transpiring before the story. The examples included are from the data. Antecedent events (1) through (4) were all initiated by students, whereas events (5) through (7) were triggered by the teacher, Ms. M.

Table 8

Final Categorization of the Antecedent Events for the 16 Stories

Antecedent Event	Example
(1) Student initiated a concept without elaboration based on observations made from the curriculum or responses to Ms. M's questions	Story #3 Ms. M: Can anyone give us some interesting fact that you found out by gathering this information about our class? Okay Mario? Mario: Only one person was left handed.

Table 8 (cont'd)

(2) Student initiated a concept or story with elaboration based on attempting to explain their responses to Ms. M's questions	Story #6 Ms. M: Do you know what an inherited trait is? Warren: Uh like ahm freckles might be inherited but one thing that is not inherited is if you're right or left handed because when you're still a baby your parents teach you what hand they want you to be.
(3) Student initiated a concern or a question in response to the curriculum activity	Story #10 Elsie: Both of my mom and dad wear glasses and like my grandma (...) wears glasses but for some reason me and my two... two (...) brothers don't wear them.
(4) Student initiated a personal comment or feeling in response to the curriculum activity	Story #15 Carmichael: (...) the sound of tiny little animals in your drinking water is really gross.
(5) Definition – Ms. M defined a term from the curriculum	Story #1 Ms. M: Okay so traits and features that are passed on from parents to their children are often called... inherited traits.
(6) Teacher initiated a question but there is either no response from students or responses with no elaboration	Story #11 Ms. M: Okay is this an acq... is his... is him having that nose and those eyebrows is that acquired? Sarah: Yeah (...)
(7) Reinforcement – Teacher repeats or rephrases or further elaborates on a concept based on student understanding or engagement with lesson	Story #8 Well neither of Melanie's parents have blue eyes either but her grandmother has blue eyes. Okay? So... that's how she probably ended up with blue eyes. Alright? Okay. Hear how that works? Okay. It's not what your uncle has, it's not what your aunt has or your cousin has? It's what you inherited through your parents, and their parents and their parents. Alright?

Table 9 illustrates which antecedent events were identified in each of the 16 stories by the two raters during the final re-categorization of the data.

Table 9

Ms. M's Stories and their Antecedent Events

Story	Antecedent Event #1	Antecedent Event #2	Antecedent Event #3
1	Definition		
2	Definition		
3	Student initiated a concept without elaboration		
4	Student initiated a personal comment		
5	Student initiated a concept or story with elaboration	Teacher initiated a question	
6	Student initiated a concept or story with elaboration	Student initiated a personal comment	
7	Teacher initiated a question		
8	Reinforcement		
9	Student initiated a personal comment		
10	Student initiated a concept without elaboration	Student initiated a concern or a question	
11	Teacher initiated a question	Definition	
12	Definition	Reinforcement	Student initiated a concept or story with elaboration
13	Reinforcement		
14	Reinforcement		
15	Student initiated a personal comment		
16	Student initiated a concept without elaboration	Student initiated a concept or story with elaboration	

Cohen's Kappa, which was 0.87, was used to compute the level of agreement for when stories occurred. As shown in Table 9, students initiated or prompted Ms. M to tell a story at least eight times. Ms. M's stories came about with references to the curriculum either with providing definitions, asking questions or reinforcing concepts. Her own initiations for the stories that she told appeared to be moving from more formalized to less formalized science discourse. However, students' initiations appeared to be mostly non-formal except for four of Ms. M's stories. In story 10, one student voiced a concern and in stories 5, 6 and 16, they elaborated on a concept they shared with the class.

Pedagogical Functions of the Stories

The procedures involved in analyzing the functions of stories included interpreting the antecedent events, the story, and the subsequent events. Each of the 16 stories displayed at least one of the coded categories: (a) activating and building background knowledge; (b) clarify concepts and vocabulary; (c) promoting engagement and attention; (d) building community; (e) teacher voice; (f) roles or positions of the teacher; and (g) other characteristics to describe the function of story.

The second rater was trained to use the codes for pedagogical function, and provided the transcripts of the antecedent events, story and subsequent events. For the first round of coding, the level of agreement was 50%. Thus, the rater and the researcher endeavored to amend the reliability measure. We paid particular attention to refining the *Clarify_Concept* code. In addition to Ms. M clarifying concepts, she also aimed to bolster the concepts she was teaching by rephrasing the story. Furthermore, we expanded the *Voice* code into two codes. We recognized that Ms. M was telling stories that had either a direct or an indirect connection to the curriculum.

It appeared that these latter (indirect) stories were more targeted to engaging students socially rather than explicitly teaching concepts to them. As a result of these changes, Table 10 depicts the final codes used in the analysis for pedagogical functions of the 16 stories.

Table 10

Final Categorization of Pedagogical Functions for the 16 Stories

Codes	Analysis	Discourse Marker
Act_Build	Activating and building background knowledge	Student introduces a concepts and the teacher builds on the student's response with a story or the teacher uses a story to bring a concept to students
Clarify_Concept	Clarify and/or rephrase concepts and vocabulary	Student poses a question and teacher responds with a story to answer or clarify and may rephrase
Engage	Promoting engagement and attention	When story is being told, students appear to be listening to the story (e.g. their eyes are turned to her; little behavioral distractions)
Build_Comm	Building community	Students ask questions about the story or contribute stories of their own
Perso_Voice	Personal voice	Teacher brings her personal experience to the formal discourse of the classroom that appears to be indirectly related to the science curriculum
Teach_Voice	Teacher voice	Teacher brings her personal experience to the formal discourse of the classroom that appears to be directly related to the science curriculum
Role	Roles or Positions of the teacher	Teacher appears to set aside her role as teacher and brings other roles familiar to her (e.g. mother) to the forefront

Due to the re-categorization of data, the pedagogical functions observed in the final coding are depicted in Table 11.

Table 11

Ms. M's Stories and their Pedagogical Functions

Story	Pedagogical Function #1	Pedagogical Function #2	Pedagogical Function #3
1	Act_Build	Engage	
2	Build_Comm	Act_Build	Clarify_Concept
3	Act_Build	Build_Comm	
4	Perso_Voice		
5	Clarify_Concept		
6	Role	Perso_Voice	Engage
7	Clarify_Concept	Teach_Voice	
8	Teach_Voice	Clarify_Concept	
9	Role	Perso_Voice	
10	Clarify_Concept	Teach_Voice	Engage
11	Clarify_Concept		
12	Act_Build	Teach_Voice	Build_Comm
13	Build_Comm	Teach_Voice	Engage
14	Clarify_Concept	Teach_Voice	
15	Act_Build	Perso_Voice	
16	Perso_Voice	Engage	

In regard to the pedagogical functions of stories, Cohen's Kappa was used to compute the level of agreement at 0.88. As illustrated in Table 11, only three stories had been shown to have one pedagogical function. Whereas the other stories that Ms. M told indicated functioning in at least two ways. It appears that if Ms. M was not activating and building background knowledge or using her personal voice, she was clarifying concepts. Most of her stories seemed either to clarify the concepts initiated by students or were told by her through definitions, questions or

concept reinforcement. In addition, analysis of the data indicated that her teacher voice was emphasized most when she was clarifying a concept or activating and building background knowledge; whereas her personal voice seemed to emerge when she shifted her role as a teacher to a different role. Based on these findings, a description of each of the pedagogical functions is provided below.

Activating and Building Background Knowledge

There were five stories (1, 2, 3, 12, 15) found to activate and build background knowledge and four patterns that elucidated how these stories were triggered. As shown in Table 9, these stories emerged in relation to four specific antecedent events. These events were (a) definition; (b) reinforcement; (c) student initiation with a concept; and (d) student initiation with a personal comment. For example, in the first story depicted in Table 12, Ms. M provided a *definition* of inherited traits explaining that traits are passed on from parents to their children. She then proceeded into a story in order to help develop an understanding of the word inheritance. It was a fictional story that drew engaged responses from students.

Table 12

Story 1 - Fictional

Speaker	Utterance	Event
Ms. M	Thank you very much. Okay so traits and features that are passed on from parents to their children are often called... inherited traits. Probably you've heard the word inheritance!... maybe in a story one of the main characters has a rich uncle who dies and the main character inherits his mansion! (raises hands and opens eyes) Okay!	Act_Build Definition (Fict)
Students	[Ooohhh.	Engage
Ms. M	[Okay... alright	
Brandon	That sounds like ( )	
Student	The (grantor) is passed on to him	
Ms. M	Okay... alright. So... so inherit... to inherit means to get something from your family	
Student	Oh!	

The story appeared to activate students' background knowledge, as indicated when Brandon rephrased part of the story in another way by stating that something was passed on. It appeared that students heard this story before and Ms. M's story helped them to link their prior knowledge of inheritance to the concept of how traits were inherited.

Stories 2, 3 and 12 also served to activate background knowledge when students were unsure of how to elaborate a concept. For example, students conducted a trait survey in their classroom where they had to survey their peers for traits that had two variations. One of these traits was left-handedness and right-handedness. Mario observed that only one student in his class was left-handed and students seemed as if they were surprised by this observation. Ms. M built on their background knowledge by stating that fewer people in the world were left-handed,

and some of them were very important figures like the current President of the United States.

This discussion is shown in Table 13 below.

Table 13

Story 3 – Current Events

Speaker	Utterance	Event
Ms. M	You could fix your mistakes. Okay! Okay. Alright. So! ahm! we've gathered this information. Can anyone give us some interesting fact that you found out by gathering this information about our class? Okay Mario?	
Mario	Only one person was left handed.	Concept without elaboration
Ms. M	Kay! We have one person in our class that's left-handed so that makes that person quite unique [	
Student	[Who's left-handed?	
Ms. M	Kay? Shhhhhh...	
Student	Santiago is left-handed but he's not here.	
Ms. M	Okay alright so that would've... that would've made a difference in our presentation. Okay and I think if you were to survey the entire world, you would find out that most people in the world are right-handed. Now it doesn't mean there aren't a lot of great people in the world that are left handed. For instance...	Act_Build Build_Comm (C_Event)
Student	Obama	
Ms. M	The President of the United States is left-handed and its... its not only this President but also President Clinton I believe was left... is left handed. I'm sorry. I could not hear your question Hayden.	
Hayden	Was President Lincoln left handed (...)?	

Table 13 (cont'd)

Ms. M	I still can't hear your question. (Ms. M waits for students to quiet down.). Go ahead.
Hayden	Was President... Was President Lincoln left handed or anybody else?
Ms. M	You know that is something you could research. It would be interesting. Maybe someone could research and find out ah... can't can't do it right now but maybe that would be an interesting when we go to the computer lab?

Therefore, Ms. M spoke about a current event to build students' background knowledge of the trait left-handedness. This story also functioned to build community in the classroom which is discussed in greater detail below. Story 15 (shown in Table 17), which also aided to activate and build students' background knowledge, prompted Ms. M to bring in her personal voice, is delineated below as well.

Clarifying Concepts and Vocabulary

There were seven stories (2, 5, 7, 8, 10, 11, 14) discovered that clarified concepts or vocabulary. Six patterns were found that illuminated how Ms. M clarified concepts or vocabulary for students. As shown in Table 9, these stories emerged based on five specific antecedent events. These events were either student initiated (a) without elaboration (b) with elaboration of a story or concept and (c) with a question; or teacher initiated with a question, reinforcement or definitions. For example, in story 10, Elsie brought a comment to the class in which she and her two brothers did not wear glasses but her parents and grandparents did wear them. Elsie did not elaborate on a possible reason, but her question indicated some concern about the inconsistency. As a result, Ms. M provided an autobiographical story explaining that the trait

can show up later in life, as was the case with Ms. M having gray hair at an older age, and therefore her son Kyle also having the potential to get gray hair as he gets older. In other words, she clarified the concept of people still inheriting traits even though they sometimes do not appear until a person ages. The discussion is depicted below in Table 14.

Table 14

Story 10 – Autobiographical

Speaker	Utterance	Event
Elsie	Both of my mom and dad wear glasses and like my grandma (...) wears glasses but for some reason me and my two... two (...) brothers don't wear them.	Concept without elaboration; Student concern
Discussion among students and teacher		
Ms. M	For instance I was born with bl... blonde hair and as I got older my hair turned brown almost black and now it's turning gray. And truly I never changed it. Kay? And the same thing happened to Kyle! He was born... I... ooh look! I can even... I think I even have...	Clarify_Concept Teach_Voice
Student	Woah! See her pictures!	Engage
Students comment and make noises		
Ms. M	Okay. I guess I don't have one that far back here. But he... he had blonde hair when he was born. And then as he got older it turned brown and curly like mine. And now it's still brown and curly because he's not... (Ms. M shows them the picture again of her son.) And he'll probably have gray hair when he gets older.	
Oliver	Oh! I don't want to be old.	

Following Ms. M's story, another student, Oliver, stated that he did not want to get old possibly expressing that he thinks getting glasses and gray hair were not desirable traits. Story 11 which is shown in Table 15 delineates how Ms. M told a story based on current events that were prompted by her question and a definition.

Table 15

Story 11 – Current Events

Speaker	Utterance	Event
Ms. M	Okay is this an acq... is his... is him having that nose and those eyebrows is that acquired?	Question
Sarah	Yeah (...)	
Ms. M	Okay because he puts them on alright... they are not part of his actual face okay? Do you know Latoya? (giggles with students) At the high school a few years ago, the kids tried to break a Guinness book of world records and they filled the gym with all the students and all of them put on those masks (giggles)... So everybody in the gym had on one of those masks. You would have just been lost completely.	Definition Clarify_Concept (C_Event)
Latoya	They have this thing called (...) ahm they have those kind of things...	
Ms. M	Mmhmm.	
Latoya	And I put one on my first year.	

As shown in Table 15, Ms. M asked a question, while Sarah responded with a simple affirmation and Latoya remained silent. As a result, Ms. M proceeded to define an acquired trait by stating that masks are not part of people's faces, rather people decide to put them on. She clarified the concept of acquired traits with this story because Sarah and Latoya were unsure of how to define it. A similar lack of responses by students also was evident in stories 7, 8 and 14. Consequently, Ms. M brought in a story in order to clarify students' understandings of inherited and acquired traits. In Story 5, Ms. M recognized students were struggling to understand the concept of some traits like freckles being both inherited and acquired. Lastly, she sometimes suddenly transitioned into telling a story while providing a definition, as demonstrated in Story 2 (Table 20) when she explained the she and her husband passed traits on to their children.

Building Community

Ms. M's stories appeared to build a community of learners in Stories 2, 3, 12 and 13. The antecedent events that led her to tell these stories were based on her providing a definition or reinforcing a concept, and/or student contributing a concept with or without elaboration. In Story 3, depicted in Table 13, Ms. M's story about the Presidents seemed to trigger various students' comments about their own observations of the Presidents. Moreover, students like Hayden, began to inquire about other Presidents like President Lincoln. There was so much discussion among students about which Presidents were left-handed or right-handed that it led Ms. M to inform students that it was a possible topic they might choose to research for science. Students' comments and questions were directly connected to a trait that they discovered in class, and Ms. M's contribution to encourage them to conduct research gave an opportunity for students to extend their learning about traits that may be common or uncommon among the Presidents.

In Story 12, shown in Appendix E, Ms. M's story about her pierced ears also appeared to build community based on the way she initiated the class discussion. At line 9, she began to ask students questions about inherited traits and other words for traits. Students were able to answer these questions. In line 27, she asked about an acquired trait and she provided Hallie with time to explain an acquired trait. Hallie elaborated on the concept of acquired traits but was confused about whether the environment or the organism chose the trait. Ms. M reinforced the concept of acquired traits with an autobiographical story (12), beginning on line 42, that humans can choose their acquired traits. She also continued to reinforce the concept by contributing another autobiographical story (13), beginning on line 47, which emphasized that the environment can affect existing traits. Essentially, a community of learners was being built as students were given opportunities to elaborate on what they knew about the topic at hand. Ms. M also provided a

class environment in which the community was built because of the discussion that surrounded these stories. Furthermore, although there was not a clear indication that students acknowledged the difference between the environment having an influence or humans choosing their acquired traits, Brenda elucidated Mario's quandary about his little cousin having orange hair beginning in line 107. She stated that while pictures were taken of the cousin's parents and grandparents, one of them could have dyed his/her orange hair even though the other members did not know. Brenda was able to synthesize the discussion around acquired traits to address Mario's concern.

Teacher Voice

This category was refined because it was evident from the data that when Ms. M spoke of autobiographical or biographical stories with a direct connection to the curriculum, she used her voice as a way to humanize unfamiliar concepts that students were learning. This was done with stories 7, 8, 10 and 14. For example, in Table 14, Ms. M referenced herself in order to explain to Elsie how inherited traits can appear later in life. In addition, in Table 16, Ms. M utilized her family to describe how traits can skip generations.

Table 16

Stories 7 (Autobiographical) and 8 (Biographical)

Speaker	Utterance	Event
Ms. M	Okay. Alright and let us know tomorrow. Because what happens is... think about it... put your hands down and think. Okay. Alright. These are my offspring. (Ms. M shows the students a picture of her children). Okay. Please stop talking. And think. Kay these are my offspring. Put your hand down and think. Shhhh. Shhhh. About what I'm saying. Okay so these are my offspring. Okay? So they have inherited traits from me and my husband. Right? Okay. So for instance, both of my children have brown eyes. My husband has hazel colored eyes so they inherited their brown eyes from... oh no! That's not true! This... my son has brown eyes so he inherited his brown eyes from me. My father has brown eyes so I probably inherited my brown eyes from my father and then my son inherited my brown eyes from me. Because my father... his grandfather also had brown eyes. Okay now! My daughter has blue eyes but! I have brown eyes and my husband has hazel eyes. But his... her grandmother... my father's mother has blue eyes.	Clarify_Concept Teach_Voice (Auto)
Student	That's weird.	
Ms. M	Okay? Alright. So you inherit traits from your parents who inherit traits from their parents who inherit traits from their parents. Okay? So sometimes like Leroy thinks... why did I get left handedness because neither of my parents do? Well neither of Melanie's parents have blue eyes either but her grandmother has blue eyes. Okay? So... that's how she probably ended up with blue eyes. Alright? Okay. Hear how that works? Okay. It's not what your uncle has, it's not what your aunt has or your cousin has? It's what you inherited through your parents, and their parents and their parents. Alright?	Teach_Voice Clarify_Concept Reinforcement (Bio)

Story 7 presented questions Ms. M posed earlier in the class discussion about the reasons why traits might be inherited and/or acquired. Students brought many examples still their misunderstandings were evident. For example, one student Leroy was confused about why he was left-handed and his parents were right-handed. Therefore, Ms. M provided an

autobiographical story in which she described herself as inheriting brown eyes from her father, and she and her husband with hazel eyes passing the eye color trait on to their children. However, as she told her story, she suddenly remembered that her daughter Melanie had blue eyes. In the following story (8), she clarifies how her daughter inherited the trait of blue eyes from a former generation relative. Essentially, Ms. M was inserting herself or her voice into the curriculum to speak of how traits can skip generations and to address Leroy's question. In other words, she illuminated the concept of inherited traits by using her voice.

In general, teacher voice was evident when Ms. M was clarifying concepts from the curriculum. She offered these stories when attempting to reinforce a particular concept with students or to define a concept. For instance, stories 12, 13, and 14, in which Ms. M spoke of her pierced ears, car accident and hair color respectively, she was trying to bolster the concept of acquired traits for the students. The only exception was in story 10 (as illustrated in Table 14) with Elsie offering a comment and concern. Therefore, teacher voice appeared to be a key teaching method for presenting content to students as Ms. M presented a human face, or most often her own face to the new concepts being taught in the curriculum.

Personal Voice

Personal voice was generated as a category to explain stories told by Ms. M that were personally connected to her but had only indirect connections to the curriculum. In other words, the stories told did not seem to enhance any particular aspects of the science curriculum. However, the stories may have helped students to learn more about Ms. M as a person. This category was explicit in stories 4, 6, 9, 15 and 16, which were categorized as either autobiographical or biographical stories. It must be noted that Ms. M's personal voice was

triggered primarily in response to students' personal comments in the classroom. For example, in story 6, as shown in Table 19, Ms. M's story about her sister being forced to use her left hand was prompted by Lisa's personal story about people being forced to use their other hand. In addition, in story 15 as depicted in Table 17, Ms. M spoke of reading a book.

Table 17

Story 15 – Autobiographical

Speaker	Utterance	Event
Carmichael	(...) the sound of tiny little animals in your drinking water is really gross.	Personal comment
Ms. M	It does? I'm really sorry okay. Ahm I just finished reading a great book... the evolution of... have you read that book? You've read that book Daisy? The evolution of ahm... a girl.	Perso_Voice (Auto)
Oliver	American teenager?	
Ms. M	Okay. Anyway she... she goes to ahm with her grandfather and they put some pond water under a microscope and she sees ahm all these one celled organisms and feel... and felt exactly the same way. Okay. alright so these two are organisms all by themselves. Kay? And they might live... oops.... `in water ahm or ahm other... other liquids yes?	Act_Build
Oliver	Which are sperm cells...	

This discussion began with Ms. M contrasting between one-celled and multiple celled organisms. As a result, Carmichael made a personal comment that expressed his repulsion about drinking water having one-celled organisms. While Ms. M's story about reading the book probably contributed to Carmichael's understanding of other children feeling similarly, the story was not explicitly clarifying any concept from the science curriculum. Furthermore, it prompted Oliver's off-topic, although relevant, comment about sperm cells being one-celled organisms.

Therefore, Ms. M inserted her personal thoughts or feelings into the scientific discourse even though there was no clear connection to the curriculum. She made this discursive move with her stories when her students brought up feeling or stories that were personal to them. She also brought up these stories when she sensed that her students wanted to learn more about a phenomenon, as she did in talking about her spider plant in story 16 (as shown in Table 21).

Role or Positions of the Teacher

Role was evident in only two stories that were biographical and told with Ms. M's personal voice. In stories were 6 and 9, she spoke of her sister being forced to use her right hand. It was clear that Ms. M shifted her role from the teacher to that of 'sister' since she witnessed the distress of her own sister being forced to use her right hand. Her emotive discourse as a sister is demonstrated in Tables 18 and 19.

Table 18

Story 9 – Biographical

Speaker	Utterance	Event
Warren	Ahm well.. (...) my biggest cousin ahm his... his dad is a lefty and his mom is a righty. And he was supposed to be a lefty at first (...) and then his mom changed him. She start giving his food in his right hand.	Personal Comment
Ms. M	Okay.	
Warren	So now he's a righty.	
Ms. M	Okay.	
Ms. M	Kay? Shhhhhh...	

Table 18 (cont'd)

Warren	And their son... their other son Jake ahm he is uh he was one too too and they changed him.	
Ms. M	Okay. And that does happen sometimes. When I was a student... when I was a child many many teachers would not let anyone write with their left hand. They made people write with their right hand because they just didn't think that it was the proper thing for people to use their left hand.	Perso_Voice (Bio)
Students ask why.		
Ms. M	I have a sister that's left handed and it really was very confusing for her because she thought she was doing something wro....nng by bring left handed and it really had nothing to do with her other than she inherited that trait. Okay. Elsie?	Role

In Table 18, Warren began speaking about his cousin being forced to use his right hand. He also used the slang term for right-handers as 'righty' and for left-handers as 'lefty'. Ms. M's response to Warren's personal comment was her story about her sister. When she spoke of her sister, her discourse suggested that it was a significant memory for her because she emphasized that her sister was traumatized by this event. Therefore, it appeared that Ms. M was portraying herself as a caring and sympathetic sister.

Promoting Engagement and Attention

This function appeared across all stories regardless of the type of story. Particularly clear examples of promoting engagement and attention were evident in stories 1, 6, 10, 13 and 16. Students appeared most engaged when Ms. M was animated or she delivered a story that conjured emotion from students. In terms of her animated behaviors, she either was expressing non-verbal actions like waving her hands or jumping, or showing something concrete. In story 1, as exhibited in Table 12, students were explicitly expressing their enjoyment as Ms. M spoke of

the rich uncle. Additionally in story 10 as depicted in Table 14, students were very interested in seeing the past pictures of Ms. M's son Kyle. Finally, when Ms. M spoke of her spider plant having the ability to produce a baby plant immediately out of its root in story 16 and she showed the plant in class, students were most intrigued by the phenomenon.

Alternatively, other stories incited students' emotions, and thus attention. For example, in Table 19, Ms. M spoke of her sister being forced to use her right hand even though she was left-handed. Ms. M's story was sparked by a student's personal comment that some people are forced to use their other hand and her neighbor that lives near her cottage uses both hands.

Table 19

Story 6 – Biographical

Speaker	Utterance	Event
Lisa	You can... you can force yourself to use your... to use the opposite hand and some people are strong in both hands like I have a neighbor up at my cottage... he can do... he can use both of his hands.	Concept with Elaboration
Ms. M	Okay.	
Lisa	It happens when he like rakes something.	
Ms. M	Alright. Okay. Okay! Yup?	
Student	My brother is both handed.	Personal Comment
Ms. M	Okay. Alright. When I was... again here is ancient history. When I was a student... when I was learning how to write ahm... people that were left handed... the teachers would often force them to write with their right hand.	Perso_Voice Role (Bio)
Students respond.		Engage

Table 19 (cont'd)

Ms. M	They wouldn't allow them to write with their left hand. They told them they have to learn to write with their right hand.
Hallie	Were you left handed originally?
Ms. M	No but my sister was.
Hallie	Cool.
Brenda	What? That's not fair!
(Students respond to the story with different comments).	
Brandon	Did they like cut off your hands?
Ms. M	No they did not cut off your hands. (Students respond). Okay alright. So you can lea::rn to use your other hand but people are inherit the trait of being left-handed and right-handed. If any of you have broken the arm that you usually use to write with, sometimes you have to force yourself to do other things with your other hand. Right?

Brenda, who is the only left-handed student in the class, was clearly concerned about students forced to use their right hand. In addition, Brandon, possibly sensed the concern, and made a comment with some extreme implications of hands being cut off. Even though Ms. M's story did not clarify any particular concept from the curriculum, it did serve to grab students' attention. Furthermore, students' peaked level of attention was also evident in story 13, as shown in Appendix E, when Ms. M spoke of her car accident beginning in line 47. Brandon and Gina asked Ms. M questions about the car accident. Most interestingly, it sparked an unpleasant memory for Gina beginning in line 70, in which she spoke of her grandmother dying in a car accident. Again, Ms. M's story about her own car accident was not functioning on a strictly academic level, but a social-emotional level where she was potentially building closer connections with her students. As she shared personal stories of her experience with acquired

traits, she provided the opportunity for students to share their own stories and possibly help them to recognize that what they were learning in science class had real connections to their own lives.

CHAPTER 5

DISCUSSION

This dissertation examined and interpreted the stories told by one teacher Ms. M in a fifth grade science classroom. This was an attempt to explore Ms. M stories or the narratives that she constructed in her classroom. Some of these stories followed a coherent theme as students chimed in, and other stories were told in one sentence in response to students' comments. However all of these stories contained elements that suggested where it occurred in class discussion and how they may have functioned. The following paragraphs conclude the findings for each of my three research questions in this dissertation.

What Stories are told by Ms. M?

Researchers have called for further investigations into the type of stories that teachers tell (Egan, 1986; Norris et al, 2005). These stories can contain scientific concepts as well as spontaneous concepts that are formed from contextual and practical knowledge (Vygotsky, 1978). They are told for the occasion and formulated in the telling (Bruner, 1987; Edwards, 2005). All of Ms. M's stories were spontaneously told which complemented J. Michael Shirley (2005) findings in his dissertation with stories being told extemporaneously. As a result, Ms. M's stories were for the most part verbal responses to the environment or context. The narratives that were analyzed were not textual nor were they part of a lesson plan which is abundant in research studies of narratives in science education (Clough, 2011; Klassen, 2010; Metz et al., 2007; Norris et al., 2005). On the contrary, the narratives that were constructed were analyzed as stories that live in society, and in this case, the science classroom (Peräkylä & Ruusuvuori, 2011). Ms. M

contributed a story spontaneously in response to what she sensed would have helped students' understanding or in response to students' inquiries.

Ms. M's stories did not follow the traditional story structure. Instead she engaged in the practice of storytelling (with a lower case s) which refers to speaking of "informal examples, illustrations, or parables of one's life experience with subtle connections to one's feelings, understandings and emotions," (Shirley, 2005, p. 157). Ms. M spoke about science directly or indirectly and embellished those concepts with (1) her experiences and (2) other experiences. These other experiences connoted situations that were personal, conventional or popular, or fictional. In her book, *An Introduction to Narrotology*, Monika Fludernik references Dorrit Cohn's typology for narratives. This typology was used to organize narratives in terms of the position of the speaker in the narrative and the proximity of the narrator to the content in the narrative (Fludernik, 2009). I use Cohn's typology to locate Ms. M's stories which is depicted in Figure 2. The x-axis is told either in first or third person. The y-axis corresponds to the distance the narrator holds with the protagonist in the story.

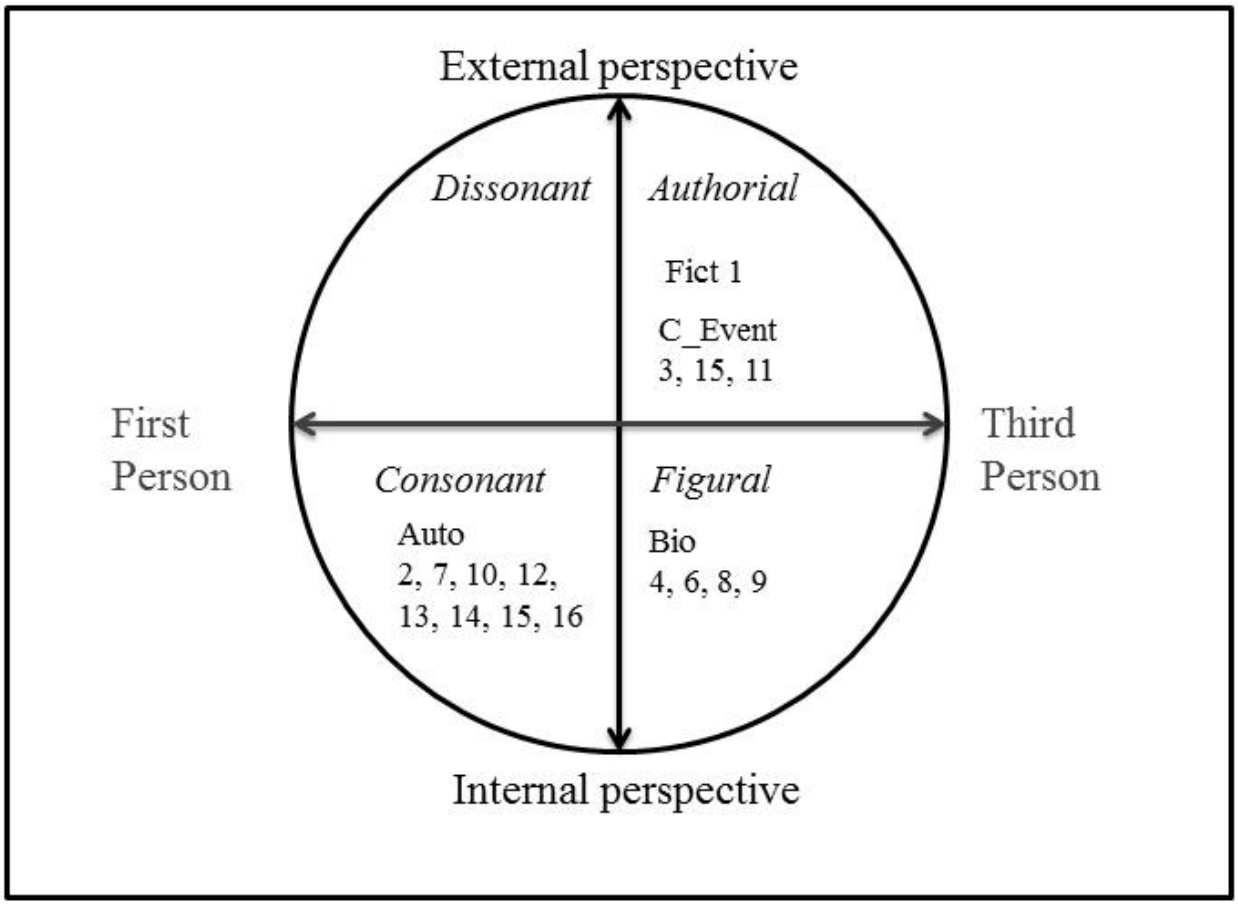

Figure 2. Typology for Ms. M's stories by type. Adapted from "An Introduction to Narratology" by M. Fludernik, 2009, London, England: Routledge.

The fictional story told by Ms. M was told in third person. She was the author and not a figure in the story. However she told the story with inflective tones that suggested to her students that they may have heard the story before. Therefore, her fictional story was not an unfamiliar one. Students were familiar with the events in the story (Egan, 1986; Hanrahan, 2006). These associations were similarly found in two of the three of Ms. M's stories based on current events. She spoke of the Presidents of the United States and acquiring freckles in the sun. Thus, students chimed in as Ms. M told the stories. These three stories were connected to the scientific concepts

of inherited and acquired traits because they were portrayed as examples. This was not the case for the third current event story.

The third story based on current events was about an incident where students at the high school in the district decided to wear masks to be considered for the Guinness World Book of Records. Her students did not know about this incident and this was the only story told by Ms. M that was not shared with the entire class. Specifically, the story was told to a pair of students as they worked on the science curriculum on the computer. Perhaps, Ms. M's intent for telling the story was different since it was portrayed more as a story suited for a conversational, informal setting as opposed to the more formal didactic setting in front of the whole class. This points out that the occasion can influence what is said in the story and how it is told (Witherell & Noddings, 1991).

The other 12 of the 16 stories were biographical or autobiographical. These stories were told in first person. Additionally, both sets of stories were told from an internal perspective where she was either a primary or secondary character in the story. As shown in Figure 2, autobiographical stories in the south-west quadrant were told in the consonant mode where the experiencing self was dominant. Ms. M' stories told in the consonant mode connoted stories about decisions she made or she held an influential role in the outcome of the story (Fludernik, 2009). Biographical stories were in the south-east quadrant in the figural mode where the symbolic self was dominant. Her stories told in the figurative mode denoted stories where she was a keen observer of the events that shaped the story (Fludernik, 2009). Most of these stories were directly related to science, and those that were not, appeared to affect students.

When do Ms. M's Stories occur?

Ms. M's stories were told in the context of the classroom prompted by interjections by Ms. M or her students. Ms. M's responses with her stories to the context and her students suggested that her teaching was textual (Pagano, 1991). She made sense of teaching science by interpreting her own actions and utterances according to particular conventions she held for herself in the past. Her stories exemplified performances that were embedded in discourse and they referred back to meanings that were embedded in her culture or life (Denzin, 2002). Her conventions 'textually' motivated her to tell story with expectations and constraints (Pagano, 1991). In other words, as Ms. M told these stories, she was paying more attention to what students were doing, and what may help them learn, and less attention to the fact that her action depicted storytelling and her utterances were stories. Pagano (1991) stated that "the activity of interpretation is an activity in which we form expectations about what will be said or what will happen next. Our anticipations regarding the future figure prominently in the sense we make of the present moment," (p. 199). Thus, Ms. M did not only make interpretations of herself with her content knowledge and skills but also interpreted (1) her students and their interactions with the same knowledge and skills, and (2) the interactions she had between her and her students. These narrative codes operate both on the level of (science) content and relations, and they are neither fixed nor all-inclusive, (Pagano, 1991).

The interconnections between the narrative codes translate into intertextuality (Bloome, Carter, Christian, Otto & Shuart-Faris, 2005). Ms. M's teaching became intertextual as she negotiated meaning with science and her students, and leveraged from those interpretations to introduce stories of others that consisted of characters she knew personally, generally or fictionally. She produced meaning with her stories by firstly utilizing her relationships with her

students, science and the world that intersubjectively made available their meanings that encompassed their repertoires (Bakhtin, 1981; Pagano, 1991). Secondly, she acknowledged the power and limit that were accessible from the variety of human narratives that were made available (Bruner, 1987; Pagano, 1991).

There were two stories (Tables 12 and 20) in which the antecedent events were only definitions. This meant that Ms. M may have relied on her skill being primarily an English teacher. She used a pedagogical convention of providing story that exemplifies the concept after it has been defined. However, there were four other stories where Ms. M interpreted the actions or utterances of her students and provided stories as responses for reinforcing a concept or answering questions students were not able to answer on their own. Ms. M may have also 'relied' on her conventions of stories being used for classroom management purposes. These stories may have helped students to get back on task or were used as preparation to begin a lesson (Shirley, 2005). However, it appeared that Ms. M was very conscious of her students' behaviors and utterances but also wished to move them forward with their science learning. As a result, more of her stories occurred on behalf of students' utterances.

The other ten of the 16 stories had at least one utterance by a student. Therefore, Ms. M provided a story to either respond to students' questions or personal comments or clarify students whose responses had no elaborations, or assist students who elaborated on concepts with stories of their own. Ms. M constructed pathways between students' ZPD and new knowledge (Vygotsky, 1978; Kubli, 2005). Students' responses ignited an image or memory in Ms. M's mind that encouraged her to bring forth a story (Egan, 1986; Shirley, 2005). In other words, she utilized the meanings that her students made available to her but also limited the extent of her narration to suit the context. For example, in stories 4 and 5, the story ended because she

changed the topic. Yet in story 12 beginning in line 42 in Appendix E, the narration continued until a student used Ms. M's available meanings (story) to construct one of her own.

Pedagogical Functions of Stories

Each of the 16 stories told by Ms. M had at least one function. Those stories with one function appeared to show Ms. M as fully governing the class discussion where she provided the story and then made a transition. When Ms. M allowed students to participate in the discussion, her stories functioned in at least two ways. Whether students were engaged with these stories depended on how Ms. M told her story. Furthermore, student learning was most evident when students contributed their own stories in response to Ms. M's stories. The following illustrates each of the functions discovered with Ms. M's stories.

Promoting Engagement and Attention

Many scholars have mentioned that stories heighten students' attention or increase their engagement in the classroom (Clough, 2011; Egan, 1986; Kubli, 2005; Metz et al., 2005; Solomon, 2002; Stinner, 1995). Ms. M's fictional, biographical and autobiographical stories were found to function in this way. It appeared that there had to be at least three conditions for engagement to occur. Firstly, Ms. M showed artifacts while telling her story (Shirley, 2005). For example, she showed pictures of her children while speaking of their traits that they inherited. Secondly, she used vocal and non-verbal expressions in her story like modulating voice pitch and hand movement. For example, when Ms. M spoke of someone inheriting the rich uncle's mansion in her story, she ended the sentence with an exclamation and she waved her hands in the air. Thirdly, Ms. M related stories whose content had a somber tone and thus elevated the

emotional atmosphere in the classroom. For instance, students sensed the seriousness portrayed when Ms. M told of her sister being forced to use her left hand. In all of these three conditions, Ms. M used story as a hook to construct mental models that stimulated students' imaginations (Shirley, 2005, p.91). She brought forth vivid or astonishing images familiar to students (Egan, 1986; Klassen, 2007; Norris et al, 2004). As she attempted to activate student knowledge in trying to understand concepts and animated her story verbally and non-verbally, she increased engagement in the classroom.

It was not clear whether Ms. M was using the five engaging stories as classroom management tools. All of her stories emerged from Ms. M defining, reinforcing or elaborating on students' understanding of scientific concepts. However, as she told these stories, she often used the term 'Okay' with rising and falling intonations. The term 'Okay' became a discourse marker that was prevalent in the consecutive telling of her stories and seemed to work on an interactional level (Fox Tree, 2006). Ms. M's use of 'Okay' did not only function to close a topic but also opened other possibilities for the discursive work she accomplished at different points in her stories (Schegloff & Sacks, 1973). For example, it is possible that Ms. M used the marker to indicate to students that she was transitioning between topics or checking their understanding (Filipi & Wales, 2003). Furthermore, she may have been using it simultaneously to grab their attention or assure them that she was listening to their responses thus involving them in the conversation or "nurturing the dialogic relationship," (Burbules, 1993; Othman, 2010). It seemed that Ms. M made every effort to welcome her students into the class discussion as she told her stories (Kubli, 2005).

Four of the five stories were closely connected to a scientific concept. For example, in story 10 as shown in Table 14, Ms. M elucidated with her story that one can inherit traits but

those traits may not appear until later in one's life. Thus, the story brought the scientific concept of inherited traits as late-onset or becoming observable later in an adult's life, into reality (Egan, 1986). However, there was one story that was not directly connected to science but seemed to fulfill another purpose as it engaged students. It helped to build empathy (Shirley, 2005; Solomon, 2002). Story 13 is given in Appendix E starting in line 47.

As Ms. M spoke of how she acquired a bruise from her car accident in story 13, two students, Gina and Brendon, asked her to share more details of the story. The story seemed to build such an emotional connection that Gina proceeded to share a story from her country that had a profound melancholy tone. Thus, Ms. M's story was not an anecdote (Shrigley & Koballa, 1989). The stark truth evident in Ms. M's story created a disposition for Ms. M's students to come to grips with reality and recognize that traits that one acquires are not always traits that one chooses, and there can be grim consequences. The story presented the scientific concept of the environment influencing traits that can trigger societal problems transforming it into a socio-scientific issue (Sadler & Zeidler, 2005). These issues are part of contemporary science education which include processes and products of science that are entwined with social dilemmas at procedural, conceptual and/or technological levels (Sadler & Zeidler, 2005).

It is important to note that the level of engagement by both these students in story 13 was unique in this classroom exchange. In past classes, Gina and Brendon did not engage as much with questions and comments with Ms. M's stories, and both students had disabilities. The outcome then of Ms. M sharing a story so intimate and allowing students to participate did help to engage all students by strengthening emotional or affective ties. Her story created an environment in which students were able to divulge their thoughts that revealed connections between science, location and socio-cultural norms (Wee, 2012). These ties may have helped

students to remember and learn the 'lived experiences' of scientific concepts (Carter, 1993; Egan, 1986; Turner & Patrick, 2004).

Activating and Building Background Knowledge

From the data collected and analyzed, Ms. M told no historical stories. Therefore the stories that activated and built background knowledge were the stories based on fiction, current events or her life. They contained elements that were familiar to students (Kubli, 2006). Students were able to use these elements as they operated from their zone of proximal development (Vygotsky, 1978). They made sense of what they were learning, and connected their respective understandings to the concept. For example, as Ms. M spoke of the rich uncle in Story 1, one student was able to respond with a synonym for someone who inherits. The non-normative idea of a rich uncle was used as a springboard to connect to the scientific concept of children 'inheriting' traits from their parents. Another example occurred when Ms. M spoke about the Presidents of the United States having left-handedness. This story was to illustrate that even though left-handedness was not a common (dominant) trait, famous people like the Presidents inherited the trait. A student again added a word to complete Ms. M's story. Thus, this new knowledge was made relevant as students made connections to what they already knew (Shirley, 2005). They began to appropriate the language for their own use with Ms. M's stories (Rogoff, 1993).

Besides students appropriating the language heard, they were also trying to grapple with their own thoughts as Ms. M told her stories. They interpreted her stories in particular ways. For example, as Ms. M spoke about her children inheriting traits from her and her husband, one

student, Zavier astutely recognized that her children did not inherit all their recognizable traits from her. This story is depicted in Table 20.

Table 20

Story 2 – Autobiographical

Speaker	Utterance	Event
Ms. M	So these traits are! ahm things like... ah these are the traits that you're born with such as your eye color or your skin colo:r and we're going to... in this activity you'll begin to look at how you're different from other people around you. Traits are important to heredity. Science calls heredity the passing on of traits from parents to offspring.	Definition
Ms. M jumps and students giggle.		
Ms. M	And offspring refers to children okay. So:: I am the parent... okay my husband and I are the parents of these offspring. Kay? So these are my children kay? A::nd if you... look at them carefully you can see that they have some of the same traits that ^ I do. Okay? They both have dark brown eyes just like me.	Act_Build Build_Comm (Auto)
Zavier	Your daughter is a girl like you.	
Ms. M	Okay? Shhhh.... Okay? (smiles) Alright we'll talk about that. Is But my son is not a girl like me okay?	
Zavier	He's a boy.	
Students giggle and comment.		
Hallie	(has her hand raised) He's a guy like your ( )	
Ms. M	But! Look at his hair! It's not grey yet but it's curly like my hair so these are traits that he has inherited from me! Okay? And there are traits that he's inherited from his dad as well as has Melanie my daughter okay?	
Students talk with Ms. M more about her family.		

Table 20 (cont'd)

Ms. M	Okay so there are... there are ahm some people inherit more traits from one perso... no not necessarily... no they inherit traits from both parents ^ I'm getting the yes okay. Alright okay. So! you're offspring of parents and you have inherited traits from your parents.	Clarify_Concept

Zavier stated that her son was a boy and not a girl like her. Thus he deduced that traits were indeed passed on but children get different traits. Due to his contribution, Ms. M was able to clarify her story by concluding that her children inherited traits in appearance from both their parents. Zavier's interpretation was on a conceptual level which contrasts with the interpretation made by another student, Brandon in story 12.

In story 12 shown in Appendix E from line 42, one student, Hallie was struggling to make sense of how humans acquire traits. Ms. M provided a story about her making the decision to pierce her ears which illustrated that humans sometimes choose to acquire their traits. Brandon's response to this story was "Did it hurt?" His response showed that he was affected by Ms. M's story and he revealed his concern for Ms. M's wellbeing. Thus as stories use creative and influential events to kindle students' imaginations (Metz et al., 2007) they can also introduce moral and ethical issues (Shirley, 2005). Ms. M may have made the choice at a time when women making such bold decisions would have been considered taboo. Brandon recognizing the earnestness of Ms. M's deliberate choice possibly having consequences voiced his concern. The mood that grew from this discussion helped students to interpret that humans can make decisions to choose the traits they acquire in society. Ms. M's story did not only help students to understand the concept but also socialized them into particular norms (Aikenhead & Jegede, 1999; Lemke, 2001; Lundqvist et al, 2009; Milne,1998). Students may have conceded that humans have the power to determine their acquired traits unlike their inherited traits.

Concluding, Ms. M's stories that activated and built background knowledge were for the most part tied to the concepts she was teaching in the classroom. The exception was story 15 in Table 17 where Ms. M's story built on one student's personal contribution and it was connected to how the student felt and not to the concept being taught. Therefore, stories that activate and build student background knowledge and are tied to the scientific concepts can help students in two ways: (1) conceptually where students logically follow the argumentation in the story (Kubli, 2005) and (2) affectively where adequate emotion is heightened for students to envisage how the concept operates in Ms. M's life and possibly their own (Egan, 1986; Kubli, 2006).

Building Community

Ms. M's stories that functioned to build community appeared to work at a meta-level or was an outgrowth of her stories either activating and building background knowledge or engaging students' attention. The community began to form as students added to Ms. M's stories, contemplated the outcome, or voiced or showed their emotional affect. As the discussion ensued, students began to interpret the relevance of her stories and made conceptual or emotional connections to their own lives (Shirley, 2005).

The stories that functioned to build community arose from Ms. M defining or reinforcing a concept. Those stories helped to build rapport between her and her students as students' knowledge was activated and they felt invested in developing the discussion. Students felt it was a safe place to share their comments, questions and their own stories (Shirley, 2005). Their utterances were either related to the scientific concept Ms. M was trying to explicate with her story or were directly asking for more details of the story. When students asked for details, their comments or questions were genuinely targeted to inquiring about implications of the story. As a

result, Ms. M's experiences as laid out in her stories, made the scientific concepts acquire life for her students. They saw how the concepts can exist outside the classroom and can have social impact. Therefore, students were welcomed as members of a community into the discipline of science and socio-scientific issues (Kovolainen & Kumpulainen, 2005; Marx et al, 1997; Sadler & Zeidler, 2005). Ms. M was able to accomplish the social-organizational and intellectual-thematic dimensions of her classroom community (Varelas et al, 1999).

The success of the classroom community with these particular outcomes with four of Ms. M's stories can also be attributed to the science curriculum. The curriculum contained activity structures that directed student engagement and the formation of socio-cognitive conceptions (Rex et al, 2006). The direction provided Ms. M and her students to construct a participatory framework where they both gave feedback to each other (Kovolainen & Kumpulainen, 2005). The objectives for the science class were clear (Enyedy & Goldberg, 2004) and there were links between the previous and following activities to generate flow (Puntambekar et al, 2007). Essentially, the curriculum assisted Ms. M and her students to have similar goals in determining inherited and acquired traits of organisms (Ballenger, 1992; Siry & Lang, 2010). However, as the classroom communities progressed, was it apparent that Ms. M was monitoring students' understandings?

In stories 12 and 13 which are provided in Appendix E, it appeared that Ms. M was monitoring student comprehension. For instance, Hallie was trying to understand how people get acquired traits. As a result, Ms. M provided story 12 about piercing her ears which exemplified that humans can sometimes choose their acquired traits. She followed up with story 13 about the car accident to explain that the environment can also influence the traits human acquire that are beyond their control. Ms. M then monitored her students' understandings but also used her

students' contributions to shape what she said in her stories. Intertextuality was in operation as Ms. M's classroom community took form (Bloome et al, 2005).

It was more evident that Ms. M was guiding the direction of the classroom community as she monitored students' understandings in stories 2 and 3 in Tables 20 and 13 respectively. However, stories 2 and 3 showed that students also gave direction as to where the discussion should lead with their contributions (Osborne, 1998). In story 2, as Zavier indicated to Ms. M that offspring can inherit different traits, Ms. M acknowledged his comment. Her response indicated surprise but also it helped her to come to the realization that his observation was also true. Zavier's comment assisted her to make sense as she was telling her story and in so doing, she reconstructed her story. Consequently, as these four stories functioned to build community, they did not only help Ms. M to monitor students' understanding but also her own.

Clarifying Unclear Concepts and Vocabulary

Clarifying unclear concepts and vocabulary was the most common function found among Ms. M's stories. In particular, Ms. M clarified vocabulary by attaching images with the terms for inherited and acquired traits for stories 2 and 11 respectively (Shirley, 2005). In the other five stories, she was either clarifying the concept of some traits being both inherited and acquired (e.g. hair color) and some inherited traits appearing as one gets older. Therefore one major function of Ms. M's stories was to reveal human activities to explain scientific phenomena (Zeidler & Lederman, 1989).

Artifacts were shown as Ms. M spoke about herself and her family. These stories did not only help to activate and build background knowledge as they did in story 2 when she defined inherited traits. In the moment of telling these stories, these artifacts helped to trigger particular

memories that aided Ms. M to clarify concepts for herself. For example, stories 7 and 8 are illustrated in Table 16. In story 7, Ms. M suddenly remembers that her daughter had blue eyes. She knew that but did not remember to include that part in her story until she looked at the pictures of her children. The artifacts helped her to grasp at isolated thoughts and coalesce them into a meaningful theme with her story (Solomon, 2002). The story's coherence may have been better if Ms. M had planned to tell this story. Instead, Ms. M verbalized her own clarification in the telling of the story as she discovered another idea that made her story relevant and meaningful. It appeared that Ms. M modeled how to 'think aloud' that both indicated that one may find a discrepancy as one tells a story, and the story's topic is personal and meaningful. She provided a heuristic more for telling a story as opposed to solving a particular problem (Klassen, 2007). As a result, was it evident in students' stories that they conceptually understood the concept of traits appearing in one generation and not the other?

In this particular classroom with stories 7 and 8, students seemed to hold on to their assumptions of traits skipping generations as a "weird phenomenon". Therefore, some of them attempted to solve the contradiction themselves that some traits are not really inherited but acquired because one can force oneself to have the trait (e.g. forcing oneself to use their right hand) (Tao, 2003). The outcome of this concept not being fully clarified may have occurred for two reasons. The first reason is that Ms. M was not a teacher to ignore side comments from students. Instead, if she heard these comments, she stopped the entire class before continuing the lesson. The result was that her focus became more oriented towards classroom management as opposed to monitoring students' understanding (Shirley, 2005). With her focus on managing the classroom, she may have missed the opportunity to recognize that students were bringing forth

similar stories with no resolutions. Their stories pointed to observing traits in one generation and not the next but they could not explain why.

The second reason why students may have held on to their assumptions was that Ms. M's own story was missing an explanation about why traits skipped generations. In her story, she did not further explain conceptually why her daughter Melanie inherited blue eyes from her grandfather. The explanation was that blue eyes were a homozygous trait where Melanie inherited recessive genes from both of her parents. These fifth grade students would be introduced to these concepts in the future when they would have entered seventh grade and continued with the WISE curriculum. Scaffolded instruction across grades is necessary to promote knowledge integration of cell division and genetic inheritance at the middle school level (Williams, Debarger, Montgomery, Zhou & Tate, 2012). Thus, Ms. M could not include this explanation because the language was not appropriate developmentally for fifth graders. The outcome then was that students adopted the heuristic Ms. M provided where they wondered verbally why they had particular traits that were not seen in their parents. Thus students interpreted Ms. M's story in personally meaningful ways but without full clarification of the scientific concept (Klassen, 2005).

This classroom with stories 7 and 8 had the most contributions from students compared to Ms. M's other classes. At least ten students made contributions with stories and comments. However, since there were classroom management issues, and Ms. M did allow many students to contribute stories, she and her students lost track of the lesson's objective which was to discuss traits (Harris & Rooks, 2010). It seemed as Ms. M and her students were trying to decipher whether specific traits were inherited and/or acquired, they both went adrift in trying to find definitive answers. An example was that one student Lloyd began speaking about a robot called

Blinky. Ms. M allowed him to tell his story and then asked him what his contribution had to do with traits. They both came to the conclusion that his story had no relation with traits but he was triggered by other students' comments about eyesight. These comments transpired because students were trying to decide whether needing to wear glasses was an acquired and/or inherited trait. Possibly, if Ms. M recognized that students were searching for conclusive clarification of inherited traits skipping generations, she would have halted students' contributions until a later time when she could return to answer all their queries.

In conclusion, even though Ms. M's stories may have helped in clarifying vocabulary for students, they seemed to be less effective for clarifying concepts. This may have been due to her stories not having a scientific explanation for how traits are inherited and how they appear in future generations. Also, her style of classroom management disrupted the flow of the discussion to the point that her students (and probably Ms. M) lost sight of what the discussion was about. This underscores the need for teacher's stories to not only be affective but also have adequate conceptual elements to at least outline the scientific phenomenon being discussed (Egan, 1986; Kubli, 2005). Furthermore, even though Ms. M allowed many students to make contributions in the class, her need to also control may have reduced her capacity to fully interrogate her students' and her own understandings of how inherited traits appear in one generation and not the next.

Teacher Voice

As stated in the results section, teacher voice was most apparent when Ms. M spoke about herself (and her children) to expound further on the scientific concept being illustrated. Stories 7, 8 and 10 occurred in class Zeta and stories 12, 13 and 14 occurred in class Gamma.

The activity taking place during class Zeta was a trait survey in Activity 2. Students had to survey their peers to determine whether they possessed a trait with one of two variations (e.g. straight pinky fingers versus curved pinky fingers). Once the students recorded their findings, Ms. M projected their results in front of the classroom. She then asked which traits were inherited and/or acquired. When students struggled to understand having a trait their parents did not have, Ms. M remembered that her daughter had blue eyes unlike her parents. Moreover, when students were trying to make sense of inherited traits that appear later in life, Ms. M spoke of herself inheriting gray hair that showed up later in her life. Specifically she began the stories in this class with the words "For instance…" which indicated that she was digressing into an example as a story in her discourse.

Ms. M taught class Gamma the following week where she began with a review of inherited and acquired traits before beginning a discussion on cells. By this time, Ms. M had a clear understanding of addressing students' concerns about acquired traits that humans can choose themselves, or can be influenced by the environment. Therefore, her story about pierced ears was an acquired trait she chose. Her second story about acquiring a bruise from a car accident was brought about by the environment. Her final story, which was 14, was to delineate that a trait can be both inherited and acquired like hair color. It seemed that Ms. M was more confident telling these stories because the scientific concepts became clearer to her as she gained more experience teaching the curriculum. She also began these stories with outlining the concept or the words "For instance…" which again depicted and told students that she was going to provide an example.

The words "For instance…" appeared to tell students that it was time to listen to Ms. M. They seemed to function as discourse markers to indicate to students that Ms. M was signaling a

story (or a message unit) that had real time application of the concept (Bloome et al, 2005). Ms. M used her teacher voice to cue their attention as she shared a story that was personally relevant. This was also a finding in Shirley's dissertation where a similar effect was garnered when teachers told their students "I am going to tell you a story," (Shirley, 2005, p. 175). At this time, the teacher's role is not questioned and his/her voice influences how students react (Hanrahan, 2006). Ms. M, the teacher assumes her professional role and uses her position to humanize a scientific concept.

Personal Voice

This voice came into being when Ms. M was no longer speaking directly about a concept from the science curriculum. Instead she began to weave the threads of her personal self with her professional self (Moore, 2008). In the excerpt 4.10 below, Ms. M is showing her students her spider plant in her classroom. She showed her students that a baby plant started growing out of the root of the adult plant. This phenomenon was different from the other ways that students knew about how plants reproduce (e.g. seeds).

Table 21

Story 16 - Autobiographical

Speaker	Utterance	Event
Ms. M	That's right and... but all.. that's a... all plants make a fruit that are...or that's where the Seeds are. Okay. This plant is called a Spider plant and here's the big plant and of of this plant is coming a baby plant. Do you see that? Okay. So if I were to cli... you can even see the roots are starting to kinda grow. Okay?	
Hallie	Oh my God! That's so weird.	

Table 21 (cont'd)

Ms. M walks around and shows the students the plant.		
Ms. M	Okay. So this is the way a plant is making an other Plant. It's sprouting right out of the plant. So I could... (Students are surprised). Quiet! I could break this off and plant it and I could start... I would have a whole new plant. I have one of these in my atrium at home and the plant is kind of walking all over the bottom of the garden. It has moved from one spot to the other as these little plants... Take root and grow and then the big plant dies.	Perso_Voice Engage (Auto)
Students comment and respond.		
Ms. M	Oh yeah. Did you see this? See there's a little baby plant there and it didn't come from a seed. It just comes right out of this plant.	

However, as Ms. M began showing and talking about this form of plant reproduction, she suddenly digressed and shared that she had the plant also at home and it grew all over the bottom of her garden. This story did not have a direct connection to science. Instead, the story was anecdotal and allowed Ms. M's students to know something else personal about their teacher (Hanrahan, 2006). Her story served to strengthen social connections (Witherell & Noddings, 1991).

Ms. M brought up the story of her spider plant at home from her own inclination. She was not prompted to tell the story unlike the other four stories identified to have personal voice. The other four stories found to have personal voice were the only stories whose antecedent events were students' personal comments. The direction Ms. M took to share a personal story was guided by her students' comments. The ways in which class discussions can lead were linked to particular outcomes sometimes unexpected by the teacher (Osborne, 1998). For example in story 6 in Table 19, Lisa's story about a person being forced to use a particular hand

prompted Ms. M's story about her sister. It was unlikely Ms. M may have told this personal story if it was not for Lisa's contribution.

Story 6 also communicated to students of a time in Ms. M's history where students were forced to use a particular hand. The way in which Ms. M delivered this story with her voice suggested that this was a personal event in which she was affected. For Brenda, this was a very unfair act since she herself was left-handed. Sometimes stories like these are told to convey certain injustices or violations. Stories told with this voice tend to "make connections that learners need to understand, respect and empathize with each other," (Shirley, 2005, p. 90). More importantly, they presented opportunities for Ms. M to share a powerful event in her life that she personally witnessed. Experiencing the event was empowering as she was able to share with students a moment that they were able to feel and imagine too (Egan, 1986).

Role or Positions of the Teacher

This function was the least common appearing in only two stories that were both tied to personal voice. It seemed that as Ms. M spoke in her personal voice, students were able to imagine (with images in the story) a role she occupied besides a teacher. Students seemed to empathize with her role as a sister who was affected by 'witnessing' her own sister being forced to write with her right hand which was unnatural for her. This sisterly role for Ms. M was neither a safe or risky position since she was not portrayed as the main protagonist in the story. Instead, Ms. M communicated how her sister felt. As a result, her story did not show her taking action that may have been necessary to clearly interpret whether she was doing something typical or atypical for her role as a teacher. In addition, these two stories told in personal voice lacked the assertion that was present in her teacher voice. In her teacher voice, she clearly took action as the

central character in her stories sharing outcomes for herself and her children, and her stories were directly related to the curriculum (Bruner, 1987; Polkinghorne, 1995). In contrast with these two biographical stories that functioned to represent role, her students found out more her identity as emanating from her personal life but not to the extent that these roles affected her primary role as a teacher (Moore, 2008). By not speaking of her central role in these stories and directed attention to her sister, she effectively shifted responsibility from herself to her sister ideally preserving her teacher role (Harrison, 2011). Her role as a teacher stayed intact as she was still able to communicate a personal incident in her life.

As teacher and author of these stories, Ms. M chose to tell these stories from her perspective. Her autobiographical and biographical stories did not contain events that others may generally know. These events were personal and her students were cast as an audience that was potentially dependent on the information in the story (Ford, Young & Box, 1967). Therefore, she had the power to decide on the amount of content to be shared, or what was "situationally appropriate" (Ford et al., 1967, p. 371). Ms. M's autobiographical and biographical stories portrayed her as a character internal in the stories (Fludernik, 2009). However, the social exchange with her students was extrinsic where she did not reveal her whole self or all the details in these stories. Instead, she disclosed parts to the extent that she would not compromise her primary role as teacher in the classroom. This phenomenon can be understood in terms of Goffman's *role distancing* whereby Ms. M diverted slightly from her obligatory role as teacher to another role where she shared segments of her life (Ford et al., 1967). A possible critique is that Ms. M then is modeled as a teacher who was generally austere and only occasionally told stories that held faint details of her life.

Ms. M was a teacher who adhered to the WISE science curriculum to teach the scientific concepts of inherited and acquired traits, and she discussed important aspects of it with her students. Some of those aspects included providing definitions, modeling how to observe traits of the Fast Plants® and telling stories. Therefore, her teaching of science was multifaceted that possibly comprised of (a) imitations of former pedagogical strategies, (b) newly constructed pedagogical strategies with her students, and (c) physical movements that brought science to life. These three facets suggested that Ms. M's storytelling can be viewed as performances where she occupied differing roles (Denzin, 2002). Her performances lay on a continuum where she occupied the functional role of a teacher of science in a "ritually organized system of social activity" to a performative role of a figure (e.g. mother, sister) that disrupted the organized system (Denzin, 2002, p. 107).

In speaking with Ms. M, she divulged that she was not aware that she was telling stories (personal communication, March 30th, 2012). This finding was similar to those that J. Michael Shirley found with his teachers (Shirley, 2005). Therefore, Ms. M did not plan what stories she told and when they were to be told. Alternatively, and as perceived in her performance, she instinctively inhabited particular roles to act upon and respond to the context and her students. Ms. M telling her autobiographical and biographical stories allowed her to resist the norm of traditional science to bring science to reality that was meaningful for her, and they became meaningful for her students.

CHAPTER 6

CONCLUSION

The diversity in the pedagogical functions inherent in Ms. M's stories suggested that her teaching was both teacher and student oriented. In addition, the diversity created a speech genre unique to Ms. M that delineated how her stories worked in her classroom. There were functions that came to the forefront and commonalities were found across the stories. Furthermore, those functions highlighted the affordances and constraints of her stories. The primary functions of all of Ms. M's stories are summarized below. Afterwards, a narrative of her teaching as constructed through her stories is provided, as well as the contribution to science.

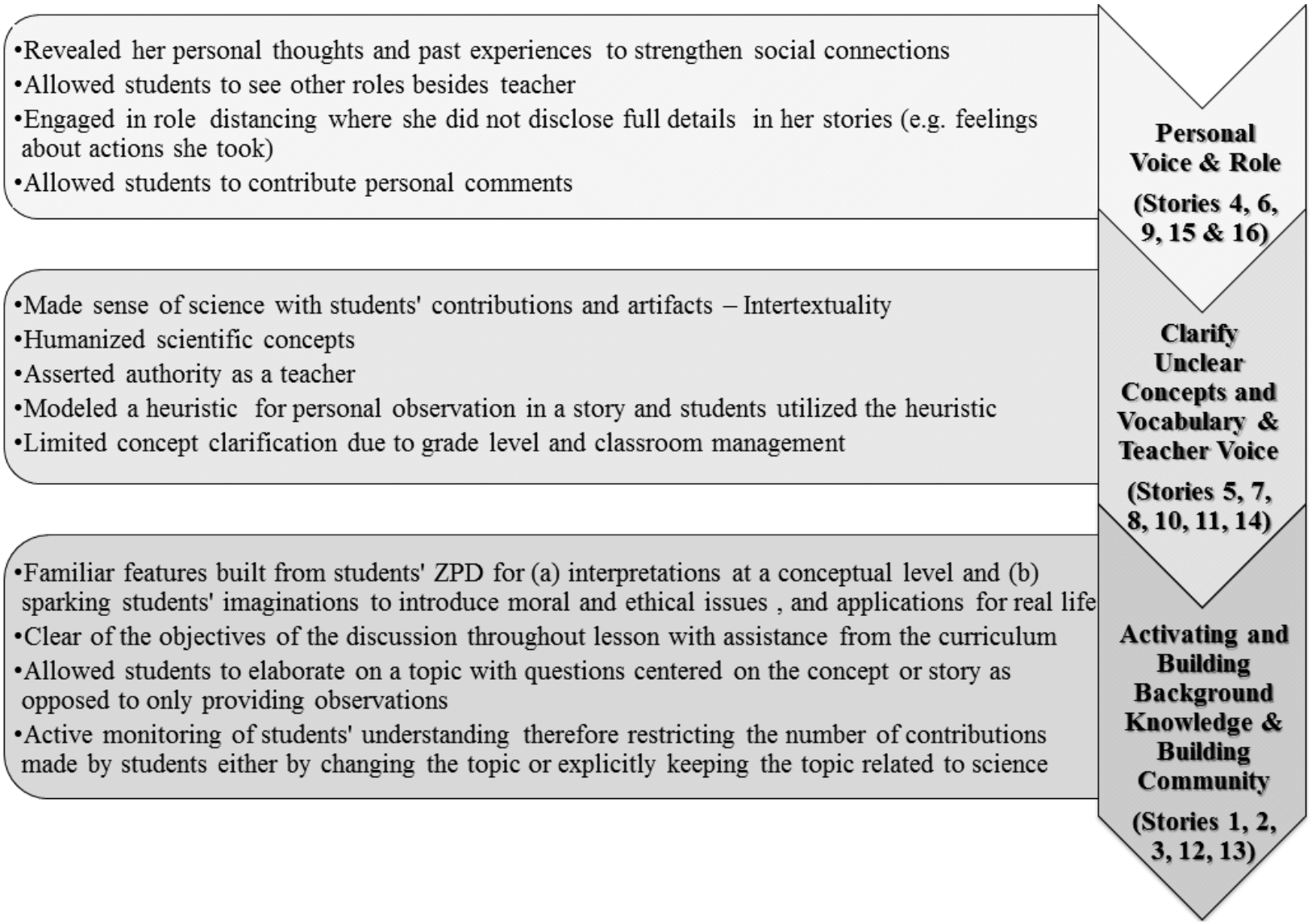

Figure 3. Primary Functions identified in all of Ms. M's stories

All of these functions were found to be important in both of Ms. M's classrooms. Stories that had personal voice and role strengthened social connections. The intent of these stories was mostly to acknowledge students' personal comments. In addition, students were able to hear and experience Ms. M in a nurturing role as a mother to her children, and a sister. Her stories had narrative effect which showed the 'personal' side to science of traits being observed, passed on and acquired (Norris et al, 2005). However, these stories ran the risk of mitigating learning if there was no explicit attempt to make connections to the scientific concept being taught. These stories were not about other scientists, so student engagement did not arise from trying to frame the main character in a compelling way (Shrigley & Koballa, 1989). Instead, student engagement came mostly from the artifacts that Ms. M brought in, and her expressions. Oliviera (2010) would call these expressions her oral strategies which needs to be explored in future research.

Ms. M was most successful engaging her students with her stories when she entered a storytelling mode (Shirley, 2005). Once she explained why she was telling the story and related it to the concept she was teaching, and students made connections to their personal lives (as exemplified in Story 6 in Table 19), these stories had the capacity to increase engagement and promote learning. They were embedded with romantic elements that encourage students to associate science content with human qualities which induced a sense of wonder (Hadzigeorgiou, Klassen & Froese Klassen, 2011). The content of her stories did not only have narrative effect, but sufficient emotive effect to motivate students to ponder about her circumstances as she presented them, and possibly what the scientific concept would mean for their own lives. Students were able to see the scientific world as embodied in story (Bruner, 1987).

Stories that had teacher voice and clarified unclear concepts and vocabulary achieved intertextuality; Ms. M' stories leveraged from her sense-making of science and her own life by

introducing both worlds to students. These examples were made most clear when Ms. M defined a concept and then immediately transitioned to telling a story. Furthermore, these stories seemed to be most effective for encouraging learning when Ms. M was fully able to explicate the concept. She was successful in this endeavor when speaking of acquired traits but less so with inherited traits. Teaching inherited traits to fifth graders can be difficult because their theories of kinship may subdue their understandings of genetic concepts (Venville, Gribble & Donovan, 2005), and it may not be developmentally appropriate (Solomon, Johnson, Zaitchik & Carey, 1996). Thus, Ms. M was limited by the vocabulary she could use to clarify inherited traits. Furthermore, research has found that many elementary school teachers may not be familiar with science inquiry practices because they may have negative experiences learning science and/or have not been taught in an inquiry-oriented manner (Appleton, 2005; Blanchard, Southerland & Granger, 2008; Windschitl, 2003). Also, these teachers who have little content knowledge have been found to lack confidence in their ability to teach science (Childs & McNicholl, 2007). It may be that as Ms. M was telling these stories, she was making sense of these concepts herself as she did in stories 7 and 8 (shown in Table 16). Making sense of these stories herself as she told them and monitoring students' understandings appeared to be difficult to manage simultaneously. This led to missed objectives of the lesson and classroom management problems. These issues were not alleviated when Ms. M asserted her authority as a teacher. It seemed that students became more focused on their behavior as opposed to learning. Therefore, stories that are used to clarify concepts and vocabulary need to have a direct and clear connection to the concept being illustrated so the teacher is fully aware of what is said by her and her students.

Stories that activated and built background knowledge and built community appeared to be the most effective to contribute to students' understanding of scientific concepts, and the ways in which these concepts lived outside the classroom. The crucial elements were that these stories had features that students were able to recognize in their own lives, and had adequate emotive effect to move students to reflect. Furthermore, the teacher monitored students' understanding to the extent that she felt confident that students understood the concept being taught, and the objectives were clear. Teachers' accounts of their experiences resembled narratives which have been found to position students as learners and shape their beliefs in terms of what the goals of classroom activity were (Rex, Murnen, Hobbs & McEachen, 2002), and what counted as knowledge (Warren, Ballenger, Ogonowski, Rosebery & Hudicourt-Barnes, 2001). Students were interested in these stories so they asked for more details. In addition, they provided stories themselves where they did not only make observations but used the scientific language in their stories or performed an action to rectify a problem in the story. The students utilized the elements in Ms. M's stories to work from their ZPD to the point at which they were using the language themselves (Vygotsky, 1978). When students are given opportunities to construct their own narratives on scientific issues that are personally relevant, their attitudes towards science appear to improve (Tomas, Ritchie & Tones, 2011). The stories invites students to reflect where they are able to think about the concepts in their own lives as opposed to trying to understand how the concepts work in lives of people that bear no personal relation.

As a final point, Ms. M was an elementary English teacher who found that science was evident in her life circumstances. She had stories and used them to engage all of her students. Her use of story was varied and the paths taken to a certain type of story was ambiguous. There

was not a pattern to the antecedent events that produced a certain type of story. However, the events that preceded her stories came from her, but increasingly from her students. As a result, Ms. M experienced her world and the world of her students that brought a storied life to science (Bruner, 1987; Connelly & Clandinin, 1990; Ochs, 1997). Her stories momentarily showed her identity (Witherell & Noddings, 1991), emotive effect (Carter, 1993) and her interactions with science in her life (Roth, et al, 1999; Smith & Sparkes, 2008).

The challenges that Ms. M generally encountered revolved around classroom management and time. She experienced more issues in class Zeta as opposed to Gamma. This may have been due to the student behaviors observed in class Zeta as more overt than those observed in class Gamma. In addition, the comments made by students in class Zeta were unexpected and they apparently caught Ms. M off-guard. An example was when Oliver brought up the notion that sperm cells were also one-celled organisms in story 15 (as shown in Table 17). Thus, she had more difficulty monitoring students' behaviors and understanding in class Zeta. The flow of the classroom discussion was absent and it led to more time being spent outside the science content. In respect to time, Ms. M told more stories at the beginning when the curriculum was being implemented as opposed to the end. She may have been more conscious of finishing the curriculum towards the end and possibly providing students greater opportunities to work on the computer to demonstrate their understanding of the concepts learned.

When it appeared that Ms. M was certain of how to respond to students' queries, her stories provided direction and engaged students in ways that provided examples or stories of the concepts in their own lives. Students' contributions were constructive whereby they elaborated on Ms. M's stories with questions, provided their own stories, or were integrating the knowledge they were learning using inquiry. Students were working from their ZPD conceptually and

affectively. It seemed that through these stories, a culture was created (Eisenhart et al, 1996; Lemke, 2001; Roth & Desautels, 2002). The culture provided an interpretation system in which students made sense of their own lives. Through her narrative, she made sense of science in her life (Osborne, 1998). She not only used story as a tool (Clough, 2011; Egan 1986; Isabelle, 2007; Klassen, 2007) but also as a window into her own identity (Ah Nee-Benham & Dudley, 1997; Moore, 2008; Seiler, 2009; Jupp & Slattery, 2010). When Ms. M brought features that activated students' background knowledge, she disrupted the image of traditional science (Goldston & Nichols, 2009; Patchen & Cox-Petersen, 2008). Instead, she reconciled her out of school experiences with school science to expose her identity and understand her students to build a community that had solemn thought, laughter and wonder. Her teaching became ideally intertextualized in thought and action.

Most importantly, the stories that were heard by students were not only to gain knowledge of her experiences but also to "enhance the maintenance of our own associated memories or express those that are similar," (Shirley, 2005, p 164.). These memories are the same regardless of the differences that are seen in terms of race, age, ability, gender, culture, ethnicity and sexual orientation. For example, as the observer-participant in the classroom, I was also influenced by the stories that she shared. I am different from Ms. M in terms of ethnicity, age and culture but I was able to relate and emotionally connect with what she said. She interlaced the threads of her and her students' worlds to weave a fabric that enveloped us into one community.

In confronting the strict knowledge orientations that may be attributable to school science (Avraamidou & Osborne, 2009; Bianchini, Cavazos & Helms, 2000; Carter, 2004; Emdin, 2010; Hanrahan, 2006; Lemke, 2000; Roth & Désautels, 2002), there may be the opportunity to nurture

science discourse and identities that embrace and include all persons. Narrative science discourse or hybridized science discourse as a speech genre, provides the necessary tools to become literate in science as it exists in real world contexts. Since students are affected by these stories, they may provide the opportunity to improve all students' attitudes towards science and help them to use science for their personally relevant problems (Linn & Hsi, 2000; Mallya, Moore Mensah, Contento, Koch & Calabrese Barton, 2012; Osborne et al, 2003). Student affect and understanding may serve to battle the growing concern of the low retention rates of students in science fields in high school and beyond (Hanrahan, 2006), and the low relevance of science to students (Eisenhart et al, 1996; Schreiner & Sjøberg, 2004; Sjøberg & Schreiner, 2010). Ultimately stories help Ms. M and her students to "validate elements of their existence" in society where science lives "through the experiences and existence of others," (Shirley, 2005, p. 164).

Limitations

The scope of my claims in this dissertation was limited to the classrooms in which the data was collected. This was a case study in which the practices of one teacher were interpreted. Therefore this study can be identified as an idiographic study in which distinctive aspects of the case was connected to common principles (Neuendorf, 2002). The author then states that these types of studies are "unique, non-generalizable, subjective, rich and well grounded," (p. 11). Thus, the first limitation is generalizability where the findings of this study are not generalizable to a population. However, this study offers "working hypotheses" that may provide guidelines of how impromptu stories work in elementary science classrooms (Hanrahan, 2006). Secondly, there is an issue of subjectivity and potential bias since it was the second year I had worked with

Ms. M regarding the curriculum and video-taping her classroom (Bloomberg & Volpe, 2008). The interpretations taken in this study are shaped by the "moralistic impulses of the author and by narrative forces or requirements," (Carter, 1993, p. 9). Furthermore, member-checking which is an important procedure of qualitative research to verify findings was not conducted. As a result, precautions were taken to guard against this second limitation with inter-relater reliability that was a vital condition for validation of the coding schemes employed in this study (Neuendorf, 2002).

The third limitation of this study was the presence of the video equipment in the classroom. It creates observer effect where the presence can influence the practice and behavior of the teacher and her students (Jordan and Henderson, 1995). Moreover, the video-camera being focused exclusively on the teacher missed non-verbal gestures of students to further examine their level of engagement (Oliveira, 2010). However, the constant presence of the video equipment allowed the opportunity to see more variation of the teacher's practices. In addition, a second microphone in the classroom was used in the class. This was a microphone that belonged to Ms. M and it provided enhanced audio so students comments can be heard and interpreted to determine if they were engaged.

The fourth limitation for this study is Ms. M's voice. It was absent in terms of her construal of my interpretation of her stories in her classroom. This will be explored in a follow-up study since her stories need to fully represent her in terms of the individual, the subjective, and the collective as her lived experiences in society and the science education community (Moore, 2008).

Future Work

Future work can investigate the effects of teachers' stories on students. The length of time and the level of details between when stories were told, and the moments students remember could be measured. Furthermore, short-term or long-term transfer may be investigated to understand if these stories were used in application, or how their sense-making differed from those intended in during instruction (Tao, 2003). Conceptually, it would be important to analyze whether these stories do contribute to student learning of science. Moreover, it may be significant to examine student affect emotively, morally and epistemologically for dilemmas presented in stories that are based on socio-scientific issues (Sadler & Zeidler, 2005).

Another line of work to be pursued would be to analyze stories told by different teachers with respect to their levels of formal knowledge in science and their cultural backgrounds. Do the stories they tell reveal aspects of their personal identities and how do they choose to disclose these aspects in their stories in the classroom? It appeared that teachers who may have experienced calamitous events in their past tell stories that are closely connected to life education. In other words, their stories are told to help students avert bad behavior and strengthen their character (Shirley, 2005). Furthermore, these stories contained explicit details possibly to connote the gravity of the situation. It would be interesting to determine (a) if these life education stories portrayed the narrator as someone who took action, or someone who re-wrote their past experiences (Gerrig & Egidi, 2003), and (b) the roles that these teachers played in making moral or ethical connections they deemed important to represent science as lived in society (Sadler & Zeidler, 2005).

On a discursive level, investigating how the discourse markers used by Ms. M functioned throughout her instruction would be valuable. It may help to understand how Ms. M

psychologically maintained her interactions with her students, and thus shed light on the pedagogical, general and personal notions that were inherent in her beliefs and positions (Edwards & Potter, 2005). In addition, her oral strategies need to be analyzed further to interpret how her affective stories sustained engagement with her students (Oliveira, 2010).

Ms. M appeared to be making sense of science as she was telling some of her stories. It may be an important line of work to understand how these stories can become part of science teachers' professional development. Teaching and learning about socio-scientific issues with teachers' stories in an inquiry environment may prompt teachers to think about science with procedural, conceptual, technological, emotive, moral and epistemological dimensions. In due course, teachers may take the initiative to go beyond the knowledge centered perspective to transform science with their stories. In addition, since teachers are working from their experiences to understand science, it may help to battle the low confidence levels often felt by elementary science teachers providing science instruction (Lumpe, Haney & Czerniak, 2000). Their stories may not only encourage emotion and a sense of character in themselves but among all students which are foundational ethos for engendering a scientific literate citizenry (Roth & Désautels, 2002).

Finally, another goal would be to share stories that are purported to be effective and have them prepared for the lesson. As a result, these stories are not told spontaneously to determine if they had the same effects on students in terms of the pedagogical functions as outlined in this dissertation. These stories would be constructed and planned ideally to represent science and society (Zeidler & Lederman, 1989) In addition, students would be asked to share stories of their own without direction from the teacher. How do their stories shape the discussion when they are explicitly asked to share something they know about science? Also, when students author their

own stories, do they use similar themes or structures that were apparent in the teacher's use of stories in the classroom? These may be possible avenues for future research.

APPENDICES

APPENDIX A

Teacher Demographic Questionnaire

Directions: Please tick or write your answer where indicated.

1) Are you:

☐ Male

☐ Female

2) Are you:

☐ African-American (not of Hispanic origin)

☐ American Indian or Alaskan Native

☐ Asian or Pacific Islander

☐ Hispanic

☐ White (not of Hispanic origin)

☐ Other (describe)

3) What is the highest degree you hold?

☐ BA or BS

☐ MA or MS

☐ Multiple MA or MS

☐ PhD or EdD

☐ Other (describe) _____

4) Did you have a major, minor, or special emphasis in any of the following subjects as part of your undergraduate coursework? Fill in one oval on each line.

	Yes, a major	Yes, a minor or special emphasis	No
a. Mathematics education	Ⓐ	Ⓑ	Ⓒ
b. Mathematics	Ⓐ	Ⓑ	Ⓒ
c. Other mathematics-related subject such as statistics	Ⓐ	Ⓑ	Ⓒ
d. Reading, language arts, or literacy education	Ⓐ	Ⓑ	Ⓒ
e. English	Ⓐ	Ⓑ	Ⓒ
f. Other language arts-related subject	Ⓐ	Ⓑ	Ⓒ
g. Science education	Ⓐ	Ⓑ	Ⓒ
h. Biology or other life science	Ⓐ	Ⓑ	Ⓒ
i. Physics, chemistry, or other physical science	Ⓐ	Ⓑ	Ⓒ
j. Earth or space science	Ⓐ	Ⓑ	Ⓒ
k. Other science-related subject	Ⓐ	Ⓑ	Ⓒ
l. Education (including elementary or early childhood)	Ⓐ	Ⓑ	Ⓒ

5) Did you have a major, minor, or special emphasis in any of the following subjects as part of your graduate coursework? Fill in one oval on each line.

	Yes, a major	Yes, a minor or special emphasis	No
a. Mathematics education	Ⓐ	Ⓑ	Ⓒ
b. Mathematics	Ⓐ	Ⓑ	Ⓒ
c. Other mathematics-related subject such as statistics	Ⓐ	Ⓑ	Ⓒ
d. Reading, language arts, or literacy education	Ⓐ	Ⓑ	Ⓒ
e. English	Ⓐ	Ⓑ	Ⓒ
f. Other language arts-related subject	Ⓐ	Ⓑ	Ⓒ
g. Science education	Ⓐ	Ⓑ	Ⓒ
h. Biology or other life science	Ⓐ	Ⓑ	Ⓒ
i. Physics, chemistry, or other physical science	Ⓐ	Ⓑ	Ⓒ
j. Earth or space science	Ⓐ	Ⓑ	Ⓒ
k. Other science-related subject	Ⓐ	Ⓑ	Ⓒ
l. Education (including elementary or early childhood)	Ⓐ	Ⓑ	Ⓒ

6) What type of teaching certification do you hold? (Tick One)

☐ Not certified

☐ Temporary, provisional, or emergency certification (requires additional coursework before regular certification can be obtained)

☐ Probationary certification (the initial certification issued after satisfying all requirements except the completion of a probationary period)

☐ Regular or standard certification

Please list your additional certifications:

_____

_____

7) Do you hold a specific certificate or endorsement for teaching science? (Circle One)

☐ No

☐ Yes

8) What grade are you teaching this coming year?

_____

9) How many years have you taught science?

YEARS

10) With respect to the science that you are asked to teach, how confident are you in your Science knowledge? (Tick One)

☐ Not confident at all

☐ Somewhat confident

☐ Moderately confident

☐ Very confident

11) With respect to the science that you are asked to teach, how confident are you in using educational or instructional technology? (Tick One)

☐ Not confident at all

☐ Somewhat confident

☐ Moderately confident

☐ Very confident

APPENDIX B

Coding Form

Coder ID _____

Story Identification

Story #	Activity #, Step #	Story Start Time (mm:ss)	Story End Time (mm:ss)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Story Type

Story #	Code - Type of Story	Attributes of Story
1		
2		
3		
4		
5		

Occurrence of Story

Story #	Utterance (Line #)	Code	Attributes of Antecedent Events
1	1		
	2		
	3		
2	1		
	2		
	3		

Pedagogical Function of Story

Story #	Code – Pedagogical Function	Attributes of Discourse Markers
1		
2		
3		

APPENDIX C

Codebook

Analysis of Ms. M's Stories

Unit of Analysis: Ms. M's stories

Definition of stories: Stories are teacher utterances, used in the first person or third person narrative view and relate an experience that occurred outside the classroom.

Coder ID: Indicate the pseudonym given to you by the researcher.

Story Identification

Instructions: Please listen to the following videotapes and record the instances that you hear the teacher, Ms. M tell a story.

Category	Description	Codes
(a) Curriculum Sequence	Codes the activity number, step number, and describes the part in the WISE curriculum in which the story emerges	Activity #, Step #
(b) Story Start Time	Code in minutes and seconds where the story emerges temporally in the class	(mm:ss)
(c) Story End Time	Code in minutes and seconds where the story ends temporally in the class	(mm:ss)

Story Type

Instructions: Please read the following transcripts of all stories told by Ms. M to determine the type of story. Write the code and brief attributes of the story that helped you determine the code. Use coding scheme shown below.

Codes	Analysis	Example
Auto	Autobiographical – first person narrative whereby teacher personally speaks about herself and is the primary character	"I planted some roses in my garden and they are now beginning to bear. They are red roses and those are my daughter's favorite."
Bio	Biographical – third person narrative whereby teacher personally speaks about someone else and may be a secondary character	"When I was little, my father used to pull up those weeds – dandelions. I helped him but it felt like a tug of war as we struggled to pull those large roots up."
C_Event	Current Event – the characters in the teacher's story are recognizable as individuals in current news	"My friend's son is autistic and there is a current debate among scientists about whether autism is caused strictly by genetics or the environment."
Hist	Historical – teacher tells a story about a science figure in the past of which she bears no personal relation	"Gregor Mendel born in Austria was the first to describe how pea plants inherit traits."
Fict	Fictional – teacher tells a story where the characters appear to be fictional or made up	"One night I went to bed and I dreamt about green peas. I got up the next morning and my hair was green!"
Other	Teacher tells a story that has other attributes	

Occurrence of Story

Instructions: Please read the following transcripts of each story and the utterances told before the story. Provide at most three codes for each utterance from the student or teacher using the coding scheme shown below. Write the code and brief attributes that helped you determine the code. This is to determine the antecedent event or when the story occurred.

Antecedent Codes	Analysis
Def	Definition – Ms. M defines a term from the curriculum
SI_Concept	Student initiates a concept without elaboration based on observations made from the curriculum or responses to Ms. M's questions
SI_Elaborate	Student initiates a concept or story with elaboration based on attempting to explain their responses to Ms. M's questions
SI_Question	Student initiates a concern or a question in response to the curriculum activity
SI_Personal	Student initiates a personal comment or feeling in response to the curriculum activity
TI_Question	Teacher initiates a question but there is either no response from students or responses with no elaboration
Other	Other characteristics to describe the antecedent events

Pedagogical Function of Story

Instructions: Please read the following transcripts of all stories coupled with their antecedent events and subsequent events. After, code for at most three pedagogical functions for eacy story using the table below. Include brief attributes of the discourse marker that helped you interpret the story's function.

Codes	Analysis	Discourse Marker
Act_Build	Activating and building background knowledge	Student introduces a concepts and the teacher builds on the student's response with a story or the teacher uses a story to bring a concept to students
C_Vocab	Clarify concepts and vocabulary	Student poses a question and teacher responds with a story to answer or clarify
Engage	Promoting engagement and attention	When story is being told, students appear to be listening to the story (e.g. their eyes are turned to her; little behavioral distractions)
B_Comm	Building community	Students ask questions about the story or contribute stories of their own
Voice	Teacher voice	Teacher brings her personal experience to the formal discourse of the classroom
Role	Roles or Positions of the teacher	Teacher appears to set aside her role as teacher and brings other roles familiar to her (e.g. mother) to the forefront
Other	Other characteristics to describe the function of the story	

APPENDIX D

Transcription Conventions

(.)	Short pause for less than 1 s
(1.5)	Timed pause in seconds
[overlap]	Overlapping speech
↑	Rising intonation
↓	Falling intonation
°quieter°	Encloses talk that is quieter than the surrounding talk
LOUD	Talk that is louder than the surrounding talk
Bold	Words emphasized by the transcriber for analytic purposes
Emphasis	Emphasis
>faster<	Encloses talk that is faster than the surrounding talk
<slower>	Encloses talk that is slower than the surrounding talk
(brackets)	Encloses words the transcriber is unsure about
((comments))	Encloses comments from the transcriber
Rea:::ly	Elongation of the prior sound
.	Stop in intonation
=	Immediate latching of successive talk

Figure 4. These conventions belong to Jefferson's Transcript Notation designed by J. Maxwell Atkinson and John Heritage (Jaworski & Coupland, 2006). Adapted from "Inoculating Against Prejudice: A Discursive Approach to Homophobia and Sexism in Adolescent Male Talk," by N. Korobov, 2004, *Psychology of Men and Masculinity, 5*, p. 189.

APPENDIX E

Transcription – 05/06

Ms. M: I'd appreciate it if... you have a question that has to do with the lesson^ you can, you may ask that question. Kay. Alright so Mario? Did you have a question?
Mario: W... Are we observing our Fast Plants?
Ms. M: Today we will not be observing plants, We'll do that on Mondays Wednesdays and probably Fridays. Alright?
Student: We... what about the (...)?
Ms. M: If you have a question please raise your hand. Ha... Hayden?
Hayden: What about the computer lab?
Ms. M: We may be doing something besides science tomorrow. I haven't decided it'll kinda depend on how far we get today^. But ahm Mrs. Kipp's class needs to be in the computer lab so probably if we do a computer lab activity, we'll use the laptops to do it. Okay? Any other questions? Before I get started. Okay! So we've been talking about inherited and acquired traits. Okay. Who can give me a very simple definition of an inherited trait? An inherited trait? Okay. Craig?
Craig: Ahm it's a trait that ahm one of your parents has and then they pass it on to you.
Ms. M: Okay. Very good! Alright. What is another word we can use for...? This is amazing. You can read my mind. Put your hands down please. What's another word you can use for trait? There are 2 other words that we u.. can use for the word trait. Who can tell me one of them? Okay.
Lisa: Feature?
Ms. M: A feature okay? And another word that we can use for trait. Virginia?
Virginia: Characteristic.
Ms. M: A characteristic. Okay. So those words are interchangeable. So when we sa... we're talking about features or characteristics or traits, we can kind of use... they're synonyms okay? They mean basically the same thing. Kay? So then we know what an inherited trait is? Something that you get when you... before you... you're you come born with this particular trait and you've inherited it from your parents or your grandparents. Okay. Your biological parents... your biological grandparents...
Gina: (...)
Ms. M: Gina? We've talked about this a lot. Okay. Alright. So what's an acquired trait? An acquired trait? How is that different than an inherited trait? Hallie?
Hallie: It's something you get from... that yo... uh that your body chooses or your... that happens when like when you're in an environment. Isn't it like a different en... environment or y... ahm your body picks for you.
Ms. M: Your body picks for you? Kay. Explain that a little bit. What do you mean by that your body picks it?
Hallie: Like if your parents are right handed and you're left handed that... like that's something that your body chooses. It's not...
Ms. M: Okay but you're still inherited with that lefthandedness unless You^ say okay I'm born with a right hand, I do... I naturally do everything with my right hand but I'm going to change to left-handed.
Hallie: Then that is (...)

Ms. M: I'm going to my right hand to my back and I'm only gonna use my left hand to do things until my left hand...
Brandon: Does that really work?
Ms. M: Excuse me. Until my left hand becomes the hand that I do everything with. So then you have acquired lefthandedness because you've decided to make that change. Okay?
Hallie: So then like you pick that for your body... not your body picks it for you.
Ms. M: Right. So human beings can do that. Okay. They can decide... they can sometimes change their traits. Okay? I decided I was going to have pierced ears. I wasn't born with pierced ears. My mother doesn't have pierced ears. My father doesn't have pierced ears. Neither of my grand... none of my grandparents had pierced ears. I decided at a ripe bold age that I was going to have pierced ears so I made that choice and I had someone give me pierced ears. Okay?
Student: Did it hurt?
Ms. M: And it hurt. Okay. So that would be an acquired trait. It could also be because the environ... something happens in the environment. Ahm... for instance I was... as I told you at the beginning of the year I was in a little car accident. And I now have a dark blue spot on my knee where I got a bruise and my doctor told me the other day I'm probably gonna have it forever because I got such a big bump that it's kinda... He called it a tattoo alright? It's not a cool picture trust me okay. (Ms. M chuckles).
(Students comment and ask questions).
Student: Ms. M... Ms. M isn't that the one that ahm...
Ms. M: That's yeah that's from the (...) yeah from my (...) car. Okay. Shhhhh. Okay. Shhhh. Okay so I'm gonna have that mark on my body probably for the rest of my life. I was't born with that mark but something happened to me. The environment caused somehow a case... so I was in this accident and so now I'm always gonna have that mark. My mother doesn't have that mark. My father doesn't have my... that mark. My grandparents didn't have that mark on their shin right below their knee. But I have it because it's acquired. It's something that happened to me that caused that to happen.
Brandon: When did it happen?
Gina: What does it look like? What does it look like?
Ms. M: What does it... It looks like a bruise. It looks like a bruise. Yes?
Brandon: When did it happen?
Ms. M: It happened right before school... about a week before school started... in August. Okay.
Student: (...)
Ms. M: Shhhhh. Okay yes I was.
Gina: Did the car like hit it (...)
Ms. M: I... you know what if you want to me ask more questions about that you can talk to me at recess. Okay Gina?
Gina: Because I don't know h.. I don't (...). Back in 1990 of (...) before I was born, well my ahm my grandmother on my mom's side had got ahm got killed in a car accident...
Ms. M: I'm sorry.
Gina: When she was 58.
Ms. M: That's too bad. I'm sorry to hear that.
Gina: That's (...)

Ms. M: I was fortunate that I was in any... that that didn't happen to me. Okay. Alright. So we've talked... we know what an inherited trait and we know what an acquired trait is and we know that sometimes traits can either inherited or acquired. Alright? For instance hair color. Hair color okay. A lot of people who are my age that had hair this color naturally okay would be in the beauty shop instantly and having it changed to a different color that isn't gray.
Hallie: You look good with that.
Ms. M: Okay. So some people choose to change their hair color but everyone's born with a hair color that they inherited. Okay? So if you still have your own natural... the haircolor that you were born with you have inherited hair color. If you change the color of your hair then hair color becomes an acquired trait. So sometimes traits can be acquired and sometimes they can also be inherited. Do you see what I'm saying? Okay Gina?
Gina: I went on this Asian website and like one of those pictures... it has picture of Asian teenage girls of like of dyeing their hair pink.
Ms. M: That's right! Okay...
Gina: It was like here and here and here.
Ms. M: But they weren't... they didn't inherit pink hair color did they?
Gina: I think they wanted it.
Ms. M: They wanted it that way so they acquired the trait of pink hair. Yes?
Student: My aunt has blonde hair (...) as a baby.
Ms. M: But your grandparents... your aunt has blonde hair? Okay but her parents do not have blonde hair so either she changed the color of her hair... you know like had it dyed Or maybe her grandparents had blonde hair and she inherited it from her... her grandparents. Okay?
Hallie: I got that.
Ms. M: Okay? Alright.
(Student comment.)
Student: So that means her great great...
Ms. M: So maybe you... yo... (Ms. M nods her head). Yes?
Mario: My cousin... my little cousin has ahm orange hair and nobody else in our family has orange hair.
Ms. M: Okay. So maybe there's... because you inherit okay so..
Mario: (...)
Ms. M: Okay so his parents don't have it and h... neither one of his... none of his grandparents have it... so it could be that one of your grandparents parents have it or your grandparents grandparents had it. (Ms. M stretches her hands up in the air). So some grandparent along the line had red hair.
Brenda: Or maybe they just dyed it.
Mario: No. [He's blonde.
Ms. M: [No he's little. Okay.
Student: He's in kindergarten.
Brenda: (...) like maybe the parents dyed their hair.
Ms. M: If... if I were to dye my hair pink... (Ms. M shakes her head).
(Students giggle).

Ms. M: Okay? If I had dyed my hair pink before I had my children they would not get pink hair.
Brenda: I know that's what I'm saying. So like maybe their like his parents...
Student: Ms. M?
(Students comment).
Ms. M: Shhhhh...
Brenda: Or their grand... or his parents or his mom and dad or... or his parents' mom and dad had orange hair but then [they dyed it.
Ms. M: [Ahhhh... but they dyed it. I see what you're saying. Okay. So maybe one of your... one of his grandparents or grandparents really do have secretly have orange hair but they dyed it a different color.
Mario: No.
Ms. M: Okay. Alright. Okay. I see what you're saying.
Student: Why they have to keep that so secret?
Ms. M: Okay. Alright! Okay. Alright so today! We're gonna start talking about... we're gonna talk a little bit more about organisms? Okay. And... and so what what is our definition of an organism? Okay. Ahm Michel?
Michel: Any living thing.

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