VEILED CHAMELEONS: ANALYZING URBAN SCIENCE TEACHERS' EPISTEMOLOGICAL AND ONTOLOGICAL BELIEFS ON "CARING" FOR URBAN STUDENTS' SCIENCE LITERACY

by

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DEDICATION

I would like to dedicate my dissertation to my father, Caliph Barrett Jr., who one month preceding his death, and ironically the application deadline for the Ph.D. Science Education program, encouraged me to apply to Texas Christian University. His exact words, “A doctoral program is a great idea and will open endless possibilities.” Because of his sacrifice throughout my childhood to constantly “go without” so that “I may have,” I dedicate this important work to his memory.

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Table of Contents

List of Figures

List of Tables

List of Appendices

Chapter 1: Contextual Framework

I am a native of Fort Worth, Texas, coming specifically, from a small, predominantly African-American community affectionately known as *Lake Como*. While Como is a poor neighborhood, it uniquely surrounds wealthier neighborhoods. A glimpse into Como's history reveals that the lake featured on the outskirts of the community was a resort attraction in the early 1900s. Eventually, the proximal wealthier communities decided to establish a community for "the help." Growing up in this neighborhood, I experienced lots of love and encouragement from my family. I didn't know that I lived in a poor environment until I was older and could recognize the difference in the physical appearance between Como and wealthier parts of Fort Worth. I had hard-working parents who instilled in me the importance of obtaining an education, but recognizing inequalities in my actual physical settings opened my eyes to the differences in education. As I got older, I realized that some teachers imposed lower expectations on me because of my race; but teachers lowered their expectations still further when they realized that I was one of the "hood kids," a phrase used to describe urban youth from poor neighborhoods. When I became a teacher, I had an epiphany: pedagogy in urban areas remained typically at the basic level, disinteresting and uninviting. At first glance, when observing this basic pedagogy in urban classrooms, teachers may appear to be teaching in an effective manner that engages urban students. However, at a closer look, some teachers are not helping students to grow from a basic level of understanding science towards an advanced understanding of science. I call these teachers, *Veiled Chameleons*, because they are able to blend into the environment and teach in a manner undetected by school administrators. As a former urban science student and urban science teacher, I feel obligated to explore

the circumstances in which urban science students' obtain, or fail to obtain, equitable opportunities to develop their science literacy.

Research Problem

Science for All (AAAS, 1993) identifies principles of effective science teaching and learning that could benefit society as a whole. Since then, one of the biggest agenda items from the science education community has been the creation of ways to provide science education for all, and thus develop a literate society. Scholars present many definitions of *science literacy*, all of which encompass some form of the following: (a) engaging in writing and discourse with members from and outside of the scientific community (Hand, Lawrence & Yore, 1999); (b) differentiating science from non-science (DeBoer, 2000; Hurd, 1998; NRC, 1996); (c) using scientific knowledge to construct logic and reasoning in solving problems (AAAS, 1993; DeBoer, 2000; NRC, 1996); and (d) developing knowledge to effectively participate in scientific discussions that involve social issues, such as the recent debate on vaccinations (Millar & Osborne, 1998). The underlying assumption about a person who is science literate is that he or she possesses the "habits-of-mind required to construct understandings of science" (Yore, Bisanz, & Hand, 2003, p. 690). Among 25 characteristics of a science literate person, Hurd (1998) includes the following:

- Recognizes that science literacy is a process of acquiring, analyzing, synthesizing, coding, evaluating, and utilizing achievements in science and technology in human and social contexts.
- Recognizes that our global economy is largely influenced by advancements in science and technology.

- Recognizes the everyday reality of ways in which science and technology serve human adaptive capacities and enrich one's capital. (p. 413)

Hurd asserts the existence of a massive social context, which requires science literacy. Since science literacy has an underlying idea that science can influence the economy, create advancements, and improve one's capital, then it seems that creating a science literate society is the key to improving life for all humankind. However, the science education community has failed to teach the fundamentals of this idea to some students who have limited access to competent knowledge in science. Tate (2001) contends that the lack of access to sufficient science education in urban settings is a breach of the civil rights of urban students. Calabrese Barton (2001a) affirms that unless the science education community transitions from a process ideology in research to taking a political stance and liberating oppressed students, the goal of science literacy for all will remain unattainable.

As Barr and Parrett (1995) posit, "Public education is not only moribund, and failing, but literally falling apart. The school mirrors the disintegration of the American family, the crumbling of U.S. social values and a nation ripped apart between the haves and have-nots" (p. 163). The disintegration of the American family refers to the high rates of single-parent families or divorced families in low-income or minimally educated households (Murray, 2013). In public education, society associates the have-nots with urban education, making it widely known for the problems and issues that accompany student success. Some of the characteristics critics associate with urban students include low-test scores, behavioral problems, non-standard English, uninvolved parents, excessive truancy, low socioeconomic status, and illegal citizenship (Tobin, Elmesky, &

Seiler, 2005). Perhaps the most important characteristic that society associates with urban schools is low-test scores, which determine the status of a school and its district. Tobin et al. (2005) note:

> These are the numbers through which students are judged, their achievement assessed, and their life chances, in many ways, determined. Thus, failed courses and low test scores not only provide insight into the status of teaching and learning in urban schools, they impact the students' lives by serving as "access codes" for students' success in the educational system and, ultimately, in society. (p. 2)

Texas has an interesting case history involving urban areas and consequently urban schools. Texas has five of the largest cities in the United States known for their urban areas: Houston, Dallas, Fort Worth, San Antonio, and Austin. In January of 2014, the Texas Education Agency (TEA) identified low-performing schools, which also happened to be urban schools, in North Texas. This list sent a shock wave throughout the Dallas-Fort Worth Metroplex. Fort Worth Independent School District (FWISD) had 38 low-performing schools and Dallas Independent School District (DISD) had 57 low-performing schools, at least, as identified by TEA. Critics of low-performing schools talked about the type of students characterized in the ways aforementioned, but they said little about the needs of urban education, such as effective teaching practices. Rather, society characterizes low-performing schools by their setting, mostly urban environments, and the type of students who attend those schools.

Statement of Purpose and Research Questions

The purpose of this grounded theory research study is to investigate how urban science teachers' epistemological and ontological beliefs influence how these teachers demonstrate "care" for urban students' science literacy. Additionally, I will examine how the teachers' perceptions of care intersect with their students' perceptions of care. Using critical race theory as a lens, I attempt through this study to answer the following research questions:

1. How do urban science teachers describe their epistemological and ontological beliefs as they relate to "caring" for their urban science students science literacy?
2. How do urban science students describe their teachers' epistemological and ontological beliefs as they relate to "caring" for their science literacy?
3. How do teachers actually demonstrate their epistemological and ontological beliefs in the classroom as they relate to "caring" for their students' science literacy?

Significance of the Study

Scholars state that teachers with constructivist epistemological beliefs are more likely to show constructivist behaviors in the classroom (Hashweh, 1996; Luft & Roehrig, 2007). However, scholars have left gaps in the literature from two major perspectives. First, research into teachers' epistemological and ontological beliefs as viewed through a critical race theory (CRT) lens is missing from the literature. Using CRT as a theoretical framework is important since it allows researchers to determine teachers' beliefs, and consequently those beliefs in action, as they teach in an urban school setting where the students are predominantly African-American, Latina/o, and economically

disadvantaged. Second, the research on analyzing teachers' epistemological and ontological beliefs and how these beliefs translate into "caring" for students' science literacy is minimal. Conducting this research could aid in the "science for all" initiative by challenging teachers to examine their epistemological and ontological beliefs as they relate to caring for their students' science literacy, which Guba (1990) asserts is the "basic set of beliefs that guides action" (p. 17). Finally, the research will give a voice to urban students normally silenced or overlooked because of a focus on low-performing schools.

I also acknowledge that my beliefs align with those of relativists. Relativists hold the view that an absolute truth does not exist, but rather the truth depends on the context and the frame of reference of the person considering a question or issue (Godfrey-Smith, 2009). In relation to ontological beliefs, relativists use the foundational premise that truth is subject to one's perspective and this view has implications for teaching, particularly in determining whose truth dominates the classroom. From an ontological relativist point of view, teachers are not the dominant figure in the classroom, but rather co-participants, collaborators, and facilitators (Schraw & Olafson, 2008). From the opposite view, ontological realists view teachers as the decision-makers for learning and believe it is more practical for students to work on an exact assignment, individually.

Social constructivism appeals to my epistemological beliefs because it embodies an appreciation of the knowledge and prior experiences others can bring to the table. Learning from others' knowledge, and learning how they constructed that knowledge, is the best way for me to expand my own knowledge. More than the belief in a non-absolute truth, this epistemology appreciates various truths. The appreciation of different truths

and knowledge is also why I value Vygotsky's sociocultural theory. When a teacher appreciates others' knowledge, a shift occurs in who holds the knowledge. For example, in a social constructivist classroom, the teacher would not view him or herself as the sole person transmitting knowledge to the students. Instead, an exchange would occur within the classroom, where the teacher and the students become equal proprietors of the knowledge constructed. The idea of who holds the knowledge may at first glance seem trivial, but this idea directly relates to my ideology of urban science education and my quest to liberate oppressed students by seeking to guarantee them full science literacy.

Definitions of key terminology

For the purpose of this research, I must define words that may have multiple meanings. Those definitions appear below:

Care describes serious attention or consideration applied to teaching effectively, so they did to avoid damage or lower the risk of students' not becoming science literate.

Effective teaching describes the following: (1) The constructivist teaching paradigm, where the teacher has the role of a facilitator, (2) Personalized instruction that addresses students' needs, (3) High expectations that minimize preconceived notions of urban students, (4) Authentic connections with students, (5) Strong subject matter knowledge and/or the effort to increase subject matter knowledge, and (6) Strong pedagogical content knowledge or the effort to increase pedagogical content knowledge. All six components together, driven by the force of making connections with urban students, have the ability to render effective urban teaching.

Epistemological beliefs describes science teachers' holistic views of the derivation of knowledge. These views include learning and understanding how students derive knowledge.

Ontological beliefs describes science teachers' holistic views of the nature of knowledge.

Science achievement defines at least a satisfactory scaled score of 3,500, as measured on the State of Texas Assessments of Academic Readiness (STAAR) End of Course (EOC) Biology exam.

Science literacy describes the readiness standards, supporting standards, and scientific process skills needed to read, write, and discuss science (biology).

Urban school describes a school in which the students are predominantly Black, and/or of Latina/Latino heritage and in an area of high poverty or economically disadvantaged. Schools and districts acknowledged as *major urban* have the following criteria:

(a) They are located in a county with a population of at least 840,000;

(b) They have the largest enrollment in the county or at least 75 percent of the largest district enrollment in the county; and

(c) They have a student population of whom at least 35 percent are economically disadvantaged.

Minimal attendance issues describes the inclusion of students who missed less than 5% of school, 9 days or less, out of 180 days of instruction.

Minimal behavioral issues describes students who had, during the study period, served two or fewer days of suspension or ISS (In School Suspension).

Chapter 2: Literature Review

This chapter presents major areas of critical race theory, constructivism, and science education in urban settings, all of which inform my research. I will (1) outline the theoretical framework of the research, (2) discuss views of science education, and (3) describe the current state of and gap in the literature as they relate to the rationale for conducting the study.

The purpose of this research is to investigate how urban science teachers' epistemological and ontological beliefs influence how teachers demonstrate "care" for urban students' science literacy. Figure 1 shows the relationship of urban science students' science literacy and how it relates to how teachers demonstrate "care." Additionally, it shows the relationship between critical race theory and how critical race theory impacts teachers' beliefs, as discussed later on in this chapter.

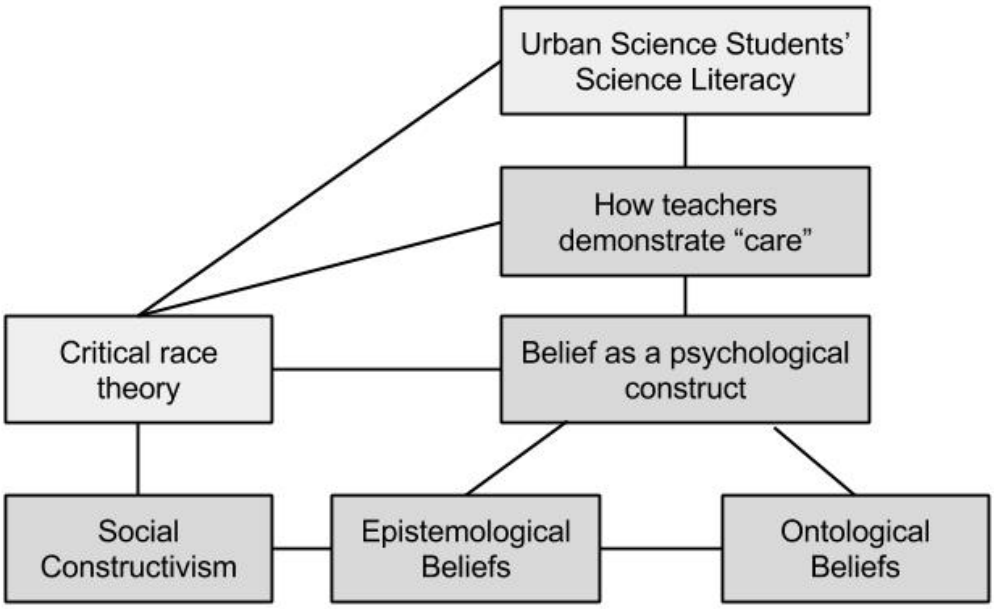

Figure 1. Overview of literature review as it relates to critical race theory. Lines show how each element connects to critical race theory.

Theoretical Framework of the Research

Critical Race Theory

History. Critical race theory (CRT) serves as the theoretical lens for my study. CRT contends that racism is a routine, typical event in our society and builds on the work of critical legal studies and radical feminism (Crenshaw, 1995). It formed when activists and scholars interested in studying the relationship between race, racism, and power decided to take action (Delgado & Stefancic, 2012). CRT draws from European philosophers and theorists. Included among these are Antonio Gramsci, an Italian writer, a political theorist, and notable Marxist thinker. They also include Jacques Derrida, a French philosopher who has made major contributions to post-structuralism and post modernism (Delgado & Stefancic, 2000). Gramsci influenced the movement by arguing that the hegemonic class does not always impose physical force, such as slavery on the less dominant class, as an agenda of its regime, but does impose a dominant ideology of thinking and speaking. He asserted that domination comes through group social psychology, promulgated by such institutions as churches, dominant cultural groups, and mass media (Denzin & Lincoln, 2003). Derrida contributed to CRT through his concept of Deconstruction (Balkin, 1996). Deconstruction became a method for analyzing legal arguments about oppression and composing counterarguments. Scholars use deconstruction in critical legal studies by finding ways "in which one term in the opposition has been 'privileged' over the other in a particular text, argument, historical tradition, or social practice" (Balkin, 1996, p. 362).

CRT also draws from such radical traditional figures as Sojourner Truth and W.E.B. Du Bois. Truth, an abolitionist and women's rights activist who escaped from

slavery, often described her social justice approach by saying, “The Spirit calls me, and I must go” (Truth, 1998, p. 65). Perhaps her biggest contribution to CRT involves the beginning of Ladson-Billings and Tate’s (1995) argument about race and property, which states, ownership of white skin gives individuals access to places not accessible to those without white skin. In the l800s, Truth argued that ownership of private property and land were the gateway to true freedom and self-sufficiency. Ownership of land would remove African-Americans from a state of dependency, as servants to whites, and place them on a new road toward independence. Although for many years Truth made an unsuccessful petition for property and land for African-Americans to the United States Congress, she still drew upon the idea as a contending domain for CRT scholars. Du Bois, a civil rights activist and leader, author, and historian, contributed to CRT by opposing the idea of white superiority. He did so by arguing against the “Atlanta Compromise,” which assumed that African-Americans would have better opportunities in training for vocational trades rather than higher education. Du Bois argued that vocational training was a subliminal strategy for reinforcing white supremacy, since vocational training was job-specific and could not warrant the type of critical thinking skills one gains by getting an education.

Conceptual model of CRT. The history section of CRT illustrated how race describes not merely skin color, but also social relationships. Consequently, the following proposed CRT model guided the analysis in the study (Figure 2). From left to right, the CRT model describes how the themes *Interest Convergence* and *Colorblindness* play an intricate part in maintaining the status quo. Colorblindness is a major theme within the

model since it informs laws enacted on society, influences microaggressions that cause stereotype threats, and is an ingenious contraption aimed at maintaining the status quo.

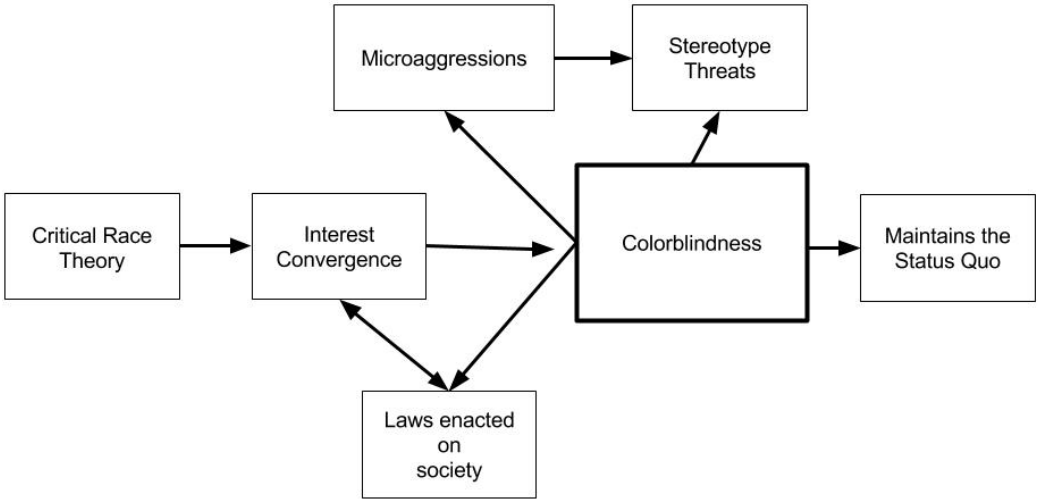

Figure 2. The proposed model of critical race theory as it relates to this study. The theme *Colorblindness* is a major part of the framework since it directly participates in maintaining the status quo.

Interest Convergence. As a theoretical stance, Interest Convergence began in the mid-1970s when lawyers and social justice experts realized that the advances of the civil rights era had stalled. In 1954, *Brown vs. Board of Education I* declared segregation to be illegal, prompting black and white students to attend school together. However, the decision to "ending" segregation took decades and the United States continues to face the same problem today. Professor Derrick Bell, a principal figure in CRT, identified *Brown vs. Board of Education I* as an interest convergence, contending that civil rights legislation only survives if it can be of advantage to the majority (Delgado & Stefancic, 2000). He acknowledged the decision of *Brown vs. Board of Education* as the United

States' ploy to affirm to the world that it was a trend-setter and a world leader in the midst of the Cold War. He cites as evidence of this ploy *de facto* segregation, which is still an issue for schools in the United States today.

Colorblindness. Mazzocco, Cooper, and Flint (2012) define *colorblindness* as "an opposition to racial categorization" (p. 168). Similarly, adding more details to their definition, Wolsko, Park, Judd, and Wittenbrink (2000) define *colorblindness* as "the ideal of learning to judge others as individuals and not on the basis of their social group membership" (p. 637). The latter definition of *colorblindness* sounds utopic and is an idealistic goal of the free world. However, scholars argue that the idea of colorblindness creates a neutral baseline among races and this perspective merely maintains the status quo (Peery, 2011). As long as we identify as a colorblind society, then this type of society poses a threat for acknowledging and resolving inequality issues that exist among races.

The idea of colorblindness supports the fallacy that the racial achievement gap or school segregation results not from hindered opportunity but personal choice (Forman, 2004). The colorblindness framework stems from the idea that the low academic achievement of "those" students results from learning and motivation deficits. The framework allows critics to express thoughts about urban students without directly identifying their skin color.

Microaggressions. Solorzano, Ceja, and Yosso (2000) state that racial *microaggressions* are "subtle insults directed towards people of color" (p. 60). Here, colorblindness also plays a role in the formation of microaggressions since colorblindness prompts us to not fully learn and appreciate the differences in cultures. Subsequently,

people may reveal unconscious stereotypes about a culture through inadvertent offensive comments.

Constructivist Theory

Constructivism contends that learners actively assemble knowledge using prior subject-matter and personal experience. From a social constructivist standpoint, learning is collaborative, undergirded by social and cultural contexts. Each person can have a different interpretation, and thus a different process of knowledge construction, because past experiences and cultural factors influence the development of people differently. Additionally, learning is more than a mere assimilation of new knowledge content. In some cases, knowledge assimilation requires access and integration into that community of knowledge.

Founding principles of constructivism. John Dewey (1997) was a constructivist and a pragmatist. While I will not situate my own dissertation research in the pragmatist camp, Dewey's founding principles of constructivism are crucial to learning. During a time when repetition and knowledge-based memory consumed educational practices, Dewey insisted that students needed real experience through collaboration and knowledge application. He also suggested that students needed teacher-planned opportunities to think in ways beyond rote memory, which inadvertently encourage higher-order thinking.

Curricula, a tool of constructivism. Jerome Bruner (1960) considered the role that the teacher, instruction, and language play in knowledge construction. He also acknowledged that students learn through social interaction. Bruner explained how the learner organizes the knowledge as it forms through categorizing information. Perhaps

most important to the discussion of epistemological beliefs is Bruner's philosophy about curricula. Bruner believed that curricula should inspire inquisitiveness in students, rather than tailor-making students to fit the curricula. It should foster the cognitive abilities of students. Central to my epistemological beliefs are Bruner's ideas of a spiral curriculum. The spiral curriculum describes a process in which educators re-teach previously taught concepts so that students have the opportunity to master concepts

Cognitive constructivism. Philosopher Jean Piaget also helped to build the principles of cognitive constructivism, which emphasize the use of constructed mental representations to understand the world (Siegel, 2009). Piaget proposed that students learn actively and illustrated this concept by developing successive, cognitive, developmental stages (Piaget, 1985). From Piaget's perspective, children have the innate ability to obtain knowledge by creating and testing their own theories of the world. Perhaps more important to the construction of knowledge is his idea of equilibration. Equilibration is, as Piaget describes it, an attempt to thrive by extracting chunks of internal data from experience and formulating new, agreeable meanings through channels of assimilation and accommodation (Piaget, 1985).

Sociocultural Theory

Thinking about learning from another perspective, Lev Vygotsky argued that the social context of learning precedes one's development (Vygotsky, 1978). Vygotsky (1978) considered the role of language and culture in the construction of knowledge, which he depicted through his sociocultural theory. Vygotsky's sociocultural theory has three essential tenets: (1) Social interaction, which is a key determinant to cognitive development, (2) The Zone of Proximal Development, which describes the amount of

learning a child can conquer on his or her own, with or without, the proper instructional guidance and (3) the More Knowledgeable Other, which explains the benefits to a struggling learner from being paired with a stronger, more knowledgeable person.

Science Education in Urban Settings

Obtaining a good science education relates to social hierarchy and low socioeconomic class directly relates to the constraints of urban science education. Calabrese Barton (2002) posits that we must consider which school-based knowledge has the "greatest exchange-value" in our society (p. 848). Several scholars have suggested that science is an elitist subject and learning science is the key to gaining access to the wealthiest parts of society (Calabrese Barton, 2001b; Millar & Osborne, 1998; Moses & Cobb, 2001; Tate, 2001). Rutherford and Ahlgren (1991) state that science, mathematics, and technology are the most pressing academic knowledge students need in order to compete with students in other countries and/or to sustain themselves in a modern world. Undoubtedly, scientific achievement is an important asset and it has the potential to disrupt the norms of social class in our society.

If one considers a teacher as a key learning resource, one can easily see how an ineffective teacher can hamper urban science education. Researchers suggest that far more non-certified or inexperienced educators teach science in urban settings than in suburban settings (Clotfelter, Ladd & Vigdor, 2005; Jacob, 2007). Peske and Haycock (2006) state in their study that "students in high-poverty and high-minority schools also are shortchanged when it comes to getting teachers with strong backgrounds in the subject that they are teaching" (p. 2). Additionally, this same study shows that 53% of high-poverty schools have teachers who lack at least a college minor in their teaching

field (Peske & Haycock, 2006). However, teacher quality was a major premise of the No Child Left Behind Act of 2001 (NCLB) (No Child Left Behind [NCLB], 2003; Darling-Hammond, 2007). In the NCLB (2001) document, the federal government requires districts to provide parents with information about the quality of their students' teacher. Some scholars doubt that inexperienced and non-certified teachers participate greatly in the grandiose scheme of effective teaching and student achievement (Jacob, 2007; Peske & Haycock, 2006). However, urban students often need highly qualified teachers the most, to help them gain a sufficient science background.

Science Literacy

Science literacy not only describes a person's proficiency in science content knowledge, but also their ability to critically evaluate and assess science concepts. It further describes a person's ability to participate in social and cultural discussions, and issues relating to an economy (NRC, 1996). In the *National Science Education Standards*, the content standards define *science literacy* as follows:

> *Science literacy* means that a person can ask, find, or determine answers to questions derived from curiosity about everyday experiences. It means that a person has the ability to describe, explain, and predict natural phenomena. Science literacy entails being able to read with understanding articles about science in the popular press and to engage in social conversation about the validity of the conclusions. Science literacy implies that a person can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed. A literate citizen should be able to evaluate the quality of scientific information on the basis of its source and the

> methods used to generate it. Science literacy also implies the capacity to pose and evaluate arguments based on evidence and to apply conclusions from such arguments appropriately. Individuals will display their science literacy in different ways, such as appropriately using technical terms, or applying scientific concepts and processes. And individuals often will have differences in literacy in different domains, such as more understanding of life-science concepts and words, and less understanding of physical-science concepts and words. Science literacy has different degrees and forms; it expands and deepens over a lifetime, not just during the years in school. But the attitudes and values established toward science in the early years will shape a person's development of science literacy as an adult. (NRC, 1996, p. 22)

According to the *Benchmarks for Science Literacy* (NRC, 1993), to become science literate, students should engage in scientific explorations to observe phenomena. As students get to high school, the context of this research, students' critical thinking skills should improve. They should not only understand theory building as an essential idea in science, but they should also recognize the importance of supporting theories with evidence. The *New Generation Science Standards* (NGSS, 2013) expand on those necessary science skills by identifying cross-cutting concepts or core ideas that they expect students to learn throughout all disciplines of science.

Beliefs as a Psychological Construct

Theory of Reasoned Action

Ajzen and Fishbein (1980) proposed the Theory of Reasoned Action (TRA) to describe how beliefs and attitudes influence behavioral outcomes. Ajzen and Fishbein

base TRA on the assumption that human beings are rational and organize information when engaging in logic. Thus, proponents of TRA see actions that involve social application as volitional, requiring effort and control.

Ajzen and Fishbein (1980) acknowledge two determinants that contribute to the TRA. The first determinant of a personal nature relates to how a person feels, positively or negatively, about executing the behavior. In short, this determinant depends on someone's "attitude towards the behavior" (Kahneman, 2011, p. 6). This factor becomes essential to forming judgments because human beings cannot analyze the behavior, or the enactment of the judgment, without considering their attitude towards it. Ajzen and Fishbein argue that human beings have to consider if the person is for or against the behavior. The second determinant, as O'Keefe (2002) explains, is the social or group considerations. For example, how would a group respond or how does this group say that I am supposed to respond? Ajzen and Fishbein (1980) call this determinant the *subjective norm*. Kahneman (2011) affirms their idea and further explains that "subjective norms are also a function of beliefs, but beliefs of a different kind, namely the person's beliefs that specific individuals or groups think he should or should not perform the behavior" (p. 7). Ajzen and Fishbein do not specify what percentage of each factor contributes to the overall intended behavior. They only suggest that the attitude toward the behavior and the subjective norms are the main determinants for determining a person's behavior.

The Theory of Planned Behavior

In 1991, Ajzen (1991) proposed The Theory of Planned Behavior (TPB), an extended and more elaborate version of the Theory of Reasoned Action (TRA). TRA and TPB differ in that TPB predicts deliberate behavior, but these theories both describe

interactions that relate to System 2, which Kahneman (2011) asserts is the deliberate more conscious part of our brain. TPB asserts that three factors influence behavior outcomes: (1) attitude toward the behavior, (2) social or group norms, and (3) Perceived Behavior Control (PBC) (O'Keefe, 2002). The Perceived Behavior Control, which Ajzen sees as a component of self-efficacy, is the internal assessment of the difficulty of the performed behavior.

Beliefs Applied to an Urban Setting

In their study, Hill, Phelps, and Friedland (2007) found that teachers had preconceived ideas about teaching in an urban school prior to their teaching assignment. One teacher participant (James) acknowledged the following bias in his interview:

> The urban myth, it's like bad settings, bad schools, and right away I found that with these kids it's not that at all. Maybe it's this particular school but it wasn't anything like from what I hear….People pretty much tell you, "Oh, you don't want to teach in an urban school" (p. 2).

James's acknowledgement of his preconceived ideas is a familiar expression and reflects the literature on teachers' beliefs about urban schools (Bolshakova, Johnson, & Czerniak, 2011; Hill et al., 2007; Leonard, Barnes-Johnson, Dantley, & Kimber, 2011). James describes how those beliefs about urban students can generate certain attitudes towards them. Since he had preconceived ideas about urban students, he realized his attitude, rather than establishing classroom boundaries and fostering a caring teacher-student relationship, resembled that of a "lion tamer" (p. 34). The image of a "lion tamer" further emphasizes that some teachers believe urban students are feral and prone to behavioral problems.

Like Hill et al., Bolshakova et al. (2011) found that teachers who had negative beliefs about their urban science students failed to establish relationships with their students and that this failure directly influenced the teachers' pedagogy. In their study, Mr. Drew seemed to struggle with building relationships with his students. He considered himself the dominant figure in the classroom and he considered the students his subordinates. The researchers state, "In order to be successful in Mr. Drew's class, one must be prepared to follow instructions, and that is basically it" (p. 973). This statement has underlying remnants of the "lion tamer" attitude expressed in the prior study. This attitude gives insight into the beliefs Mr. Drew has about his urban students that affect his attitudes toward them and therefore his pedagogy.

Epistemological and Ontological Beliefs of Science Teachers

Overview of Epistemological and Ontological Beliefs

In order to understand teachers' practices, one must gain insight into teachers' beliefs (Luft & Roehrig, 2007). Scholars have studied teachers' epistemological beliefs, or how teachers believe students acquire knowledge, and their ontological beliefs, or teachers' beliefs about the nature of reality (Bendixen, Dunkle, & Schraw 1994; Hofer & Pintrich, 1997; Lincoln & Guba, 2000; Luft & Roehrig, 2007; Schraw & Olafson, 2008). Teachers' epistemological beliefs have an impact on the strategies they use in the classroom (Schommer, Crouse, & Rhodes, 1992). In fact, Hofer and Pintrich (1997) outline a schema illustrating how teachers' epistemological beliefs directly influence pedagogical practices and classroom tasks, that directly relate to the students' acquisition of knowledge.

Hashweh (1996) found that teachers who aligned themselves with constructivist epistemological and ontological beliefs also exhibited a constructivist model classroom. Other scholars have arrived at similar findings, where science teachers who identified with constructivist epistemological views were more likely to engage in best research practices in science education (Hashweh, 1996; Tsai, 2002; Wallace & Kang, 2004). However, the literature does not specify whether teachers who identified with constructivist epistemological views and relativist ontological views exhibited those same beliefs in practice when confronted with students they perceived as difficult to teach. Thus, to capture those beliefs, scholars suggest gaining a holistic view of science teachers' interconnected epistemological and ontological beliefs (Brownlee, Boulton-Lewis, & Purdie, 2002; Wallace & Kang, 2004).

Measuring epistemological and ontological beliefs. Some scholars have used self-report questionnaires, followed by factor-analyses to measure a person's epistemological and ontological beliefs (Schommer, 1990; Schraw, Benidixen, & Dunkle, 2002). In order to gain a holistic view of teachers' epistemological and ontological beliefs, scholars have used various interviewing techniques (Kitchener & King, 1981) and open-ended, free-response questionnaires (Schraw & Olafson, 2008; Yang, 2005).

Teachers' epistemological and ontological holistic beliefs. In their research, Schraw and Olafson (2008) outline four categories of epistemological and ontological teacher beliefs: Epistemological Realist, Epistemological Relativist, Ontological Realist, and Ontological Relativist. Epistemological Realists believe in the acquisition of an absolute body of knowledge. Teachers who identify mostly as Epistemological Realists often implement instruction that focuses on knowledge and recall. Additionally, realists

place a heavy emphasis on establishing a firm foundation for concepts. Epistemological Relativists are more learner-centered. Rather than rely on direct teaching methods, teachers who identify as Epistemological Relativists engage students in inquiry and prompt them to solve problems. Ontological Realists believe that all students should complete the same, teacher-made assignment. Moreover, teachers who embrace this paradigm most likely will have students work individually, not collaboratively in groups. By contrast, Ontological Relativists believe in project-based, collaborative learning. Teachers in this paradigm often engage students in active discussion. Ontological Relativists create a co-partnership and shared ownership with their students. Students not only participate in class discussions, but they are also co-contributors in developing assignments.

Conclusion

The purpose of this research is to investigate how urban science teachers' epistemological and ontological beliefs influence how teachers demonstrate "care" for urban students' science literacy. In this chapter, I have outlined the theoretical framework of the research, discussed views of science education, and described the current state of and gap in the literature as a basis for conducting the study.

Chapter 3: Research Design and Procedures

This study investigates the influence of urban science teachers' epistemological and ontological beliefs on "caring" for their urban students' science literacy. The research methodology used for this project was Grounded Theory Methodology. This chapter describes the theoretical framework of Grounded Theory Methodology and specifies how I identified, recruited, and selected participants for this study. Additionally, I have outlined how I collected my data in three phases while simultaneously analyzing the data using the constant comparison analysis (Strauss & Corbin, 1998).

Grounded Theory Methodology

The purpose of Grounded Theory Methodology is to formulate and derive a theory based on the collected data (Charmaz, 2006; Charmaz & Henwood, 2007; Schwandt, 2007). While the purpose is clear and unified, the epistemological beliefs are disjointed. Initially, Glaser and Strauss (1967) developed the Grounded Theory Methodology as a qualitative approach with the intent to show it as a sufficient methodology for quantitative research. In fact, Glaser argued that data gathered through Grounded Theory Methodology have the same significance as data gathered by statistical methods in quantitative research.

Grounded Theory Epistemological Origins

Bryant and Charmaz (2007) argue that the *a priori* epistemological belief of classical Grounded Theory Methodology came under the epistemological stance of positivism, a form of quantitative research. Positivists contend that knowledge forms through the verification of logical, mathematical, and sensory experience (Godfrey-Smith, 2009). Glaser's research experience originated from a quantitative background, a

philosophical positivist view, in contrast to Strauss, who came from a philosophical pragmatist's background. Thus, scholars suggest that Straussian grounded theory has a pragmatic epistemological framework (Bryant, 2009). While there are many renditions of pragmatism, generally pragmatists focus on the consequences or outcomes of research rather than on the originating conditions (Creswell, 2007).

Its founders based Grounded Theory Methodology on the concepts of empiricism, a process of anchoring theory to measurable events (Corbin & Strauss, 1990). In later writings about classical grounded theory methodology, Glaser refutes the idea that the original epistemological stance was positivistic. He contends that discussions about epistemological beliefs in the realm of Grounded Theory Methodology are null and inapplicable because he encourages all epistemological beliefs (Glaser, 2007). Because of this perspective, various scholars, who were reluctant to believe that researchers could conduct any type of research without acknowledging and aligning themselves with an epistemological stance, criticized Glaser (Breckenridge, Jones, Elliot, & Nicol, 2012; Bryant, 2009).

Grounded Theory Methodology started to make a change in paradigmatic beliefs shortly after the publication of three canonical texts: Berger and Luckmann's (1991) *The Social Construction of Reality,* Garfinkel's (1967) *Studies in Ethnomethodology,* and Kuhn's (1962) *The Structure of Scientific Revolutions*. Berger and Luckmann and Garfinkel debated positivist epistemology by suggesting the newer and slowly accepted constructivist epistemology as a contending epistemology for the acquisition of knowledge. Kuhn contributed to the constructivist epistemology by arguing that scientific paradigms are a way of *doing* science and, in the more constricted sense, a paradigm is a

specific, notable achievement, which shifts the thinking of a science community. Constructivism added to the epistemological debate about Grounded Theory Methodology the notion that "data don't speak for themselves" and that scholars should not undermine the sociological aspect of data (Bryant & Charmaz, 2007, p. 38). Consequently, the entrance of constructivist thinking started to influence scholars and brought about a shift to a new paradigm called Constructivist Grounded Theory Methodology.

In Constructivist Grounded Theory Methodology, *a posteriori* epistemological beliefs fuse post-modern, positivist, and relativist views (Bryant & Charmaz, 2007). The relativist, or interpretivist, stance in Constructivist Grounded Theory Methodology is essential since relativists do not believe in an absolute truth. To relativists, truth depends on one's point of view. How one situates one's point of reference is important since this perspective sets up the relationship between the researcher and the participant. The researcher acknowledges the participants' perspectives and is an essential tenet for constructivist grounded theory (Breckenridge et al., 2012). Thus, Constructivist Grounded Theory Methodology provides a platform for participant voices.

The unique component of Constructivist Grounded Theory Methodology is that data collection and data analysis occur simultaneously. Essential data collection and data analysis methods for grounded theory include the following: memo writing, interviews, observations, theoretical sampling, theoretical sensitivity and constant comparative analysis using inductive and abductive logic (Bryant & Charmaz, 2007). Theoretical sampling entails obtaining more participants until the theory saturates fully (Strauss & Corbin, 2008).

Methods

The Constructive Grounded Theory Methodology aligns with my own epistemological beliefs as a social constructivist. Constructivist Grounded Theory includes a relativistic stance, which also aligns with my epistemological beliefs for two reasons. First, using a relativistic stance allows me as a researcher to appreciate and respect all notions of truth. Secondly, essential methods of grounded theory involve theoretical sampling, where the researcher continues to use participants in the research until the emerging theory saturates.

Setting and Participants

Creswell (2007) recommends recruiting 20 to 30 participants for a grounded theory study. Other scholars suggest ranges from 15 to 30 participants for a grounded theory study (Guest, Bunce, & Johnson 2006; Morse, 1994). In any sample range, scholars advise focusing on quality, in-depth interviews rather than on the quantity of interviews (Guest, Bunce, & Johnson, 2006). Therefore, this research includes two populations and two types of perspectives for this study: ninth grade biology students and ninth grade biology teachers. I only used biology teachers and their students since biology is a mandatory assessment in the state of Texas. I included six teacher participants and 18 student participants (three students from each teacher) in this study until the emerged grounded theory exhibited saturation.

Teachers. The inclusion criteria for the teacher participants were as follows: (a) secondary science teachers who were currently teaching biology as a state assessed science discipline, (b) biology teachers who were employed within an acknowledged urban school and urban district in the Southwestern region of the United States, and(c)

teachers with at least three science students who assented to participate in the study. I excluded teachers with less than three years of teaching experience from participating in the research. No other factors excluded teachers from participating in the research.

Students. The inclusion criteria for the student participants were as follow: (a) students who were taught by one of the six science teachers, (b) students who had minimal attendance issues in their state assessed science class, and (c) students who had minimal behavioral issues, which could influence their beliefs about the degree to which a teacher cares about their science literacy. No other factors excluded students from participating in the research.

Setting. The Texas school district that participated in this study has the following student demographics: 74.2% of students classified as economically disadvantaged, 71.5% considered at-risk, 62.7% of students are Hispanic, and 22.9 % are African-Americans as compared to 10.9% of white students, 0.2% of American Indian students, and 1.9% of Asian students (Texas Academic Performance Report, 2015).

Of the students in this Texas school district who passed the State of Texas Assessment of Academic Readiness (STAAR) exam in 2015, 59% are African-Americans, 70% are Hispanic, and 93% are White. The achievement gap of Black students was 24% as compared to White students. The achievement gap of Hispanic students as compared to White students was 7%. Consequently, I recruited teachers and students from three high schools that best represented the collective data of the Texas district.

Recruitment

I recruited participants in two stages: First, I recruited teachers who met my criteria and, second, I recruited students from these teachers' classes. While the Texas school district used in the research is an acknowledged Urban School District, not all high schools within the district exhibited the criterion of "urban." Therefore, I engaged in purposive sampling by recruiting teachers at schools that either closely represented or went beyond the district's represented demographics (Tongco & Dolores, 2007). I began the recruitment process by soliciting, via email, principals of urban high school campuses. Once principals consented and identified biology teachers who might be interested in participating in the study, I emailed biology teachers to invite them to participate in the research and asked their permission to recruit their students (Appendix A).

I recruited students only after their teacher agreed to participate in the study. Recruiting students in conjunction with their teacher was essential since I wanted to obtain the students' perspective on how their teachers exhibited care for their science literacy. Therefore, I needed the teachers and their specific, current group of students to take part in the study. I invited students to participate by making a brief announcement at the end of their biology class period, with the principals' and teachers' permission, and I sent out parent letters with assent forms (Appendix A). I included in the study as many students who assented to participate; however, I set a minimum requirement of three student participants per one teacher. By using a minimum of three students, I allowed the third student to serve as a tie-breaker in case students offered alternate views of their

teacher. The total participants used for the study included two biology teachers and six students from three different high school (Table 3.1).

Table 1

Urban Science Teachers and Students Participating in the Study

High School A	High School B	High School C
2 Biology teachers	2 Biology teachers	2 Biology teachers
6 students in 9th grade biology (3 students per teacher)	6 students in 9th grade biology (3 students per teacher)	6 students in 9th grade biology (3 students per teacher)
Totals *N*= 24 participants (6 teachers and 18 students)		

Data Collection

An Institution Review Board approved (DRB 1505-149) the data collection methods. Field notes, classroom observations, and student and teacher interviews provided the data, which I collected in three phases. In the first phase, I conducted seven classroom observations on each teacher participant with a standard classroom observations protocol (Appendix B). Table 2 describes how I scheduled classroom observations. I conducted only two periods of classroom observations per day and I visited all classroom periods of teachers' biology schedule throughout the seven weeks of phase one. Conducting observations in phase one, I reasoned, would allow me to gain insight into how teachers *actually* demonstrated their epistemological and ontological beliefs as these beliefs related to caring for their urban science students' science literacy (Research Sub-Question 3). Also, conducting classroom observations in phase one eliminated the risk of priming. Kahneman (2011) describes priming as an activation of associations in memory just before carrying out an action or a task. I did not want

teachers to describe their epistemological and ontological beliefs and then activate their pre-noted thoughts in the classroom while I was conducting observations. Instead, I wanted teachers to teach their classes without having insight into the study's interview and survey questions. The third reason for visiting all of the teachers' class periods was my desire to experience the total dynamics and gain a holistic view of how the teachers demonstrated their epistemological and ontological beliefs.

Table 2

Schedule of Classroom Observations

Week	Monday	Tuesday	Wednesday	Thursday	Friday
1	Teacher A Teacher B	Teacher C Teacher D	Teacher E Teacher F	None	None
2	None	Teacher A Teacher B	Teacher C Teacher D	Teacher E Teacher F	None
3	None	None	Teacher A Teacher B	Teacher C Teacher D	Teacher E Teacher F
4	Teacher E Teacher F	None	None	Teacher A Teacher B	Teacher C Teacher D
5	Teacher C Teacher D	Teacher E Teacher F	None	None	Teacher A Teacher B
6	Teacher A Teacher B	Teacher C Teacher D	Teacher E Teacher F	None	None
7	None	Teacher A Teacher B	Teacher C Teacher D	Teacher E Teacher F	None

In the second phase of data collection, I conducted two 15-20-minute interviews with each teacher participant (Appendix C). I conducted the first interview the week after the last classroom observation and the second interview two weeks after the first interview. I intended the delay between interviews to prevent teachers from fully

recalling their answers to the questions from the first interview. I asked all participants identical questions in the same sequence. I initiated probing questions inductively as a follow-up to participant responses. I audio taped all interviews using two digital audio recorders and then I transcribed them in sequence using Inqscribe digital media transcription software. Additionally, I transcribed and conducted in-vivo coding on the first interview before conducting the second interview with teacher participants. The rationale for transcribing the interviews in sequence was to ensure the authenticity of an essential grounded theory method-- the constant comparative analysis.

In the second phase of data collection, I also conducted two identical 15-minute interviews with each student participant (Appendix D). I conducted the student interviews after both teacher interviews. Table 3 describes the schedule I used to conduct and transcribe all participant interviews throughout the 12 weeks of the study.

Table 3

12-Week Description of Study

Week	Description of Study
1-7	Conduct classroom observations throughout the entire week
8	Conduct teachers' interview #1, students' interview #1, and transcription of interview #1 (both teachers and students).
9	Finish transcribing teachers' Interview # 1 and in-vivo code Interview #2
10	Conduct teachers' interview #2 and transcription of interview #2
11	Finish transcribing teachers' interview # 2 and in-vivo code teachers' interview #2
12	Conduct the final week of study- Students' interview #2, transcribe students' interview #2, in-vivo code students' interview #2.

Coding and Analyzing the Data

In Grounded Theory Methodology, the researcher simultaneously conducts analyses with data collection (Strauss & Corbin, 1998). The two cycles of coding ensure the occurrence of the constant comparative method: (1) in vivo, initial (open), and process coding and (2) focused, axial, and theoretical (selective) coding (Saldana, 2013). Figure 3 gives the coding schema used for this grounded theory research.

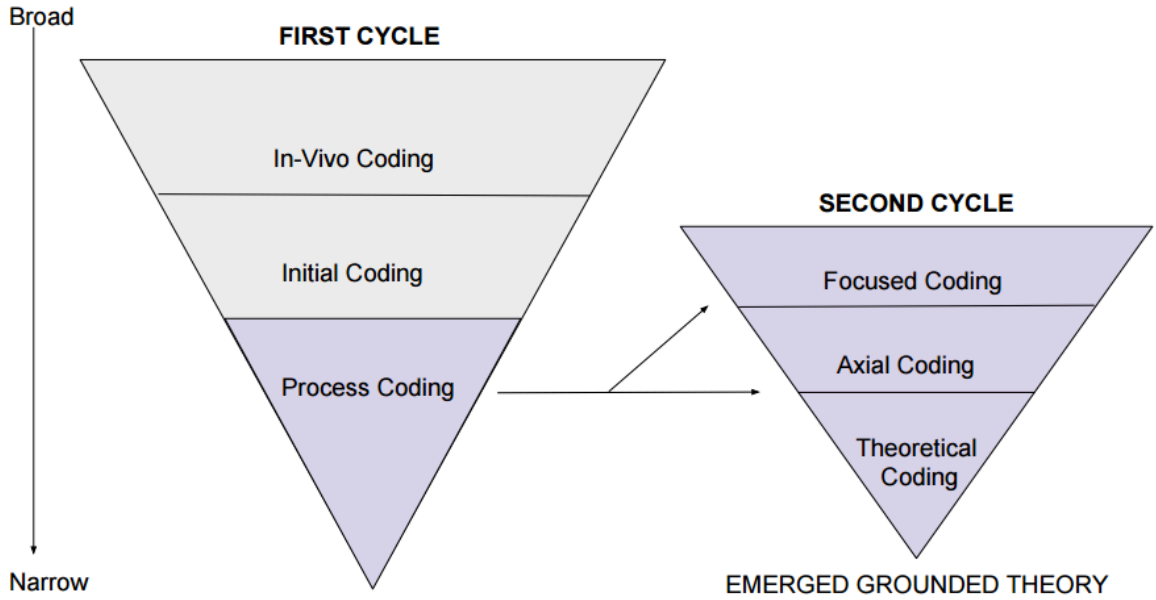

Figure 3. The coding schema used in grounded theory methodology. Process coding results directly contributed to the second cycle of coding.

The triangles exhibit a dual representation: (1) the physical amounts of the collected data and (2) the various ways in which I analyzed the data. The figure illustrates how I dissected the data from a broad directional range, starting with the top tier of the triangle, moving in a more narrow direction, and ending with the bottom tier of the triangle. The aim in the second cycle was to conduct theoretical coding until a grounded theory emerged from the data.

Before conducting the first and second cycle coding, I grouped all six teachers' interview responses with their corresponding interview questions. Likewise, I grouped students' data with their corresponding teachers' data before conducting the first and second cycle of coding with student data. I combined teachers' responses to each question, conducted in-vivo coding, and analyzed the preliminary data to compare and contrast teachers' interview responses (Appendix E). I combined students' responses to each question, conducted in-vivo coding, and analyzed the preliminary data to compare and contrast students' interview responses (Appendix F).

First cycle of coding. In the first cycle of coding, I combined all teachers' responses according to the interview question. For example, in the first interview, I asked teachers: "How do you maximize students' learning in the classroom?" I took the responses from all six teachers for this question and assigned an in vivo code for each response. Through in vivo coding, the researcher takes coded language directly from the data. For example, a teacher may have replied, "I maximize learning by making sure that students discover the concept more than one time." In this case, the in vivo code for this particular teacher's response could be "Students Discover." Established codes formed from the researcher's perspective and experience (Saldana, 2013). Once I coded each response with an in vivo code, I could broadly compare how teachers responded to each interview question.

After assigning in vivo codes, I then conducted initial (open) coding, which simultaneously can include forms of in vivo and process coding. I began initial coding by again grouping the responses from all six teachers according to each interview question. With the initial coding, I began to assign in vivo codes for each line of the teachers'

responses. To illustrate initial coding, I will use the same example response aforementioned:

1	I maximize learning by	LINE 1: MAXIMIZE LEARNING
2	making sure that students	LINE 2: MAKING SURE
3	discover the concept	LINE 3: DISCOVER CONCEPT
4	more than one time.	LINE 4: MANY TIMES

Initial coding is particularly important because it provides a microscopic view of the data (Saldana, 2013; Strauss & Corbin, 1998). Analyzing the data line by line required me to pay specific attention to the different directions of the emerging theory.

After I conducted initial coding, I began process coding. Again I grouped the responses from all six teachers according to each interview question. I coded the data line by line, the same as during initial coding, but this time I used gerunds in the codes to signify action (Charmaz, 2002; Saldana, 2013). To illustrate process coding, I use the following example:

1	I maximize learning by	LINE 1: MAXIMIZING LEARNING
2	making sure that students	LINE 2: ASSURING STUDENTS
3	discover the concept	LINE 3: DISCOVERING CONCEPT
4	more than one time.	LINE 4: REPEATING

Process coding was an essential pre-requisite for moving into the second cycle of coding because it gave insight into the participants' actions, which Strauss and Corbin (1998) argue can be "strategic, routine, random, novel, automatic, and/or thoughtful" (p. 247). I conducted in vivo, initial (open), and process coding in the same manner with students' responses to their interview questions.

Second cycle coding. The aim of the second cycle was to take the codes from the first cycle and place them into categories by grouping them into similar themes. The coding process continues until one category becomes the foundation of the emerging grounded theory. The second cycle of coding started as I conducted focused coding. Focused coding has two goals: (1) to turn codes into significant categories and (2) to make the researcher decide on which codes from initial coding "make the most analytical sense" with the goals of the study (Charmaz, 2006, p. 57). Using the initial and process codes from the first cycle, I searched for analogous codes and assigned a descriptive, category name to encompass each group of similar codes. For example, I use the following transcript excerpt to demonstrate a sample category:

Category: STUDENTS DISCOVERING CONCEPT MAXIMIZES LEARNING

1	I maximize learning by	LINE 1: MAXIMIZING LEARNING
2	making sure that students	LINE 2: ASSURING STUDENTS
3	discover the concept	LINE 3: DISCOVERING CONCEPT
4	more than one time.	LINE 4: REPEATING

After developing and assigning the categories to the first cycle codes, I developed a preliminary, hierarchical chart to distinguish categories from subcategories. The hierarchical chart was significant for three reasons (Rubin & Rubin, 2012): (1) it ranked the importance of the many categories by using analytic memos, (2) it narrowed the focus of the research from such a broad spectrum of data as explained in figure 3.1, and (3) it set up the work to conduct axial coding.

Once I placed the codes in focused categories, I conducted axial coding, which scholars suggest forms the bridge between initial and focused coding (Charmaz, 2006;

Saldana, 2013). The aim of axial coding is to reconstruct data disfigured from initial coding (Saldana, 2013; Strauss & Corbin, 1998). Axial coding relates "categories to subcategories" by defining the requirements of a subcategory the researcher places into a category (Charmaz, 2006, p. 60). The categories were specific to the goals of the research and the epistemological and ontological views of the researcher.

The last phase of the second cycle of coding was theoretical (selective) coding. Theoretical coding sets the stage, the "core category," for the emerging grounded theory by becoming the "umbrella" that encompasses all of the findings (codes and categories) of the research (Saldana, 2013, p. 163). Saldana (2013) calls theoretical coding the "spine of that [the] skeleton that holds, which supports the corpus, aligns it, and connects to everything else" (p. 163-164). The theoretical code creates an interpretive, analytic story that in essence transitions to the grounded theory (Charmaz, 2006; Saldana, 2013).

Classroom observations. Before conducting classroom observations, I met with each teacher participant to discuss the classroom observation protocol (Appendix B). The protocol established what teachers could expect as I conducted the observations. Typically, I would get to the class during the passing period before the observed class. To collect data, I never used technology resources such as an iPad or laptop. Instead, I used a writing pen and leather-bound journal to make a physical statement that I was a classroom *observer* not an administrator or teacher *evaluator*. A side effect of displaying this outward appearance was the rapport I built with teachers and their students as demonstrated through the quality and candidness of their interviews.

Analytic memos. Perhaps, one of the most influential methods of data collection for this project was my memo (journal) book. I used the book to record everything from

observations to my own sentiments when I left classroom observations or student and teacher interviews.

In addition to the essential grounded theory coding methods, I employed theoretical sensitivity, theoretical saturation, and theoretical sampling until a theory emerged from the data. Theoretical sensitivity involves the researcher's "grounding" him or herself in the research. That is, I immersed myself in reading canonical texts on theory, research, and supporting evidence in order to gain insight into the data. Theoretical sensitivity also involves using insights from my own experience and from other grounded theory methodologists in the field in order to discern data and interpret meaning (Saldana, 2013). Theoretical sensitivity and theoretical saturation are part of processes that involve sampling participants from the data until the point of exhaustion (Guest, Bunce, & Johnson, 2006). All methods previously mentioned were important in maintaining the authenticity of grounded theory methodology.

Chapter 4: Unveiling "Care"

The presented findings are in three sections. The first describes the teachers as revealed by observations of their teaching. The second section provides a description of the 18 students who interact daily with the six teachers. The last section outlines the seven categories that emerged from the data. In order to further explain each category, I have described themes and sub-themes within each category.

Section I: Description of Participants

Teachers

I describe the six teachers, who participated in the research, by science teaching experience, ethnicity, and their pseudonyms that appear in the rest of the findings chapter (Table 4). I then describe each teacher in more detail.

Table 4

Demographic Information of Teacher Participants (n=6)

School	Pseudonym	Years of Experience	Ethnicity
High School A	Mr. Rodriguez	9	Hispanic
High School A	Mrs. Johnson	5	Black
High School B	Mrs. Thomas	3	Black
High School B	Mrs. Colbert	10	Caucasian
High School C	Mr. Harris	4	Caucasian
High School C	Mrs. Gonzalez	4	Hispanic

Mr. Rodriguez. *"Some of them were just too difficult for me to reach."*

Mr. Rodriguez consistently employed direct teaching methods in his classes. Although he grouped the lab tables in seats of four, students rarely had opportunities within his lesson to collaborate, process, and discuss concepts. I describe the lessons as teacher-centered. When Mr. Rodriguez talked, the students mostly complied. I used the term

comply to describe how most students remained silent, which may give the impression that they were engaging in the learning, but I saw little evidence of students' understanding or checks of understanding from the teacher. Students also did not conduct many biology laboratory investigations or activities to practice or reinforce concepts. Activities mainly took the form of completing worksheets or watching video clips related to the concept.

Mr. Rodriguez was the dominant force and the main attraction in the classroom. Students' questions, when they asked questions, came in two forms: (1) clarification and (2) tangential thinking. The students' clarifying questions mostly asked Mr. Rodriguez for more directions or to repeat the directions about the assignment and what they were supposed to do. Mr. Rodriguez would respond to clarifying questions by restating the directions or in a polite "yes" or "no" fashion. On the other hand, when students engaged in tangential thinking, students would listen to Mr. Rodriguez's lecture and pick up catch-phrases or topics that they could relate to life. Instead of those phrases or topics being an opportunity to foster a deeper understanding of the lesson's objective, the conversations between Mr. Rodriguez and his students' actually derailed the main idea of the lesson. An example of tangential thinking from one of the classroom observations occurred when Mr. Rodriguez asked students to compare the structures and functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids. Some of the students associated proteins with red meat and this association fostered a lengthy discussion about whether or not red meat causes cancer. Although the association of protein with red meat helped students link the concept to real life, it also derailed the focus of the objective, thereby causing students to unsuccessfully learn the objective.

Mrs. Johnson. *"You have to make the expectation that you are students first and school matters. If we could change that culture, it will make a difference because it will spread into the classroom."* Upon arrival to Mrs. Johnson's class, I immediately noticed the attractive physical components of the learning environment. There were grand bulletin boards of biology posters, motivational quotes, a missed assignments folder, classroom goals, and a bin area for students' notebooks. Mrs. Johnson had good PowerPoint, notes-style lessons, but very few activities, manipulatives, or biology laboratory investigations accompanied the lessons. She seemed to complete lessons and students seemed to complete independent work consistently well before the end of the class period. When she assigned students an activity, the activity consisted of coloring worksheets or using construction paper to make foldables. Foldables are a form of graphic organizer, three-dimensional, and are a method to help students organize concepts and information. I describe Mrs. Johnson's lessons as teacher-centered. Students mostly worked independently. Mrs. Johnson was the dominant force in the classroom and students complied with her traditional, I (the teacher) do most of the talking and you (the students) do most of the listening, approach. Mrs. Johnson positioned her lab tables in a traditional pattern facing the front of the classrooms. She often missed opportunities for students to process and discuss their learning with their table partners in lessons.

Mrs. Thomas. *"You can't help everyone; they have to help themselves."* Mrs. Thomas's classroom was in an area of the school inaccessible by the main hallways. The classroom was in a secluded area, towards the back of the school, and adjacent to an eerie ramp and exit door. The area was so hidden that I wondered if the exit door was an open invitation for students to skip class and leave campus. After 15 minutes of looking for

Mrs. Thomas's room, I walked into the classroom and sat in an empty seat, relieved that I had finally made it. Mrs. Thomas sat at her desk and the students at their desks. I looked her direction and offered a flustered smile as if to say, "I made it!" Mrs. Thomas did not return a smile, but instead sat at her desk with a grim look on her face that translated, "Today is not the best day." Students sat quietly at their desks. Some of them were completing a worksheet assignment; Others had their head down and/or were listening to their headphones. In my field notes, I wrote,

"*Today doesn't seem to be a good day to observe Mrs. Thomas's class. Maybe I should leave and come back on a different day? I feel bad for being here, because teachers have bad days just like everyone else in the world.*"

I thought that this type of class and thus the classroom environment would be a one-time instance since everyone has "bad days." Unfortunately 80% of my classroom observations felt uncomfortable, awkward, and bothersome in the same way. During my next classroom observation with Mrs. Thomas, I walked in the classroom and again sat towards the back, in an empty seat next to one of the students. The aura of the room seemed cold and uninviting as Mrs. Thomas taught her lesson from her desk and students took notes from their seats. Mrs. Thomas seemed to have a negative disposition and she demonstrated this disposition in her teaching and interactions with her students. During one particular observation, Mrs. Thomas's administrator walked into her classroom to conduct a mini classroom observation. Even with an administrator in her room, she did not get up from her desk to peruse the room, monitor students, or answer their questions as students worked.

I noticed that Mrs. Thomas did not re-direct students if they were off task, such as on their cell phones, or not engaged in the lesson. As long as students did not cause trouble, she would not bother them. Her attitude seemed to translate as: If students want help, then I will help them; if students do not want help, then I will not bother them.

Mrs. Thomas also rarely connected the learning to prior concepts in her lessons, but she did give students projects and presentations as assignments. Most instructional strategies involved note taking, which consisted of students writing information from PowerPoint slides. When students asked Mrs. Thomas questions during the note taking, if they had questions, her response lacked a detailed explanation and failed to connect essential ideas to previously learned concepts. Students did few activities and had few opportunities for science laboratory investigations. In my field notes, I wrote,
" I am sitting next to a student and observing Mrs. Thomas's class takes notes. After about six minutes of watching the students write down the notes in silence, I whispered to a student, "So, what are we doing in class today?" The student replied, "We are just writing down notes from the slides." This feels awkward. I would love to see the students interact, process, and discuss more."

Mrs. Colbert. *"You never know what your students may become."* Before actually observing Mrs. Colbert's class, I had a few meetings during her lunch time to discuss the specifics of the research and to go through the classroom protocol. Each meeting, I noticed that students flocked to her class during lunch for tutoring, to work on homework independently, to hang-out with their friends, or to help cut out activities laminated for Mrs. Colbert's lessons. Students appeared to perceive Mrs. Colbert's room as a safe place.

During each classroom observation, Mrs. Colbert started the lesson by stating the objective and the essential question that she wanted students to answer at the end of the lesson. Throughout the lesson, or at times when she felt students were derailing from the main idea, Mrs. Colbert would remind students of their objective and what she wanted them to know. Each time she reminded students of the objective, she would change the wording and synthesize what they knew so far about the concept.

Mrs. Colbert used many instructional strategies to accompany her lessons. She structured the lessons to give her students a clear beginning, middle, and end. For example, in one of her lessons, the students completed a warm-up with a team activity in the beginning of the lesson, completed a research activity in the middle of the lesson, and had to present their research at the end of the lesson. The beginning of the lesson started with an inquiry, or an essential question. Her approach to students' learning seemed to be student discovery. By allowing the students to discover the concept, she prompted them to take ownership and become the primary stakeholder in their own learning. Typically the middle of the lesson included some sort of biology lab or activity. At the beginning of the unit, when students were just exploring a concept, Mrs. Colbert would incorporate a biology laboratory experiment into the lesson. When students had already discovered the concept but needed more reinforcement or a deeper understanding, Mrs. Colbert would integrate into her lesson an activity that gave them more practice.

Another observation that I continually noted in Mrs. Colbert's classroom was the physical activity of the students and their student-to-student accountability, which illuminated the student-centered nature of Mrs. Colbert's classroom. Mrs. Colbert's students seldom sat stagnant in their seats for the entire class period.

Mrs. Colbert's students were *contributors* in the lesson, as if their teacher had engrained in them their role as stakeholders in the classroom. Consistently, the students processed and discussed the learning and they did so with each other before involving Mrs. Colbert. When the students asked Mrs. Colbert questions, she would push them to use more academic language versus everyday language, thereby building their science discourse.

Mr. Harris. *"They view you as a peer when you are most certainly not a peer."* Typically, Mr. Harris would begin class by telling students the agenda for the day. The lesson's schema would consist of such components as notes, a worksheet, and a practice activity. Although Mr. Harris's students did not complete many biology lab experiments, they sometimes completed mini laboratory experiments.

When students conducted mini labs, Mr. Harris would bring materials to each lab table of students in groups of four or five. He would then walk around to each group, explaining what he wanted them to do. Students would have about seven minutes at each station, but this timeframe would change considerably since Mr. Harris would have to re-explain the directions to each group of students as they moved to different stations. By having students rely on specific directions for each station lab, Mr. Harris was failing to provide his student with an opportunity to collaborate with each other, to process information, and have quality discussions on the concept that they were learning.

I would describe Mr. Harris's teaching, partially illustrated by his station labs, as teacher-centered. Mr. Harris did not consistently incorporate formative assessment into his lessons. When he asked students questions, he focused primarily on the knowledge-level rather than application-level ideas that prompt critical thinking. His main

instructional strategy involved entertaining students through his lessons. Presenting instructional content in a lively manner is an important aspect of science, but too much entertainment can stir up tangential thinking in students, which could ultimately derail the main focus of the objective.

Mrs. Gonzalez. *"They have to know that you care for their well-being outside of the classroom…. Just the trust and knowing that they can come to me about anything."* Mrs. Gonzalez had a good rapport with her students. During my first classroom observation, I noticed that students verbally expressed their appreciation to Mrs. Gonzalez and their rationale for participating in her class. Mrs. Gonzalez had a special gift for motivating reluctant students. She readily recognized students who exhibited difficulty in learning concepts or in their performance. To help students who had difficulties, she consistently modified lessons and positively reinforced student-learning success. For example, in my analytical notes I stated, "Mrs. Gonzalez is a cheerleader in the classroom. In this lesson, she has said to her students…. *You can do it and it's okay to just try*."

I would describe Mrs. Gonzalez's teaching as student-centered. Each lesson's objective consistently aligned with the lesson's activities and laboratory experiments. Moreover, the activities provided relevant, meaningful learning experiences for students. Mrs. Gonzalez clearly understood the value of allowing students to construct knowledge through experiences. Students consistently conducted laboratory experiments and station labs. Furthermore, Mrs. Gonzalez was the only teacher I observed whose students either applied laboratory concepts or conducted a portion of the laboratory experiments for the purposes of assessment.

Students consistently demonstrated their connection of the learning to real life; however, Mrs. Gonzalez would always bring them back to the focus of the lesson when students instituted tangential thinking. Mrs. Gonzales made it a point to activate students' prior knowledge and verbalized to students often that they were "adding on to what you already know." For example, when Mrs. Gonzalez's students had already completed the biomolecules section of the curriculum, where students had to compare the structures and functions of different types of biomolecules (i.e., carbohydrates, lipids, proteins, and nucleic acids), she reminded them of this prior knowledge as the students began to discover the structural components of Deoxyribonucleic Acid (DNA).

Section II: Beginning Conversations with the Students

In an era when society does not always value students' opinions, I wanted to gain the students' perspectives on how their science teachers illustrate "care" for students' science literacy. In one of my first meetings with the students who participated in this study, I met Niko, a student of Mr. Rodriguez. The excerpt of our first conversation follows:

Niko: Miss, what are you doing here [at his school, in his class]? Are you like a teacher or something?

Researcher: Well, yes and no. I used to teach science, but now I am a graduate student at TCU.

Niko: Oh, cool. Well then what are you doing here?

Researcher: Well, I am doing research about science teachers and students in urban environments. I know that sometimes you guys [urban science students] get blamed a lot for not doing well on state exams, but I don't think it's entirely your fault. So, I'm studying how science teachers care for students, increasing your science knowledge, which can prepare you for your state exam.

Niko: [*Raises his hand to high-five me.*] Miss, I like you! You understand us!

The conversation between Niko and me was my first realization that this research was important and, moreover, that it was time to unmute students, whose perspectives society had often overlooked. The conversational moment with Niko also connected the importance of this research to the activists' responsibility, as defined by Critical Race Theory. To unmute the voices of students like Niko through this research will mean restoring their important perspectives to society.

In the next section, I recount conversations from Juan (Mr.Rodriguez), Lina (Mrs. Colbert), Carmen (Mrs. Johnson), Mary (Mrs. Thomas), Carlos (Mr. Harris), and Madison (Mrs. Gonzalez). I asked the students, "How does your teacher show you that he or she cares about you learning science?" The selection of students provides one student per teacher to offer their perspectives of how their science teachers demonstrate "care" toward the students' science literacy.

Juan: Because he's always like, he's there whenever we don't understand. He never says, "No, I can't help you right now or something." He makes the time to help you.

Lina: Probably by the way that she teaches us, she's patient, she wants us to get interested in biology.

Researcher: So, she's patient and the way that she teaches you. When you say the way that she teaches you, what do you mean?

Lina: Um, in a really good way. She explains to us really good, and every time she explains she knows how to make us look at it like it's not a hard point, but it's an easy point.

Carmen: Kinda'

Researcher: Tell me what makes you say "kind of?" What makes you say "She kind of cares about my learning in science?"

Carmen: She says we get what we get [the grade] and she's not changing it.

Researcher: Okay, so if you could change anything about your teacher so that she shows students that she cares, what would it be?

Carmen: To try more instead of sitting at her desk clicking slides with her remote. Also, I would want her to explain stuff more instead of going to another topic the next day.

Mary: Um. [*Long pause*]

Researcher: Do, you think your teacher cares whether or not you learn science?

Mary: Um, I don't think so.

Researcher: Why do you say that?

Mary: Because I feel like we only take notes in class. Most of the time she would just put the notes on the board and that's it. When we finish writing down the notes, she would just click to the next slide. Not a lot of explaining or anything, unless a couple of brave people said we don't understand. Some of my friends in other biology classes say that they do labs and stuff. Not us.

Researcher: What would you want her to do differently to show you that she cares whether or not you learn science?

Mary: Um, I think she should at least try to pass around [walk around] the class and ask us how we are doing and if we need help. Like if we don't understand something, I think that she should help us understand it. She really just sits at her desk most of the time.

Carlos: He teaches us the main stuff we really need to know in life. We don't just talk about science, we talk about everything.

Madison: Um if we are having a hard time learning something, she will come over to our desk and re-explain and help us. I like that because it shows me that she really wants to help me learn.

The first conversation with students was my first realization that I was creating a "safe place" for them to speak *their* truth of how teachers show care. By "safe place" I mean, a place where someone could listen to students and their stories without passing judgment

on their vernacular or assessing their intelligence. In this "safe place" students spoke freely. And I simply listened.

Students

Eighteen students participated in the study. I have provided their demographic information, their pseudonyms, ethnicity, age, and their corresponding biology teacher in Table 5.

Table 5

Demographic Information of the Student Participants (n= 18)

Participant Name	Ethnicity	Age	Biology Teacher
Maria	Hispanic	15	Mr. Rodriguez
Niko	Hispanic	15	Mr. Rodriguez
Juan	Hispanic	14	Mr. Rodriguez
Carmen	Hispanic	15	Mrs. Johnson
Ashley	Black	15	Mrs. Johnson
Dante	Black	14	Mrs. Johnson
Stacy	Black	15	Mrs. Thomas
Craig	African American	15	Mrs. Thomas
Mary	Hispanic	14	Mrs. Thomas
Marc	Hispanic	15	Mrs. Colbert
Lina	Hispanic	15	Mrs. Colbert
Serena	Black	14	Mrs. Colbert
Gabriela	Hispanic	15	Mr. Harris
Carlos	Hispanic	15	Mr. Harris
Julian	Hispanic	15	Mr. Harris

Madison	Black	16	Mrs. Gonzalez
Casey	Hispanic	15	Mrs. Gonzalez
Lisa	Hispanic	14	Mrs. Gonzalez

Maria. *"I want to go to college and make my family proud."* Maria was a first-generation American. Before Maria was born, her parents migrated from Mexico in search of better lives for their family. Maria seemed to be a model biology student. She completed her work on time, asked questions when she needed more information, and seemed very interested in learning biology concepts.

Niko. *"I'm trying to do better this year, Miss."* Throughout his middle school years, Niko frequently got into trouble. Thus far in high school, Niko seemed to be making a conscious effort to do better in school. Although science was not Niko's favorite subject, he achieved a satisfactorily performance in biology.

Juan. *"I kind of want to go to college, but I really also want to own my own company. I want to be a boss… don't want no one to be the boss of me."* Juan was a first-generation American. His parents migrated from Guadalajara, Jalisco (Mexico). Juan will be the first member of his family to obtain his high school diploma. He expressed aspirations for going to college, but he wants to work first to help out his family financially.

Carmen. *"This high school is not like my friends' high school across town. Theirs is better."* Carmen seemed to be a quiet student, but in smaller groups she was outspoken. She lived in the apartments down the road from her high school and expressed a desire to attend another high school across town, attended by some of her other friends.

Because Carmen's mom felt that her current high school was more accessible to where they lived, Carmen's mom did not enroll her in the "good" high school across town.

Ashley. *"I'm not going to lie, Miss. Kids do get on my nerves when they can't do simple stuff that she asked them to do."* Ashley was a member of her high school's cheerleading team. Ashley has an outspoken personality. She was compliant with her biology teacher (Mrs. Johnson) and often expressed frustration with non-compliant classmates. She performs satisfactorily in her biology class.

Dante. *"I could probably do better, if I tried harder."* Dante was a member of his high school's football team. It appeared that being a member of the football team motivated Dante to do well in school. His parents were very supportive of Dante's schooling and football career. In his biology class, Dante achieved a satisfactorily performance of anything asked of him.

Stacy. *"In class, I'm telling you, she barely even teaches."* Stacy had attended all the feeder schools that led directly to her high school. She expressed that her previous elementary and middle schools were satisfactory; however, her high school needed to make some changes in both teachers and students. Stacy expressed the possibility of attending college and shared that she would be a first-generation college student. Science was not her favorite subject and, according to Stacy, she didn't understand how anyone could become a teacher if he or she did not like kids.

Craig. *"Education is the highest accomplishment."* Craig was a first-generation American. His parents migrated from Nigeria and lived in the neighborhood closest to his high school. Craig's aspiration to attend college was not only a requirement of his family, but also a definite endeavor, as viewed by Craig, immediately following high school.

Craig was a hard-worker and often completed his work early. Though satisfied with completing his work early, he also frequently expressed interest in wanting to learn more science. He was quiet in class and very compliant. He never questioned his teacher, but he seemed to want to prove to his teacher that he was a good student.

Mary. *"I am just a regular student."* Mary did not participate in extra-curricular activities at school and expressed no desire to be a part of any clubs or sports activities. She performed satisfactorily in science classes; she also acknowledged that she should put forth more effort in science.

Marc. *"My biggest goal is to be on varsity for soccer next year. If I couldn't play soccer, I'm not sure what I would do."* Marc was a member of his high school's soccer team. From Marc's perspective, being on this soccer team was a badge of honor, and he was willing to go through all necessary lengths to stay eligible to play soccer. Marc was a second-generation American. Science was not his favorite subject, but he enjoyed learning science because of his teacher.

Lina. *"I really love my science teacher."* Lina was a first-generation American. Her parents migrated from Mexico in search for better lives for their family. Lina and her family had only been in the Texas for less than four years at the time of the study and although she sometimes struggled with her English, she made great strides in learning science.

Serena. *"Every day I try to do my best."* Serena was a very shy student in class. Her family lived in the housing complex closest to her school. Serena has five siblings, two older and three younger, but different family members were helping to raise Serena because of her mother's drug abuse habit.

Gabriela. *"I always do my work. It's pretty easy work."* Gabriela lived in the community of her school with both of her parents. Her mother was very involved in her schooling. She checked Gabriela's grades online and met with her teacher often. Gabriela expressed that sometimes teachers gave her work that was really easy and thus she would finish work early during class. She also said that her mother believed her school needed to increase its level of expectations for students.

Carlos. *"My teacher is pretty cool, Miss. We have a lot of fun."* Carlos enjoyed being in his science class because he thought his teacher was fun. He had many friends in his class who also lived in his neighborhood. His family migrated from Mexico when Carlos was a baby. His transition to the United States had been easier for him, since he was bilingual in Spanish and English as a child.

Julian. *"I've moved around a lot. I hope to stay at this school the longest."* Julian lived in the community closest to his high school with his mother. Throughout his schooling, Julian moved from place to place and thus had been to six different schools from first to ninth grades. In fact, this was Julian's second high school since starting the ninth grade. As a result, Julian often found it difficult to have friends, but his mom promised him that he would make friends since she planned to stay put in the community.

Madison. *"I feel like I'm a normal teenager."* Madison lived in the apartments closest to her high school. Her mother was a single parent and Madison often had to help take care of her siblings after school. Madison seemed to do satisfactory in her biology class, but often appeared to be pre-occupied during class. She focused on her teacher, but sometimes when her teacher would give the class directions, Madison would have to ask other classmates.

Casey. *"They thought I was bad, I just couldn't concentrate."* Since grade school, Casey struggled with academics. He was not a strong reader and this caused him to work at a slower pace than some of his science classmates. He also struggled with Attention Deficit Hyperactivity Disorder (ADHD), and this condition caused him to lose focus during classes. According to Casey, most of his former teachers would put him outside of the classroom during lessons when he was unable to focus or when he bothered other students.

Lisa. *"I don't think that some kids care, some blow it off, but she will get on to them."* Lisa was enrolled in a regular biology course, but she often demonstrated that she needed to take a pre-advanced placement or honor's biology course. According to her teacher, and confirmed by my observations of her in class, Lisa often illustrated strong critical thinking skills; however, her former schools never recruited her as a gifted and talented student. Lisa expressed interest in going to an honors or advanced placement course if given the opportunity.

Section III: Grounded Theory on Care

The tested critical race theory (CRT) model guided the formation and analysis of the categories and themes in the study (Figure 4). The major themes of the CRT model are as follows: (1) interest convergence, (2) microaggressions, and perhaps the largest theme of the model is (3) colorblindness. Out of all of the themes from the CRT model, the analysis pointed to overwhelming evidence relating to colorblindness. A known result of colorblindness is that the majority group assigns subordinate positions in an effort to maintain the status quo (Peery, 2011). Throughout the descriptions of the categories and themes from the study, I discuss how the theme specifically relates to Critical Race

Theory. Figure 4 provides the reader with a visual model to relate CRT to the emerged categories and themes.

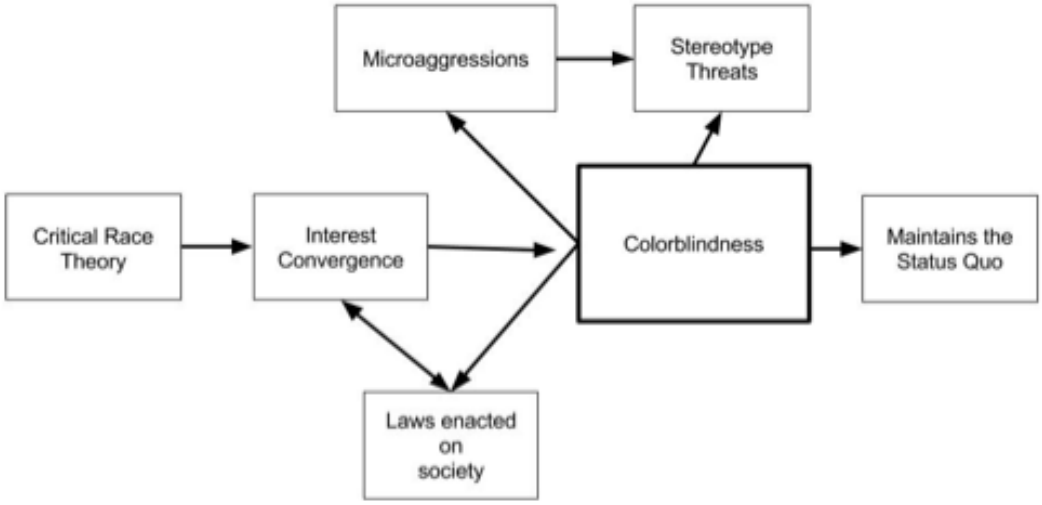

Figure 4. The tested model of critical race theory.

The emerged grounded theory illustrated a veiled response to "caring." I have presented a schematic drawing of the developed categories that directly pertain to critical race theory (Figure 5). As explained in the next section, I did not detect evidence of CRT in all categories. As a preview into the full analysis of the study, I found that science teachers illustrated two main approaches to "caring" and I describe them as "Praise" and "Whip" in Figure 5. Teachers who identified with the first caring approach frequently exhibited a moral epistemology, a facilitator's role in the classroom, and focused on the individual needs of their students. Teachers who identified with the second caring approach frequently exhibited a traditional role in the classroom, a baby-sitter's complex, by treating their students as child-like, and tended to focus less on satisfying students' needs and more on satisfying their own needs as a prerequisite for effective teaching.

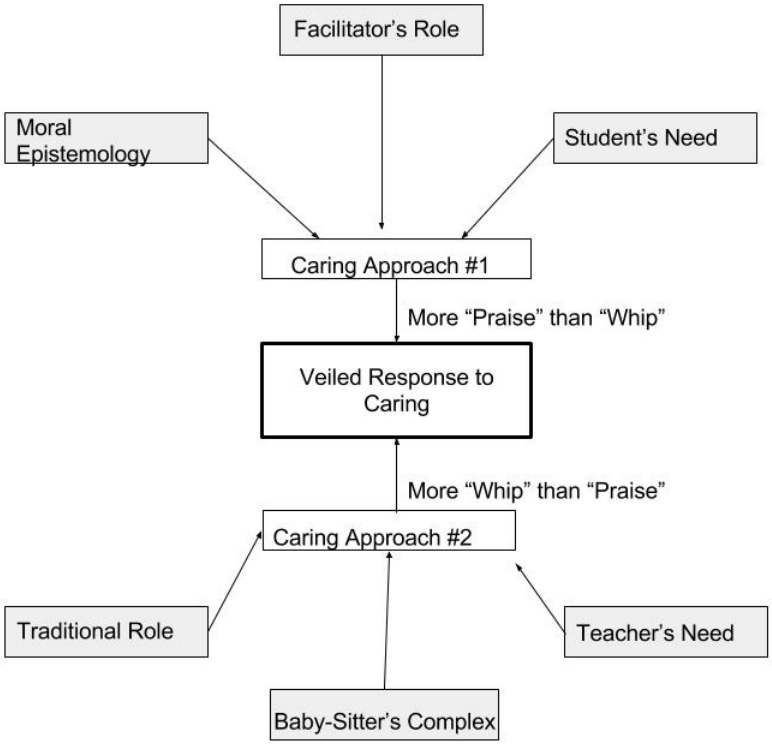

Figure 5. Schematic drawing of the emerged grounded theory of "caring"

Emergence of Categories and Themes

Based on the preliminary data, one can conclude that teachers and students responded to their interview questions in a similar manner. In answering question one of the teachers' interview, two of six teachers stated that structure was an important "caring" quality in maximizing students' learning in the classroom. Also in responding to question one, three of six teachers responded that relevance was an important "caring" quality in maximizing students' learning.

In the students' interviews, 10 of 18 students responded that their teachers demonstrate "care" for their science literacy by thoroughly, repeatedly explaining biology concepts. In the second question of the students' interview, 11 of 18 students responded

that their teachers reveal they "care" whether their students understand a topic in science by questioning them or by inviting them to ask questions.

The similarities of students' and teachers' responses continued throughout the preliminary data, but through the initial, line-by-line coding, teachers' epistemological and ontological beliefs about their urban science students began to emerge from the data. Seven categories and 16 themes emerged from the data. Table 4.3 illustrates the number of participants who responded to the corresponding theme (Responses), and the number of times I coded the theme throughout the collected data (Coded References). The categories and themes emerged from both teachers and students. Interestingly, as I have depicted throughout the explanations of the categories and themes, students often responded adversely to their teachers' responses; however, those adverse responses still fit within the topic of the emerged categories and themes. Appendix G expands concepts from Table 6 by including the emerged categories, themes, and sub-themes from the collected data.

Table 6

Emerged Categories and Themes from Data

Categories	Themes	Responses (N=24)	Coded References
Structure of maximizing students' learning	Focused learning goal of the lesson	16	46
	Topic is relevant to students' science literacy	16	44
Social and constructivist epistemology	Teacher uses inquiry as a key method for students' acquisition of knowledge	17	71
	Learning is in the form of lab experiments, hands-on activities,	19	79

	or manipulatives		
	Students discover the concept and their teachers give them multiple opportunities and ways to discover the concept	7	31
Moral epistemology	Teacher has the responsibility to society to assure students' proficiency in science literacy	3	13
	Teacher has the responsibility to parents to assure students' proficiency in science literacy	3	9
The role of the teacher	Teacher has the role of the facilitator in the classroom	11	39
	Teacher has the role of the dominant force in the classroom	6	16
Tug of war between the students' needs versus the teachers' needs	Teacher acknowledges and executes strategies for students' lack of foundation in science	9	28
	Teacher prioritizes their needs first as a pre-requisite for students to learn science	23	86
Baby-sitters' complex	The teacher acknowledges the students' responsibility for their competency in or incompetency in science literacy	12	33
	Infantilization of urban science students: The teacher views urban science students as child-like, childish, and/or juvenile in nature	11	37
	Students feel inferior to the teacher because of the teacher's level of education attainment	8	20
The principal illustrations of "care"	The main characteristic of teachers' caring approach is more "praise than whip"	13	36

The main characteristic of teachers' caring approach is more "whip than praise"	12	42

Structure of maximizing students' learning

Teachers discussed their epistemological beliefs as incorporating a certain structure in students' daily learning. One benefit of having a structure was to maximize students' learning. Teachers claimed that they provided this structure by, first, developing and, second, utilizing a focused learning goal of the lesson and then utilizing a topic important to students.

Focused learning goal of the lesson. An important epistemological belief among teacher participants included in this study involved maximizing, or the adverse, *not* maximizing students' learning. Teachers showed "care" for urban students' science literacy by developing a structure or plan to maximize their learning. One of the components of this structure was the need for a focused learning goal throughout a lesson.

Researcher: How do you maximize students' learning in the classroom?

Mrs. Colbert: Working bell to bell with a *structure* in mind. You really have to think of the sequence in which students should learn concepts and then you have to use that sequence to provide *structure* for what students need to learn.

Researcher: What would this structured learning look like in the classroom?

Mrs. Colbert: At the beginning of the class, you have to have a learning goal, but it's key that you focus on that learning goal throughout the entire lesson so that students won't get sidetracked.

In her interview, Mrs. Colbert discusses the importance of structure in maximizing students' learning and how structure coincides with the learning goal of the lesson.

Learning targets within the learning goal. During my classroom observations with Mrs. Colbert, I frequently noted that Mrs. Colbert used learning goals throughout her lessons. Likewise, I found that Mrs. Gonzalez frequently used learning goals as a reminder to students of what they needed to learn. However, both teachers also included learning targets within their learning goal. For example, in Mrs. Gonzalez's class the learning goal and biology standard stated, "Students will compare the reactants and products of photosynthesis and cellular respiration in terms of energy and matter." Along with this goal, Mrs. Gonzalez would write learning targets underneath the main goal, such as "Students will be able to identify products. Students will be able to identify reactants. Students will be able to explain key differences of photosynthesis and cellular respiration." I asked Mrs. Gonzalez to explain her reasoning behind learning targets.

Researcher:	How do you maximize students' learning in the classroom?
Mrs. Gonzalez:	Instructional time is invaluable, so I look at the learning goal or standard that students have to learn and I use our time together wisely, because I know that I have to really plan out my teaching for the time that I have them in class. There is no guarantee that my students will come to tutoring or even come to tutoring when they need it .
Researcher:	I noticed that you have a main learning goal, but underneath you have little short learning goals. Can you explain to me how this fits with you beliefs about how students learn?
Mrs. Gonzalez:	Well, when you look at the learning goal that I have on the board today about photosynthesis, it is a goal that may take us 5 or 7 days to explore. So, I use learning targets, what

you see underneath, as a manageable mini-goal that students can learn during that day.

When I asked Mrs. Colbert's and Mrs. Gonzalez's students about the use of learning goals, students agreed with their teachers' explanations of why learning goals were important to students' learning.

Serena (Mrs. Colbert): The learning goal helps me to keep on track about what she wants us to know. In some of my other classes, sometimes my teachers talk the whole period, and it is so much, I never really know what I am supposed to be learning.

Serena states that the learning goal is supposed to hone in on the learning. Casey amplifies this perspective by expressing that their teacher makes students use a chart for to track specific learning goals.

Casey (Mrs. Gonzalez): It's like this, Miss. That sentence that she has on the board, the one that's bigger than the other sentences, is what Mrs. Gonzalez wants us to know. The little sentences underneath the big one, is what we are supposed to know when we walk out of class today. We also have to keep up with our learning goals on this chart.

For both Mrs. Gonzalez and Mrs. Colbert, the learning goal was measurable, attainable, and communicated throughout the entire lesson so that students would not lose sight of the big idea. All six teachers mentioned using a learning goal as an essential component for demonstrating "care" to urban students' science literacy. However, I found that only two of six teachers participating in this study actually used learning goals with their urban students. In the transcript excerpt below, Mrs. Thomas states that her students reflect on learning goals, but this statement contradicted my notes from her classroom observations.

Researcher: How do you maximize students' learning in the classroom?

Mrs. Thomas: Um. So for the most part, I like to have a structure or a flow in how I want the class to go. So, um, there is a set amount of things that you are going to do on your own, a time for them to have some direct teaching and a time for them to reflect on the learning goal or what they just learned. For the most part, we are learning the entire time.

In my classroom observations of Mrs. Thomas, I found that she did not have a structure or flow in her lessons. She did not have an embedded time that prompted students to reflect on their learning or the learning goal for the day. When I asked students about how Mrs. Thomas maximizes learning in the classroom, one student said:

Mary (Mrs. Thomas): We really don't have like learning goals for our lessons. For the most part, we just write down a bunch of information on PowerPoint slides. If we don't write it down, then we get into trouble. So, I guess you could come up with your own goal if you wanted to from writing down stuff on the slide, but we never have one for the class.

Although I found that Mrs. Thomas did not incorporate learning goals in her daily biology lessons, she still acknowledges structure and learning goals as components of her epistemological beliefs. She also mentions that students are "learning the entire time," and five of six teachers included in this study expressed that their students were "learning the entire time."

Instructional time is untouchable time. The teachers indicated that they demonstrate "care" by helping urban students learn, which I carefully noted as an action or a verb, for the full duration of the class period. They discussed the full instructional period as an *untouchable* time. Thus, from their perspective, *untouchable* time means that the teachers maximized students learning by making sure that students actively learned throughout the entire class period. In the excerpt below, Mrs. Colbert discusses "learning bell to bell."

Mrs. Colbert: I guess training them to get them to start on time, um being prepared, um working bell to bell, um learning bell to bell with a structure in mind, that we are going to do this first and then I think this will maximize being able to teach bell to bell.

Mrs. Colbert's student Serena agreed with Mrs. Colbert's description of students learning from "bell to bell."

Serena (Mrs. Colbert): I feel like we do a lot of stuff in Mrs. Colbert's class, so it's kind of like even though we are working the entire time in class, it doesn't feel like it because we are not working on the same thing…the entire class. With some of my teachers, we will have a worksheet to do for the entire period. In Mrs. Colbert's class we don't do that.

In another excerpt, Mrs. Johnson also mentioned that she wants her students to learn the entire class period.

Mrs. Johnson: I strive for my students to be actively engaged in learning throughout the entire class period.

Researcher: Why is learning throughout the entire class period important to their science literacy?

Mrs. Johnson: Because it also reinforces the learning.

So, Mrs. Johnson believes that when she actively engages students in learning the entire period, she also reinforces newly learned concepts; however, her students stated the opposite as regards to being actively engaged the entire class period.

Ashley (Mrs. Johnson): Okay, Miss, if by engaged in the lesson you mean we do a lot of stuff in class, we don't. We don't do a lot of activities or labs or nothin', just a lot of worksheets that if I really tried, I could get it done fast.

Ashley describes being engaged in the lesson as the quantity and the quality of activities that occur during class. In her opinion, she knows that activities and labs are an intricate

part of learning science; however, she has not experienced that type of learning in her science class.

Topic is relevant to students' science literacy. The teachers said they demonstrate "care" to urban students' science literacy by attempting to make the topic relevant to students. They indicated that to be relevant, learning must be applicable to real life. Thus, meaningful learning, accompanied by real-life application, is another way of maximizing students' learning. However, I also found that the teachers I interviewed had different definitions of what it meant to make learning relevant, meaningful, and applicable to real-life.

Real-life application. Mr. Rodriguez indicated that real-life application means that he incorporates a "hook" at the beginning of his lesson to grab his students' attention and get them interested in the contents of the lesson.

Mr. Rodriguez:	Um. I think in science you probably want to hook on to something that they recognize in their own world to pull them in. So you have to try and find that. For a lot of kids that spend a lot of time watching science programs or reading science-fiction books it's easier to wheel them in versus the more challenging ones you have to find something that is a commonality between me and you.

In my observations, I found that Mr. Rodriguez seldom embedded "hooks" within his lessons. His students agreed with my observation findings, but they specifically mentioned the importance of making the learning relevant and applicable to real-life.

Maria (Mr. Rodriguez):	Sometimes, biology can be really boring. It helps me when I can think of biology outside of the words in the book.
Researcher:	What do you mean by the "words in the book"?

Maria:	Well, like if my teacher can tell me how biology relates to my life. If he does that, then I can probably understand it better.
Researcher:	Does your teacher ever do things at the beginning of the lesson that gets you guys interested in the lesson?
Maria:	Sometimes he shows us a video, but not all the time.

Maria specifically acknowledges that it helps her to think of biology outside of the words in the book, but what she is really saying is the importance of connecting the learning of science to real-life experiences.

Mr. Harris also holds epistemological beliefs that students acquire knowledge through meaningful, relevant, and real-life application. In the excerpt below, Mr. Harris states that maximizing student learning in his class means incorporating enjoyment and entertainment in his instruction, so that the lesson is relevant to students' lives. Here, we see an addendum in the definitions of *meaningful*, *relevant*, and *applicable* to real-life by entertaining students in the classroom. Specifically, Mr. Harris mentions making the learning more personal for the students.

Researcher:	How do you maximize students' learning in the classroom?
Mr. Harris:	Maximize....Student learning....in the classroom? [*Pauses as to really think about a "right" answer that I may have been looking for.*]
Mr. Harris:	Enjoyment, interest, a slight bit of entertainment and a little bit of relevance for the kids. They just had to do a watershed project where they had to map their house's watershed. This makes it a little bit more personal for themselves.

During Mr. Harris's observations, I noted that he frequently incorporated entertainment in his lessons. Because of his usage of entertainment as a "teaching" method, students perceived his class to be fun, but fun classes do not mean that students are learning.

Researcher:	Do you feel like you are learning a lot of biology concepts?
Gabriela (Mr. Harris):	Yes! I feel like we have a lot of fun in class.
Researcher:	What's one of the things that you've learned in class today?
Gabriela:	[*Pause*] Um, I don't know, Miss, I have to look at my paper first.

Perhaps Gabriela felt pressured to tell me what she had learned in class that day, but from other observations, I realized that Mr. Harris mostly equates entertaining students during the lesson as making the learning relevant, meaningful, and applicable to real-life.

Science literacy associated with developing students' academic language. The teachers I interviewed expressed the need for students to distinguish everyday vocabulary from academic, science vocabulary. Mrs. Thomas states that when her students use academic language in the classroom, the correct usage of that academic language is an indication that learning is occurring.

Researcher:	How do you know that learning is occurring in the classroom?
Mrs. Thomas:	I think a lot of it is when you see them engaged. They are asking questions, they are talking to each other, you hear the academic language, you hear the vocabulary, and they are able to accomplish the task set forth using this academic language.

Mrs. Thomas's students had an interesting point about the need to acquire academic language in order to learn science.

Stacy (Mrs. Thomas):	I kind of feel like learning science is like learning another language.
Researcher:	Wow! What do you mean by that?
Stacy:	Because there are a lot of things that you have to know before you can even try to answer a question. Like, you have to know what the words in the question really mean.
Researcher:	How does Mrs. Thomas help you learn what the stuff in the question really means?
Stacy:	Really Miss, she really doesn't. When it comes to vocabulary, we really just copy the definitions out of the book. I'm going to be honest with you too. When I copy words out of the book, it's easy, but I still couldn't tell you the definition unless I read it off my paper. Like, we really need to do more if I am going to really learn those words.

Stacy's perspective on science being a foreign language is profound. Additionally, she brings to light a type of learning that frequently occurs in urban students' classrooms, which is copying definitions from the textbook.

Mr. Harris states that students' use of academic language indicates, they are growing in the classroom and that he can measure that growth through assessments.

Researcher:	How do you know that learning is occurring in the classroom?
Mr. Harris:	When learning is occurring in the classroom, you can see the kids growing through word usage and through the behavior of the kids. The [*pause*] assessments. They are able to do assessments and do well on them.

Mrs. Colbert denotes that she demonstrates "care" to her urban science students by acknowledging and attending to students' development of academic vocabulary.

Mrs. Colbert:	My students are using a different language other than science when they come into my classroom

> and this is something that is very important to their science literacy. Maybe they're using a different language like everyday language, and then I say to them well this is how science would say it. Because they've figured it out in their own language, and they've explained it in their own language, now you give them input and they can make a connection between the two and I think that's how I show students I truly care about their science literacy. You have to be able to meet them where they are and help them grow from there.

In my observations, Mrs. Colbert frequently incorporated academic vocabulary acquisition strategies in her lessons. Students completed Frayer Models, a graphic organizer that requires students to define a vocabulary word, draw a picture, and define the vocabulary word using their own words. Besides using many instructional strategies to strengthen students' science vocabulary, she prompted students to practice their vocabulary in the classroom.

Lina (Mrs. Colbert):	We are always working on vocabulary in Mrs. Colbert's class. One of my favorite things to do is a match up game that we do with our table partners. We try to figure out the picture, the word, and definition in the game. If we do it right, then we get extra points on exams or candy or something.
Researcher:	Do you feel like doing stuff like this helps you to learn the science vocabulary?
Lina:	Yes. When you know the words, it makes test questions easier.

Lina conveys the same revelation as Stacy about the importance of learning academic vocabulary. Both students suggest that test questions are harder when they don't understand the words in the test questions. Here is where I first started to recognize the beginnings of colorblindness from the critical race theory model. Teachers who focused on strengthening students' academic vocabulary did not view their students

through a colorblind lens, because they recognized the language needs of their students of color and addressed those needs. Moreover, teachers stated that when they attempt to make science concepts relevant to students' science literacy, students' academic vocabulary would begin to flourish as they started to make connections.

In conclusion, the teachers emphasized learning goals in the classroom as an essential component of their epistemological beliefs. These teachers showed "care" to urban students' science literacy by developing a structure or plan, in the form of learning goals and learning targets to maximize students' learning. One of the components of this structure was the need for a focused learning goal throughout a lesson. The teachers I interviewed claimed they demonstrate "care" to urban students by ensuring that students learn for the full duration of the class period, known as an *untouchable* time. Meaningful learning, accompanied by real-life application, was another dimension of maximizing students' learning, but I also found that the teachers had different approaches to making learning relevant and applicable to real-life.

Social and constructivist epistemology

Three themes and seven sub-themes emerged from the social and constructivist epistemology category. The teachers identified components of their epistemology with the social and constructivist epistemology. They claimed their students engage in active learning and a collaboration with either their peers or with the teacher. They also suggested that students shape meaning into knowledge through inquiry and other hands-on activities.

Teacher uses inquiry as a key method for students' acquisition of knowledge. Two epistemological beliefs that reigned supreme among the teachers participating in this study were the acquisition of knowledge within a social context and the acquisition of knowledge within a constructivist context. I designated the sixth question of the first interview for teachers as the most important question. Question six asks teachers to describe their beliefs as to how students learn science best. My aim was to see if the teachers' beliefs on how their urban science students learn science best aligned with how these teachers illustrate "care" in the classroom. Two teachers stated that students learned science best through the method of inquiry (Appendix E).

Best science learning practices. All teachers said they use research-based, best science practices to express care for urban science students' science literacy. For example, teachers described a best science practice as embedding a learning objective and science standards into the lesson. Interestingly, I found that teachers wanted students to have knowledge of a standard, so that they could intersect standards instead of approaching them as separate entities. Mrs. Johnson argues that having students connect ideas to prior knowledge is a best practice, and one of her students, Dante, agrees with her.

Mrs. Johnson:	For the most part, I try to connect the TEKS (Texas Essential Knowledge and Skills).
Researcher:	What do you mean?
Mrs. Johnson:	For my kids, you really have to go with the approach of adding on to what they already know. If they think, "Here she is teaching me one more thing that I need to learn," they are not going to get it.
Dante (Mrs. Johnson):	When we learn about stuff in science, it does feel like we are adding on more information. Sometimes

	I am like, how long are we going to keep talking about DNA?! I guess DNA is really important.

One teacher also pointed to the need to teach for understanding, rather than for knowledge.

Mrs. Gonzalez:	Students really have to understand the material instead just surfacing the basic knowledge about a concept.
Researcher:	Why is that important?
Mrs. Gonzalez:	Well, first the test questions that they are going to encounter will be "understanding" type questions. So, if I teach at just the knowledge level, my students won't even have a chance.

Mrs. Gonzalez's response about students needing to learn beyond the knowledge level goes hand in hand with what students Lina (Mrs. Colbert) and Stacy (Mrs. Thomas) mentioned earlier about encountering biology test questions. To go along with this theme, I recount one of my classroom observations in which all teachers were teaching the same science standard on explaining cellular processes. The example describes how students explained cellular processes in ways that indicated their progression from the knowledge to understanding level (Table 7).

Table 7

Components of Knowing Versus Understanding Cellular Processes

Knowledge of facts

Level 1 "I know that Active Transport and Passive Transport is a type of cellular process." –Juan (Mr. Rodriguez)
Level 2 "Active transport means to move from low to high concentration. Passive transport means to move from high to low concentration."-Julian (Mr. Harris)
Level 3 " In active transport, you move against the concentration gradient from low to high. In passive transport, particles move with concentration gradient from high to low"-Lisa (Mrs. Gonzalez)
Level 4 "Active transport requires energy because it moves the particles against the concentration gradient from low to high. And passive transport doesn't require energy at all. It moves molecules with the concentration gradient from high to low. If you think about it, active transport is like climbing a mountain. As you climb the mountain, it's going take more energy." –Lina (Mrs. Colbert)

Understanding the concept

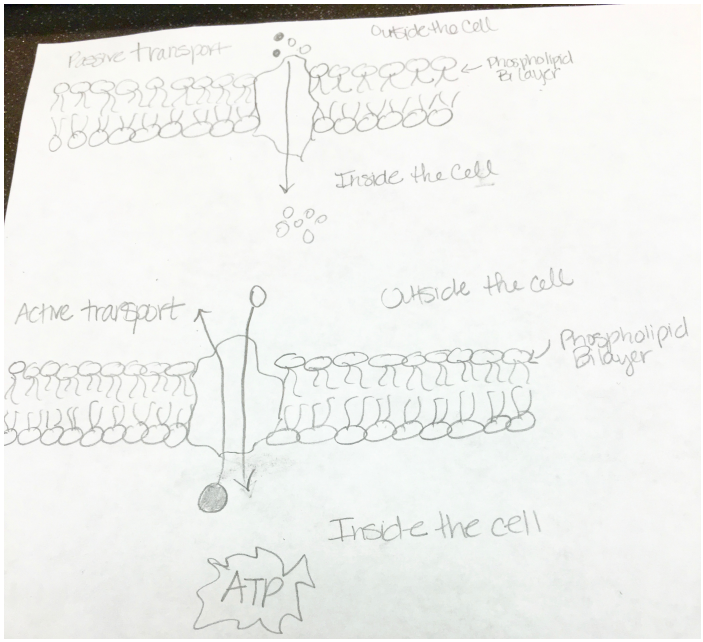

Figure 6. Lina draws a picture to accompany her explanation of Active and Passive Transport.

Learner-Centered. All of the teachers agreed that inquiry, or instances where students could discover biology concepts, were best practices. All of them stated that students learn science best when they present science concepts in a hands-on learning environment.

Researcher: How do your students learn science best?

Mrs. Colbert: Well, there are probably a few answers to this question. First, my students learn best in an environment where they can discuss things. I am convinced that I should never be the person that is always talking! Students should be able to learn from each other. Also, students learn best probably through inquiry. And you know, I give the objective. And I try to give the objective every day without too much detail. And maybe a question, something that they are trying to discover or figure it out… it's an inquiry type question for them to discover and as they come across the answer. In essence, I guess I "care" about using inquiry methods because it [the learning] has a chance in sticking with the students versus me just telling it to them.

Mrs. Colbert presents two ideas synonymous with those of other teachers who participated in this study. First, she mentions that her students should be in a social atmosphere conducive to learning. Specifically, she states that she does not want to be the person who is "always talking." Mrs. Colbert finds value in the acquisition of knowledge through her students' thoughts and how they exchange their thoughts with each other. The second idea that Mrs. Colbert presents is that inquiry is a valuable teaching method, which allows her students to discover the concept rather than merely "telling" them about the concept. She discussed giving her students a question to figure out as they go through the lesson. I found that Mrs. Colbert's statement aligned with my analytic memos from her classroom observations. She frequently implemented lessons during which her students could discuss with and learn from other students. All of the teachers interviewed

discussed "caring" for students' science literacy through setting up social situations where students could learn from each other. The teachers, including Mrs. Gonzalez, conveyed social epistemological beliefs relating to the collaborative nature of learning.

Mrs. Gonzalez:	I think students learn science best when they are able to do labs and they are inquiry-based.
Researcher:	How do you normally set up your labs that are inquiry-based?
Mrs. Gonzalez:	I tend to give them a problem to solve. It's important because they know that they have to use each other to solve the problem. In fact, I don't even let them ask me questions for help until they've exhausted all possibilities with their teammates. Once they've tried to figure it out with each other and they still need help, I try to coach them through the process of problem solving rather than just giving them the answer.

Mrs. Gonzalez finds value in her students' collaborating and finds value in her students' developing problem-solving skills. Like Mrs. Colbert, Mrs. Gonzalez creates lessons requiring students to try to solve an inquiry type of problem. She specifically states that she doesn't want to give students the answers to problems, but instead her focus is to coach students through discovering the concept or solving the problem. From my classroom observations of Mrs. Gonzalez, I frequently noted in my analytic memos in Mrs. Gonzalez's use of inquiry in her lessons. Specifically in a lesson about the structure and function of DNA, students had a 3D DNA puzzle to put together with their lab groups. Through puzzle solving, students were able to view their puzzle and form theories about DNA's structure. Having students postulate about the structure of DNA and discuss their findings with the class eliminated the need for traditional, direct teaching methods regarding the structure of DNA (i.e., Adenine pairs with Thymine, and Guanine pairs with Cytosine). Instead, students could collaboratively derive those same

theories, through puzzle, or problem-solving. Mrs. Gonzalez often had a question of the day that students were trying to answer.

Inquiry and Socratic questioning. One of my interview questions for students was to ask them, "How does your teacher know when you understand or don't understand a topic?" All students responded that when their teacher questions them, they know whether or not students understand a topic (Appendix F).

Serena (Mrs. Colbert):	Well, she will ask questions and if we answer them right, she will know that we understood it and we got the point. And the wrong answer means that she needs to explain again and she needs to be more specific.
Mary (Mrs. Thomas):	Um, we have to ask questions.
Researcher:	Okay, so do you ask questions?
Mary:	No.
Researcher:	Why not?
Mary:	I really don't like to ask her questions.
Researcher:	So, how does she know if you understand?
Mary:	She asks us do we have any questions?
Researcher:	Do you ever have questions that you want to ask?
Mary:	Yes, but then I just Google them.

Although Mary makes a point of acknowledging that she doesn't like to ask her teacher questions, both she and Serena believe that questioning is an essential strategy in understanding a topic. Likewise, the teachers argued that using questioning techniques was an element of their epistemological beliefs.

Mr. Harris:	You absolutely have to ask students questions. If I don't ask them questions, then I won't know whether they've actually learned anything.

Throughout my classroom observations, I noticed the different types of questioning and sometimes the sarcastic tones teachers used in posing questions to students. Teachers who pushed for students to gain an understanding of a concept, rather than knowledge of the concept, often engaged in inquiry and a Socratic type of questioning. Interestingly, the teachers who posed inquiry type questioning demonstrated relativist ontological beliefs. Since teachers did not have a fixed belief in a "right" way of thinking in the classroom, teachers often prompted students to explore key ideas independent of a "right" answer. Below is an excerpt between Mrs. Colbert and Marc. Mrs. Colbert's students were discovering the phenomenon of genetic drift. During the lesson, students were rolling dice and determining how many *driftworms* survived based on the number the die landed on.

Marc (Mrs. Colbert):	Well, I kind of feel like genetic drift is based on chance.
Mrs. Colbert:	What do you mean chance? What is your definition?
Marc:	Like, something that kind of happens by accident. Like if you run into someone that you weren't thinking that you would run in to.
Mrs. Colbert:	Well, how did you come to that conclusion? What evidence do you have to back that idea up?
Marc:	Well, because when you roll dice, it's kind of like by chance. You don't really know which number the dice will land on.
Mrs. Colbert:	So, think about your idea of chance. What kinds of things can you think of that could happen to the drift worm by chance? And let's take this idea a

	step further. How does this idea of chance play a role in the organism's genotype or phenotype?

So, Mrs. Colbert uses inquiry to question Marc about genetic drift. Marc's perspective that chance causes genetic drift prompts Mrs. Colbert to have him consider how chance plays a role in the organism's genotype and phenotype.

Teachers coach students through discovering the concept. Three out of six teachers coached students to discover science concepts. Students expressed the need for teachers to coach them through exploring biology concepts.

Niko (Mr. Rodriguez):	My teacher, he kind of coaches me through learning biology.
Researcher:	What do you mean by that?
Niko:	Um...It's like sometimes I barely understand, but he always coaches me through it and it motivates me to do better.
Lisa (Mrs. Gonzalez):	My teacher is a good teacher. Whenever she's teaching, she kind of coaches us.
Researcher:	This is so interesting! Why do you say that?
Lisa:	It's kind of in the way that she asks us questions. Like…I don't know how to explain it, miss. It's like she teaches us that we can't just depend on her, but the people in our groups. And like, if we ask her a question, she will ask us or the people in our group what they think, and if she sees we really didn't discuss it together, then she makes us go back and do it.

Niko's and Lisa's statements are profound. Niko states that his teacher coaches him through the learning and Lisa affirms Niko's statement by adding that coaching and questioning students while they are learning science shifts students from depending on the teacher to depending on their peers and each other.

Learning is in the form of lab experiments, hands-on activities, or manipulatives. Many teachers stated that they implement lab experiments and hands-on activities as a strategy for students to learn science. Although all teachers expressed constructivist epistemological beliefs, my classroom observation consistently found that only two of six teachers participating in this study used learner-centered activities such as inquiry laboratory experiments and manipulatives (hands-on activities) in their lessons. In the excerpt from four different interviews, Mr. Rodriguez, Mrs. Johnson, Mrs. Thomas, and Mr. Harris state their beliefs as to how students learn science best.

Researcher:	How do your students learn science best?
Mr. Rodriguez:	Probably through hands-on type of stuff like labs or manipulatives, visuals, videos… Anything like that.
Researcher:	How do your students learn science best?
Mrs. Johnson:	Um. This year actually, I have had a mix of kids. Some of them are very kinesthetic and some of them are verbal, but I would say for the most part they need to touch it.
Researcher:	How do your students learn science best?
Mrs. Thomas:	Um. How do they learn science best? A combination of being able to see it and relate it to something else, me being able to tell you something and give it to you in a relatable form, once I do that giving you some type of way that you can touch it, draw it, or something else that you can hands-on see it in some type of way.
Researcher:	How do your students learn science best?
Mr. Harris:	[*Pause*] Hands on.. But that is such a teacher's response.
Researcher:	Teacher's response? What do you mean?

Mr. Harris:	Well, most teachers know that this is the best way to learn science, but it doesn't mean they actually do it.
Researcher:	Why do you think that is so?
Mr. Harris:	I'm not sure… I guess some of them just don't care or don't care enough.

Mr. Rodriguez agrees that students learn science best when the learning experiences are hands-on. Mrs. Johnson uses the word "kinesthetic" to describe the need for students to learn science hands-on. Mrs. Thomas states that students learn science best by having students "touch it [and] draw it" in a relatable form, but Mr. Harris has an interesting perspective. According to Mr. Harris, most teachers know that students learn science best through hands-on learning experiences; however, some teachers "just don't care or don't care enough."

Students' summative assessments gauge their understanding of concepts, which either does or does not align with teachers' lessons. The teachers see assessing students as an important component of their epistemological beliefs. Intriguingly, some of the students argued teachers' summative assessments in the adverse of how teachers responded.

Researcher:	In what ways are your summative assessments similar to your learning beliefs?
Mrs. Thomas:	Um. That's a good question. [*Pause*] Well, the assessments that I make are similar to the STAAR (State of Texas Assessment of Academic Readiness) exam. I give them the type of questions that I know that they will encounter when they take their end of year exam.
Researcher:	How does doing this relate to your beliefs about learning?
Mrs. Thomas:	Well, if my students are participating in my lessons, they will do well on my exams.

So, Mrs. Thomas believes her lessons align with and adequately prepare students for summative assessments, and consequently their end-of-the-year state assessment. However, Stacy describes different sentiments contrary to the response of Mrs. Thomas.

Stacy:	Oh my God. Mrs. Thomas's exams, OMG (Oh my gosh), it's like not even like class. In class, I'm telling you, she barely even teaches. And then I feel like if we get a review paper for the exam, the exam is nothing like the review.
Researcher:	Tell me, what do you mean by that?
Stacy:	Miss, it's like, the questions are nothing like her test. IF [*said with emphasis*] she asks us questions, it'll be like, "What is this (referring to a concept)? What is the function of like a mitochondria or something like that," but when you get the test, the question be this long [*holding up space in between both hands*]!! It just doesn't match up, so it's harder for us to take the exams.

According to Stacy, Mrs. Thomas's lessons don't prepare her for science exams, but here is where I would like to closely analyze Stacy's statement. In her statement, Stacy reveals that Mrs. Thomas tends to ask level-one questions that engage rote memory, knowledge, and recall. Stacy contends that those basic questions differ from the type of questions that she has experienced on exams. Additionally, she makes the gesture of the length of the questions to signify the difference, which suggests that the questions on the exams are critical thinking type questions.

Learning activities are purposeful and reinforce the concept. Throughout my classroom observations, I noted that some teachers intentionally selected activities that would reinforce concepts that students learned during the lesson. The following is an excerpt from my analytical notes:

> "*I feel like some of the teachers really understand the idea of lesson planning and it is evident that some teachers do not. This is the fourth time I have been in Mr.*

Harris's class and have felt that the students' activities did not reinforce the concept. Today, Mr. Harris discussed the Eurkaryotic cell and function, but the follow-up activity of the lesson focused on the students coloring parts of the cell. The activity did not reinforce the function. September 8th, 2015"

Students discover the concept and their teacher gives them multiple opportunities and ways to discover the concept. The teachers said they showed "care" by giving students multiple opportunities to learn and reinforce science concepts. Throughout the teachers' interviews, I noticed that they frequently argued that urban students' lack of a foundation in science concepts directly related to their science literacy. I explore urban students' insufficient knowledge of biological concepts in the categories "Tug of war between the students' needs versus the teachers' needs" and "The Baby-sitters' complex." However, I introduce the teachers' argument about urban students' insufficient knowledge here, to emphasize the recurring theme of the need for multiple opportunities to discover, learn, and reinforce science concepts. For example, Mrs. Johnson describes a component of her epistemological beliefs and how she illustrates "care" for her students' science literacy by affording them multiple opportunities.

Researcher:	How do you show students that you care whether or not they do or don't understand a topic in science?
Mrs. Johnson:	[*Pause*] I give them multiple opportunities to learn. And this is experimental, so if at first we don't succeed we try and try again. So, I guess giving them opportunities to be successful and this shows them that I care.
Researcher:	And I just want to make sure when you say "giving them opportunities" you mean like giving them opportunities to turn in their work or giving them opportunities on learning the concept or?
Mrs. Johnson:	Both. By trying to give them multiple ways to access the learning. So like if what I presented to them in a PowerPoint didn't work, um trying to show them an activity that they can practice with, trying to show them a

video that they can be relevant with the concept um…. Just trying to give them multiple access in their learning.

Students design the lab rather than step-by-step instructions. The multiple opportunities for students to present information came in creative forms, such as prompting students to design their own labs. Students identified and investigated their own real questions about natural phenomena.

Mrs. Gonzalez: Well, somewhere I heard a quote that says "The day you're willing to veer off the lesson plan, follow a kid's lead, and learn from your students is the day that you become a teacher." That's exactly how I feel. I don't want to train robots. I want students to learn how to think for themselves and develop critical thinking skills.

Mrs. Gonzalez describes why she prompts students to design their own lab. Her rationale for leading students to design labs rather than providing step-by-step instructions is so that students engage in critical thinking. She also associates consistent rote memory thinking with training students and developing critical thinking skills as educating students.

Teachers prompt students to problem solve the concept rather than merely learn about the concept. Students expressed boredom with teaching strategies where they had to sit and solely listen to their teachers talk about science.

Carmen (Mrs. Johnson): Miss, let me tell you. Sometimes, I think science is really boring. And, I really don't think science is to supposed to be boring because you are supposed to do labs or experiments and stuff.

Researcher: Well, what makes it so boring?

Carmen: Really, I kind of feel like it's the way my teacher is teaching it. It's just boring.

Researcher:	Well, if you could change something, what would you do?
Carmen:	I think I would make it a little more fun like, you know like those CSI (Crime Scene Investigation) shows. You know like, you are trying to solve a problem or a case or something.

Teachers guided students in scientific inquiry and extended discussion on biology concepts. Teachers implemented activities and posed questions that developed students' problem solving skills. As students develop more problem solving skills, they use those skills to communicate learned information to their peers.

In conclusion, the teachers expressed beliefs relating to social and constructivist paradigms, with an emphasis on inquiry as a valuable teaching method. The teachers said they use research-based, best science practices in the forms of inquiry, labs, and hands on activities to express care for urban science students' science literacy. Although all of the teachers claimed to use such practices, very few of them actually exhibited these in the classroom.

Moral epistemology

Throughout my teachers' interviews, students' interviews, and classroom observations, it became apparent that the teachers' moral epistemology impacted them three-fold. First, teachers' moral epistemology would surface in conversation incognito and intertwined with constructivist and social epistemologies. Second, moral epistemology became the basis on which the grounded theory emerged. Lastly, critical race theory in the form of an interest convergence surfaced.

Teacher has the responsibility to society to assure students' proficiency in science literacy. Teachers who participated in this study argued they either had or did not

have the responsibility to society to assure students' proficiency in science literacy. Teachers who assumed they have a responsibility to society described understanding the "big picture." Those teachers intentionally sought to enhance their students' science literacy so that students could use that knowledge outside the classroom. Teachers who argued that they do not assume responsibility to society described themselves as a mere piece in a puzzle consisting of many pieces. In other words, those teachers focused on other factors that influence urban students' science literacy instead of what they could control in their classroom. In the excerpt below, Mrs. Colbert describes how she assumes she bears a responsibility to society to assure her students' proficiency in science literacy.

> Researcher: What about science education? How would you say care relates to science education?
>
> Mrs. Colbert: Well yeah, since I love science so much, I care that my students are getting a good science background. So that when they hear things on the news and they are talking to other people, later in life I want them to sound scientific. So yeah, I care about that tremendously. Um, I care that if they decide to go into pharmaceuticals or some health related field, I care. And you know, something that occurs to me in my head all of the time is that you got to care about all kids. Because, you don't know what they are going to become. You know, you really don't know what… I mean I think of like one day I am going to be old, and one of them maybe taking care of me! Right? I mean that's kind of a crazy concept, but that's what I think. And so, they may be the ones helping you later. They may be the EMTs coming out to help you one day.

Here, in Mrs. Colbert's statement, I see evidence of the type of interest convergence postulated by critical race theory. Mrs. Colbert acknowledges that students could, in the future, work in a field where they would need a science background to potentially taking care of her health. In the event that her students choose a career such as medicine that requires taking care of her health, she wants to help students gain a good understanding

of science. Mrs. Colbert's statement echoes Derrick Bell's description of interest convergence. Bell (1980) states that the majority class are more inclined to support legislation, or in this case curriculum, when it is also beneficial to them. Rather than viewing a good science background as beneficial to students and their families through college scholarships or increased income from a stem career. Mrs. Colbert views a good science background as benefitting her.

Teacher has the responsibility to parents to assure students' proficiency in science literacy. Teachers stated sentiments of either feeling or not feeling a responsibility to their students' parents to help students become science literate. Teachers who described not feeling a responsibility to their students' parents also argued urban students' parents needing to be more responsible and essentially needing to show more "care" for their students. The first sub-theme that emerged from the "Teacher has the responsibility" category was "Earn my Paycheck."

Earn my paycheck. All teachers participating in this study stated in some form or fashion that they had earned their paycheck. The difference in this statement resided in whether teachers stated their ownership of assuring that students are science literate or whether teachers deflected ownership to the students' parents. I have provided an example from the data to illustrate how teachers expressed responsibility to students' parents or said students' parents needed to take responsibility for their child's science literacy.

Researcher:	How do you define your role as a teacher?
Mrs. Colbert:	You have a responsibility to the parents because essentially they pay you, they are who you are working for… and um, you have the role [responsibility] of the students that while they are in your classroom to give them the best

opportunity to learn as much as possible. And that's your overall responsibility and help them to pass any test that the state may throw at them. And I mean you need to consider what they need to be able to do in the future like, they need to communicate, they've got to be able to have writing skills, and so you've got to incorporate all of those responsibilities.

Mrs. Colbert describes her role in the classroom as being an employee of her students' parents. She assumes the responsibility for helping students to learn science, including the skills that accompany a science literate person.

Do unto others mantra. Like Mrs. Colbert, Mrs. Gonzalez states a "Do unto others" mantra. The mantra describes how some teachers described treating students the way they would want other teachers to treat their own children.

Mrs.Gonzalez: I have a great relationship with my students and I think that they know that I care about them.

Researcher: How did this relationship get to this point? What steps did you take?

Mrs. Gonzalez: I don't know if it was steps, but I surely wanted my students to know right from the beginning that I want the best for you, the same as if you were truly my own child. This is really important because every day I make it a point to be the science teacher that I would want for my own child. And, I don't always succeed! But for the most part, this is at the forefront of my mind! And this means, some days I have to work later. Sometimes I have to go out of my way to set-up and do labs and investigations because I know that they are more engaging…and my students really need it.

In another excerpt below, Mr. Harris explains that he doesn't feel he should assume responsibility to parents for his students' science literacy.

Mr. Harris: I have the responsibility to teach as best as I can and I believe that is how I show care to my students' science literacy. With that being said, there are some things out of my control. I cannot control outside factors that my

> students face. I cannot control the knowledge that they come in with. I cannot control their parents. Students' parents should have a lot of responsibility. I see them [my students] only about an hour a day. They see their kids more hours out of the day; so they [the parents] have to take some responsibility in making sure that their students are proficient in science.

Four of the six teachers participating in the study discussed the same sentiments as Mr. Harris. These teachers argued that morally their students' parents should take most of the responsibility in helping students to become science literate. Here, I see evidence of interest convergence again, except oppositely from Mrs. Colbert's response previously discussed. Mr. Harris does not see a benefit for himself in helping students to become science literate. Because of this non-mutualistic, non-beneficial relationship, he identifies others who should assume responsibility instead of focusing on what he can control in his classroom.

In conclusion, teachers expressed sentiments of either feeling or not feeling the responsibility to their students' parents to help students become science literate. I also found that within this category some teachers exhibited a "Do unto others" mantra, when illustrating "care" to students. The mantra described how some teachers manifested treating students as if they were the students' parents or treating students the way they would want a teacher to treat their own children.

The role of the teacher

The teacher's role was one of the most important aspects of the participating teachers' epistemological beliefs and how they illustrated "care" to their urban students' science literacy. Moreover, the teacher's role in the classroom also revealed the negative

effects of colorblindness when used in the classroom, such as the assignment of subordinate positions, as I later point out in the data.

When I asked teachers about their role in the classroom, all mentioned that they were facilitators in the classroom. Although all teachers expressed and described their role in students' learning, and thus the classrooms, as facilitators, my classroom observations indicated that four of six teachers resembled a more dominant, traditional force in the classroom.

Teacher has the role of the facilitator in the classroom. I describe the facilitator's theme as the teacher doing less and the students doing more. From those observed classrooms, the focus was on the students and constructing the students' knowledge was the main focus. Teachers who facilitated students' learning did not appear to their students as the sole knowledge holder, but as a resource or instrument to help students construct knowledge.

Less of the teacher doing, more of the students doing. Below is an excerpt of an interview conversation with Mr. Rodriguez.

Mr. Rodriguez:	I know that every teacher probably says that their role in the classroom is a facilitator. My reality is sometimes I am and sometimes I'm not. I know I should probably be doing less in the classroom, but my reality is that I feel like I have to do everything.
Researcher:	Why do you feel like that?
Mr. Rodriguez:	Probably because if I had to just rely on my students, it would never get done.
Niko (Mr. Rodriguez):	Mr. Rodriguez does all talking in the classroom. I think he thinks that we don't want to participate in class, but it's not all of us.

Niko's statement that Mr. Rodriguez does all of the talking in the classroom affirms Mr. Rodriguez's statement that he does not assume the role as a facilitator in the classroom. Mr. Rodriguez's teaching style is teacher-centered rather than student-centered in the classroom. He knows that students should have more of a role and focus in the classroom, but he doesn't think his students have the ability to achieve the learning without his direct, step-by-step input.

The teacher takes a neutral position in students' critical thinking. Some teachers and their students stated that during discussion, when teachers prompted students to think critically about biology concepts, teachers remained neutral as the students voiced their perspectives.

Lisa (Mrs. Gonzalez):	When we are discussing stuff in Mrs. Gonzalez's class, she never really pushes us to think about it *her* way. Okay well, when we get off topic she will kinda say okay, let's go back to what we are talking about, but it's like she really forces us to think on our own.

The sub-theme directly aligned with my classroom observations. Teachers who demonstrated the facilitator's role in the classroom also displayed a neutral stance as students engaged in critical thinking.

Teacher has the role of the dominant force in the classroom. Although most teachers believed they should play a facilitator role in the classroom, I found that four of six teachers exhibited a more dominant, traditional role in the classroom. Teachers in this category often formed the center of the classroom. In my analytical notes during classroom observations, I noted that when students participated in activities and labs, teachers disempowered students by displaying their rationale. Teachers who demonstrated the dominant role would often bring materials to each table.

Craig (Mrs. Thomas): Sometimes we do labs, but not really. When we do labs, we don't really do it as a group. We have to listen to the teacher and she tells us step by step what to do. Sometimes kids don't listen to the teacher and I think that's why we don't do labs often.

Craig not only illuminates the fact that his teacher does not do labs very often, but he also suggests that his teacher assumes the dominant role in the classroom when the students do labs. Likewise, I found that all teachers in this category failed to give students the opportunity to play active roles in lab experiments, such as recorder, timekeeper, materials manager, and safety manager. Instead, teachers obligated themselves to all of the lab roles that they should have assigned to their students. Here, I see evidence that when the teacher has the dominant role in the classroom, the teacher portrays to the students that the teacher is the ultimate-knowledge holder and that students must rely on him or her to acquire that knowledge. Again, the dominant role in the classroom mirrors the effects of colorblindness from critical race theory by assigning subordinate positions and systemically keeping students in a place of educational dependency.

Teach them the "right" way. Teachers who illustrated the traditional, dominant role in the classroom seemed to believe that they needed to teach students, the "right" way. In expressing the notion of one right way to derive an answer as opposed to many ways, teachers revealed their ontological beliefs. Throughout interviews, teachers acknowledged that there were different modalities into learning and different routes to get to that learning. However, interestingly, as teachers began to discuss teaching their urban science students, they indicated the need to teach students the "right" way through idealist, ontological beliefs.

Mrs. Thomas: My students have to be taught the right way.

Researcher:	What do you mean about the "right" way?
Mrs. Thomas:	A lot of times they will say to me, but "Miss can't I get the answer this way also" and it's normally through some sort of short-cut. I'll tell them "yes," but that I want them to do it this way.
Researcher:	And, why is it important that they do it the way that you are teaching them?
Mrs. Thomas:	Because I want them to learn it the right way. If they go into another teacher's class next year, they are more than likely going to teach them a concept the way that I am teaching it.

Mrs. Thomas acknowledges that students could derive the answers or learn things in other ways, but she believes that she must teach students the "right" way. Here, in her statement, critical race theory begins to surface as I recognize elements of colorblindness. Bonilla-Silva (2010) states that people of color can also possess colorblindness. Mrs. Thomas has racially disconnected herself from the majority of students that also look like her. She is more concerned with teaching her students in a dominant way they will encounter throughout their science education. The importance of students learning the "right way" supersedes their ability to contribute to how she is teaching biology. When prevented from contributing to their own learning, students suffer a negative outcome of colorblindness. Mazzocco, Cooper, and Flint (2012) define *colorblindness* as "an opposition to racial categorization" (p.168). However, the question that I would like to pose here is who opposes this racial categorization? The answer is that those in authority oppose racial categorization and as long as there is an opposition to racial categorization, we will have difficulty acknowledging and resolving inequality issues that exists among races. Furthermore, when there are issues of inequality that exists among races, we will

establish upper and lower echelons in society. Colorblindness, as practiced in the classroom, reinforces the status quo. In the process, the teacher assumes superior position over the students and the students never elevate to a level necessary to adequately learn in the classroom.

As students engage in critical thinking, the teacher heavily sways their thinking to that of the teacher. Teachers who demonstrated the dominant role in the classroom also impacted students' perspectives as students engaged in critical thinking. Teachers in this category often had few opportunities for students to process and discuss concepts. However, when teachers did give students opportunities to engage in discussion, they also heavily influenced the discussion. Moreover, the students' responses, chorale or unidirectional, often mirrored the teacher's thinking.

> Gabriela (Mr. Harris): Honestly, I kind of feel like if you do what the teacher tells you to do and think how the teacher tells you to think, then you can pass his class.

Gabriela's statement is mind-boggling, and it illustrates the negative outcomes that occur when teachers practice colorblindness in the classroom. Colorblindness is a systemic perspective, which maintains the authority of those in power. The attempt to be fair actually leads to an unfair outcome. A position imposed on students, such as having one right way to do things, sets up a hierarchy with the teacher as the ultimate-knowledge holder. When this hierarchy occurs, the students become lower-ranking in relation to the teachers, which is indeed evidence of the assignment of subordinate positions due to the effect of colorblindness. Now, one might ask, "Why does this subordinate position matter?" The answer is that it enables students in their learning and fails to empower them to think critically as provided in Gabriela's statement about Mr. Harris.

In conclusion, teachers either adopted the "facilitator" role in the classroom or the traditional, dominant role in the classroom. Teachers who facilitated students' learning, did not appear to their students as the sole knowledge holder, but served as a resource students could consult as they constructed knowledge. One result of the teacher's serving as a facilitator was that students felt a greater sense of responsibility for their own learning. Teachers who exhibited a more dominant, traditional role in the classroom were also often the center of the classroom and exhibited teaching students, the "right" way. There seemed to be one right way of deriving an answer as opposed to many ways for deriving an answer.

Tug of war between the students' needs versus the teachers' needs

Mr. Rodriguez: I need them [his students] to want to learn.

Researcher: How would your students' wanting to learn help you as a teacher?

Mr. Rodriguez: Because when they want to learn, it helps me to work hard for them. I need them to help me help them.

The conversation between Mr. Rodriguez and me was my first realization that students and teachers both had needs to fulfill. Teachers had requirements to teach and students had requirements to learn. However, as I listened to teachers' and students' interviews, teachers' needs seemed to compete with students' needs. Here, interest convergence seemed to align with the tug of war analogy between teachers and students since as long as teachers had their needs met, they could see benefit in helping students to attain science literacy. As a counter argument, one might argue that we need to find ways to meet teachers' needs, at the very least, enough for them to meet the students' needs. I

agree with this statement; however, we should not use teachers' needs as a roadblock for meeting the needs of students.

Teacher acknowledges and executes strategies for students' lack of foundation in science. Throughout participant interviews, it became increasingly clear that teachers' epistemological beliefs had components of filling gaps or voids in students' learning needs.

> Mr. Harris: I would say most of my students don't have a good foundation in science. When I am teaching, I try to make it as basic as possible.

Teachers frequently mentioned that their urban science students often lacked a foundation in science, necessary to strengthen their science literacy; however, both themes in this category showed a distinct tug of war between teachers' needs in order to teach science and students' needs in order to achieve a proficient level of science literacy. Mr. Harris acknowledges that his students do not have a good foundation in science and he must combat this lack of "good" foundation by "making it as basic as possible," but Mr. Harris may still practice colorblindness in the classroom. In fact, his statement reinforces the idea that in actuality he is practicing colorblindness in his classroom because keeping the instruction "basic" further marginalizes his students and systematically, whether conscious or sub-conscious, maintains the status quo.

Teachers' knowledge of students. To introduce this theme, below is an excerpt from an interview with Mrs. Colbert.

> Mrs. Colbert: Before I can meet the needs of my students, I actually have to know what their needs are. I can't assume that they are going to be exactly like my students from last year. I can anticipate certain ideas that there is a good chance that they may have trouble, but I can't assume everything about them.

Mrs. Colbert introduces this theme so eloquently by stating that to meet the needs of her students means she must actually know their needs. Here is more evidence that supports the critical race theory theme of colorblindness. Again, colorblindness asserts that all people are starting from a neutral position. If all students are starting from the same neutral point, a teacher cannot identify their educational needs. Mrs. Colbert is not practicing colorblindness in the classroom because she specifically states that she has to know her students' educational needs in order to address their learning in science.

In their interviews, students also described a desire for teachers to meet their learning needs. Students wanted teachers to understand their learning needs such as language barriers or stemming literacy issues. Furthermore, moments teachers viewed as students not interested in learning, were actually incognito moments that hid the severity of students' learning needs.

Juan (Mr. Rodriguez):	I think a lot my problems in science come from not knowing English so well. I don't really speak English at home or even in my neighborhood. I also don't really speak English at school unless we have to. I know that I'll have friends that can kind of tell me what they says.
Serena (Mrs. Colbert):	I don't think I'm a good reader. I kind of feel like Mrs. Colbert knows this and she doesn't embarrass me, like some teachers do. This year, I am going to really try to do better in reading.

Juan and Serena voiced to me their barriers to learning science. Juan states that he has a language barrier because he doesn't understand English well and Serena lacks proficiency in reading. Again, the ability of the teacher to know his or her students, their barriers, and their educational problems that need improvement is evidence that colorblindness is not practiced in the classroom.

A sense of meeting the students' learning needs. Teachers who acknowledged students' learning needs as a priority valued executing strategies to combat students' lack of foundation in science. Consequently, their focus on illustrating "care" to their urban science students resided in meeting the students' learning needs. In one of the examples below, Mrs. Thomas states that she focuses on the readiness standards from the students' state, biology, end of course (EOC) exam.

Researcher:	How do you decide what to teach and what not to teach?
Mrs. Thomas:	Okay, because of my pyramid, half of my students came in this year not passing their eighth grade exam. And so you don't even have the foundation that you need, I focus on readiness standards because that is 60% of the State exam. I know you will pick up that supplemental as I am giving it to you, so I focus on what you have to know. We start there and then we go small.
Mary (Mrs. Thomas):	I kind of feel like if I pass my biology exam at the end of the year, it won't be because of Mrs. Thomas. It's probably because I remember the stuff we learned in eighth grade. I just don't feel like she understands how I learn. And it's not just me because other kids in my class say the same things.

Mrs. Thomas's thought process reflects a desire to make sure that she teaches students the concepts that they will encounter on the biology End of Course (EOC) Exam. She presumes that, holistically, students need the "meat," or the main biology concepts, which they will encounter on their state biology exam. So, Mrs. Thomas illustrates "care" for her students' science literacy by meeting students' needs on the EOC exam, but Mary doesn't feel that Mrs. Thomas cares. She specifically states that she doesn't think that Mrs. Thomas understands how she learns. Again, Mrs. Thomas's response shows evidence of colorblindness. Judging from Mrs. Thomas's answer, I presumed that she

told me what I wanted to hear; however, her statement conflicted with my observations and Mary's interview. To understand how students learn means that you also acknowledge the educational inequalities that students possess.

In another excerpt, Mrs. Colbert reveals that she bases her decision on what she needs to teach on another type of student need.

Researcher:	You mentioned earlier that you are going to really try to do better in reading this year. How will you do this?
Serena (Mrs. Colbert):	Really, miss, it's because of Mrs. Colbert. Three times a week after school, I will be coming into her class and working on some reading stuff on the computer. We have a plan and I trust her to help me.

Serena has built a relationship with Mrs. Colbert because Mrs. Colbert recognized her barrier to learning science. In Serena's response, I see a positive effect of when teachers do not practice colorblindness in the classroom. Mrs. Colbert does not view her students through a neutral lens in the classroom. If she did view her students through a neutral lens, she would not be able to recognize the different educational injustices that her students bring to the classroom. As a result of not practicing colorblindness in the classroom, Mrs. Colbert recognizes Serena's lack of proficiency in reading and implements a plan to combat this educational barrier.

Researcher:	How do you decide what to teach and what not to teach? [*As Mrs. Colbert verbally stated her response my question, she slowed down her words towards the end of her first sentence and gave me this look as to say, "I'm going to give you the answer that most teachers say, but I am going emphasize what <u>all</u> teachers should be doing."*].

Mrs. Colbert:	Well, I think part of it is based on our curriculum framework, but then you have choices to make. You have to look at your students and figure out what they need. For example, do they need scaffolding? Do they need additional material? What do they need to get to this point? So then, you have to pick and choose based on how you know your students because you have to scaffold for a bunch of your students because they may not be able to take what's in the curriculum and just go for it.

So, according to Mrs. Colbert, she illustrates "care" to her students by using the instructional strategy, scaffolding, which directly relates to Lev Vygotsky's (1978) idea of sociocultural theory and to the Zone of Proximal Development (ZPD). According to Vygotsky, the ZPD explains the amount of learning a child can acquire on his or her own, with or without the proper instructional guidance. Mrs. Colbert affirms the ZPD in her practice and uses it as a strategy for her students' learning needs.

Teachers prioritize their needs first as a pre-requisite for students to learn science. The participating teachers argued that they had requirements that needed to be met in teaching their urban science students. A peculiar observation within teachers' interviews is that some teachers described the need to meet students' needs in order to teach science, but others further provided distinction by describing their requirements to illustrate "care" to their urban science students.

A sense of meeting the teachers' needs. When the teachers described the distinction between their need to teach science compared to their need to illustrate "care" for urban science students' science literacy, I realized teachers illustrated different levels of "care." In the excerpt below, Mrs. Johnson describes challenges to her caring

approach. As I listened closely, Mrs. Johnson began to describe her needs as a teacher and how these have affected her illustration of "care" to her urban science students.

Researcher:	Are there any challenges with that caring approach?
Mrs. Johnson:	I would say access to materials is limited, so you are kind of limited to your resources in general. The students here are an issue. Only about six percent of them [the students] actually care about learning science.
Researcher:	Six percent of your students care about learning science? How much of this has affected your teaching?
Mrs. Johnson:	It has affected it a lot, just because it has been a real struggle all year long. Like, simple instructions. Turn to page two, etc. whatever. Simple instructions, we don't follow. So even if we are giving them and I write them on the board, the vast majority of my students cannot follow instructions. Verbal! Written! Directive! Cannot follow! And that is a huge thing when you don't follow instructions or refuse to follow instructions, it changes what I am willing to do with you in class. Just because if I am going to spend 35 minutes repeating or screaming directions, instead of maybe giving directions once or twice for maybe those who didn't hear it and we spend most of the majority of the time just on the simple stuff.
Researcher:	What do you mean, "Willing to do with you?"
Mrs. Johnson:	Meaning labs, activities, stuff like that. If I need you to do basic stuff like follow instructions and you are unable to do it. Then, I will not be doing that type of stuff with you.

According to Mrs. Johnson, the low percentage of her "caring" students has created a struggle that has greatly affected her teaching. She needs her students to illustrate "care" to their own science literacy by listening to instructions. Moreover, Mrs. Johnson makes a bold statement: "When you don't follow instructions or refuse to follow instructions, it changes what I am willing to do with you in class." Mrs. Johnson's description of her teaching style has components from the constructivist paradigm, but she prioritizes her

needs as a teacher before executing those beliefs. Consequently, how Mrs. Johnson illustrates "care" to her urban science students conflicts with her epistemological beliefs. Through other conversations with Mrs. Johnson, she felt beat down as a teacher. She had ill feelings towards the administration in her school and those negative feelings spilled in to the classroom, which could have influenced her teaching.

In another excerpt, Mrs. Thomas discusses her needs as a teacher. She expresses that when students illustrate that they don't "care" about their science literacy, she cannot help them.

Researcher: Are there any challenges with that caring approach?

Mrs. Thomas: Um. Everybody doesn't want to be helped. Even in an environment, it's blatantly obvious that without an education you're not going anywhere and there is no way out of this community without an education. At this point, every kid doesn't care about that. It just doesn't matter to them. There are some kids who don't want to learn. They genuinely don't want to learn or do anything different. They are there because the courts said that they have to be here. I just want to socialize and I have no intention of even touching work. If you don't care and you do not want to be here, I cannot help you.

Researcher: What about the students that do "care"?

Mrs. Thomas: Then I do my best to help them.

Although Mrs. Thomas mainly refers to the students who don't illustrate "care," she states that she helps students who show they do "care" about their science literacy.

Teacher uses the students "academic need" title as a major reason for their students' lack of success. I introduce this theme through an interview conversation that I had with Mrs. Johnson.

Mrs. Johnson: People have to realize that we have a high number of at-risk and economically disadvantaged students

	at our campus. Most of our students, well I won't say most, but a lot of our students are not really worried about their education.
Dante (Mrs. Johnson):	See, this is the thing that really makes me mad, Miss. Just because I come from a [certain area], it doesn't mean I can't learn. Not all the kids that you meet from [certain area] don't mean that they don't care. We just want our teachers to care too.

I found that not all teachers directly used students' at-risk title as a reason for students' lack of success, but six out of six teachers referred to students' at-risk status in some form throughout their interview.

Mr. Rodriguez:	I have a high population of special education students and at-risk students in my class. I'm not saying that's the only reason for lack of students' success, but it is a major reason.

Here, one may argue that since Mr. Rodriguez recognizes his students' at-risk status, then he is not practicing colorblindness in the classroom. However, when teachers reject practicing colorblindness in the classroom they are able to recognize educational injustices and seek to do something about those injustices. Thus, it is not enough to merely recognize that the students of color in a teacher's classroom are "At-Risk," without using the proper pedagogy to address the "At-Risk" need.

In conclusion, the tug of war between teachers and students overwhelmingly illustrated how teachers' needs competed with students' needs. The focus on illustrating "care" to their urban science students hinged upon whether or not teachers met the learning needs of students. Teachers who prioritized the students' needs before their own needs described teaching in a manner that filled student's learning gaps. Teachers who prioritized their own needs before their students' needs argued their students' lack of

science foundation as the key reason for not achieving a proficient level of science literacy.

Baby-Sitters' Complex

The Baby-Sitters' Complex is a category taken from several teachers' interviews. Teachers described their role in students' learning as being a baby-sitter. In the excerpt below, Mrs. Johnson uses "baby-sitter" to describe her role in the classroom.

Researcher:	How do you define your role as a teacher?
Mrs. Johnson:	Realistically? [Laughs] Um, yeah, with my reality and my truth I am baby-sitting. I am baby-sitting a room full of struggling children.
Researcher:	Why do you feel like you are baby-sitting them?
Mrs. Johnson:	Because, they refuse to claim their own success in education. I don't know if there is some type of wall or barrier or if they just give up. So, you can't really encourage them to do anything. All you can do is present it to them and it never really goes past that point. So, after that you are kind of just baby-sitting. So, this is what you are supposed to be doing. I told you what you are supposed to be doing so hopefully some of you will get it done.
Ashley (Mrs. Johnson):	She treats us like babies, like we're three years old or something.
Researcher:	Why do you think that she does that?
Ashley:	I don't know. It's like she loses patience for us quickly.

According to Mrs. Johnson, she correlates "struggling" students with a caretaker who has to care for struggling children. As I interviewed other teacher participants, I got to the root of teachers' perceptions of a "baby-sitter," how this word intersects with teachers' epistemological beliefs, and how this word impacts how teachers illustrate "care."

The teacher acknowledges the students' responsibility in their competent or incompetent science literacy. Teachers emphasized students needing to learn responsibility and take ownership in their science literacy. Students also acknowledged that their teachers expressed that students need to take responsibility for their own learning. Interestingly, the meaning of *responsibility* resided in mostly physical preparation.

Students are not physically prepared to learn. According to the teachers, students could be responsible for their learning by being physically prepared to learn (i.e., pencils, notebooks).

Craig (Mrs. Thomas):	Mrs. Thomas tells us to bring our materials to class. That mostly means something to write with, a pencil, pen, or something and a notebook. But, Miss I always bring my stuff. She never has to tell me, because I always bring my stuff. Sometimes I feel like she spends so much time on the kids that don't care that she forgets bout the ones that do.

Teachers argued that students who did not bring writing utensils were not taking responsibility for reaching a competent science literacy level. Additionally, teachers argued that students who did not complete their homework assignment were not taking responsibility for reaching a competent science literacy level. What I found most interesting about this particular theme was that teachers did not see students taking ownership or being a stakeholder in learning biology concepts. Teachers wanted urban students to assume responsibility as the teachers saw fit. The method in which teachers described urban science students assuming responsibility aided in the establishment of the next theme.

Infantilization of urban science students: The teacher views urban science students as child-like, childish, and/or juvenile in nature. In an example below, Mr. Rodriguez describes how he maximizes his students' learning, but while explaining his epistemological beliefs about maximizing their learning, he also reveals further insights into his urban science students through an act of microaggression. As with other urban science teachers, Mr. Rodriguez believes his urban science students have criminal intentions.

Researcher:	How do you maximize students' learning in the classroom?
Mr. Rodriguez:	I am focused on just working the whole time, from bell to bell. And, I don't let anything deter me or I don't let any bandits take me off task.

In Mr. Rodriguez's response, he refers to students that may cause the class to derail from the lesson's focus as *bandits*. In the excerpt below, Mrs. Thomas also uses the term *childish* in depiction of her urban science students.

Mrs. Thomas:	My students can be very childish. Sometimes I feel like they can't do anything without me when we are doing stuff in class.

So as with the previous theme, teachers described urban science students as childish, babyish, and immature in nature. Teachers also insinuated that the students' juvenile demeanor was an essential reason why students struggled in their learning. More than the juvenile description of urban science students, teachers frequently described the role of their students in their epistemological beliefs through a fantasized, infantile state. From a critical race theory perspective, the words "childish," "bandits" and other juvenile descriptions with which teachers referred to urban science students are microaggressions, which are insults that target marginalized groups of people. Here, I also see evidence of

microaggressions as a by-product of colorblindness, as I presumed in my tested critical race theory model. The practice of colorblindness in the classroom leads to a certain level of disconnection from a racial consciousness that might otherwise be in place. Because of this decreased level of racial consciousness, teachers are more inclined to engage in microaggressions as evident in Mrs. Thomas's and Mr. Rodriguez's responses. Since colorblindness assigns subordinate positions, microaggressions work as a vehicle to target those same marginalized groups in those subordinate positions.

Teachers viewed their urban science students as infants, as evidenced by their approach to teaching essential biology concepts. To drive home this point of the infantilization of urban science students, I will first explore two dimensions that emerged from the data. That is, how teachers spoon-fed information to their urban science students and the effects of such spoon-feeding.

Spoon-Feeding Information. As teachers presented information for students to learn, two attitudes formed based on teachers' perspectives of whether or not urban students were capable of learning science. In the first attitude, the data revealed teachers' perspectives that their urban science students were capable of understanding essential biology concepts and to accompany this idea, teachers used specific instructional strategies. In the excerpt below, Mrs. Colbert eloquently illustrates the first attitude and how she helps students to find their power in their learning.

Researcher:	How do you show them that you care? What kind of things do you do in the classroom that shows your students that you care about their science education?
Mrs. Colbert:	I think I do that by making a classroom where they have to learn on their own, but they are not going to fall. Because, if they ask the questions, I'm going to be there as a scaffold to help them so that they don't fall. I'm going to help them

> by saying "No, it's okay. You can take chances. If you tip over, I am not going to let you fall." You know what I am saying? So, that's how I feel like I show them that I care about their science education. And you know what, I feel like that's why I try so hard to get students to work with each other…. So that they know, we are in this together. We are a team and we help each other, not just me.

So according to Mrs. Colbert, she empowers students to learn on their own, but she's also present with students as they learn, letting them know that they are not going to fall. Mrs. Colbert also discusses the educational strategy, " scaffolding. " In chapter two, I discussed, Vygotsky's (1978) idea of the Zone of Proximal development (ZPD) and how it relates to instructional strategy of scaffolding. In Mrs. Colbert's statement, she further affirms Vygotsky's sociocultural theory by arguing that scaffolding includes students working with each other and helping each other. Vygotsky identifies this element of the ZPD through the More Knowledgeable Other tenet, which explains the benefits to a struggling learner from being paired with a stronger, more knowledgeable person.

While Mrs. Colbert's attitude illustrated a perspective that urban science students were capable of learning science, four teachers illustrated perspectives doubting students' ability in learning essential biology concepts.

Mr. Rodriguez: I would say that the majority of my students are missing the essential skills. So, I try to get them to where they need to be, but how can I get them there in one year? That's unrealistic.

From the attitude that teachers illustrated, I identified two groups: epistemic advantaged and epistemic oppressed. The first group consisted of teachers, and I labeled them the *epistemic advantaged* group, since teachers exerted their authority over the students as the ultimate-knowledge holder. The second group consisted of students, and I

labeled them the *epistemic oppressed* group, since students did not contribute to the formation of their knowledge, but rather teachers explicitly decided the breadth and depth of students' ability to learn concepts. Dotson (2014) defines *epistemic oppression* as the act of consistently excluding students from contributing to their knowledge production. however, *epistemic advantage,* or sometimes referred to as *epistemic exclusion,* describes an infringement on students' ability to construct knowledge (Dotson, 2012). In this section, I discuss those groups as they pertain to the emerged data; however, in the next chapter I further explore epistemic oppression and epistemic advantage in conjunction with synthesizing how both ideas pertain to the emerged data as a whole.

In the epistemic advantaged group, as evident in classroom observations, teachers spoon-fed information to their urban science students to such an extent that it prevented students from thinking for themselves. Teachers' concluding perspectives, that their students were incapable of understanding essential biology concepts, also showed in their behavior as the teacher symbolized the ultimate, knowledge holder in the classroom. The students' learning outcome when the teachers became the knowledge holder in the classroom, along with the teachers' assumption that students were incapable of understanding essential biology concepts, exposed two revelations. First, this assumption stripped students of their power and stakeholder ownership in their learning. Second, it "watered" down concepts, thus removing the full, grade level expectation of those essential biology concepts. Instead of equipping students to rise to the level of education needed to increase their science literacy, teachers did the complete opposite by creating learning experiences in which their students had to solely depend on them for their learning. Such learning experiences became an oxymoronic statement of the teachers'

premise that urban science students should take initiative and responsibility for their own science literacy. Here is where I see evidence of the Theory of Planned Behavior (TPB) playing a role in science education. TPB predicts that an accumulation of a person's attitude toward an act, the beliefs of the group of which a person is a member, and the person's perception of the ease or difficulty of a task are the best predictors of a person's behavior (Ajzen, 1991). In light of this theory, a teacher who has a negative attitude towards teaching urban science students, in conjunction with the group's beliefs that they are incapable of learning, can short circuit the students' best effort to learn. After all, if the teacher considers the teaching task as difficult, then they are unlikely to engage in behaviors that maximize learning experiences for urban science students.

The central idea of training urban science students rather than educating urban science students. Teachers who actually exhibited the role of the traditional teacher were in actuality training students, which gave the teachers an epistemic advantage over the students. Consider a conversation that occurred between Mr. Harris and me. As mentioned above, Mr. Harris considers himself a facilitator in the classroom; However, based on my classroom observations, I can say that Mr. Harris employs direct teaching methods and exhibits more components of training students, rote memory, knowledge and recall learning, rather than educating students to think critically.

Researcher:	What is your role in student's learning?
Mr. Harris:	[*Pause*] A facilitator in a lot of means and methods. I mean they are not going to just go out and do a project unless I tell them to do it, but you also kind of set the standard and the bar and the expectation on what they are supposed to do and how they are supposed to do it. So, in a lot of regards a facilitator.

Researcher:	So you said *facilitator.* Do you feel like you do most of the work in the classroom or they [your students] do most of the work in the classroom?
Mr. Harris:	That's a good question. I mean I put the trays out, the pens out. [*Mr. Harris gets side tracked by talking with a few students, but I felt like he was deflecting my question*].
Researcher:	So, you feel like they do most of the work or you do most of the work when it comes to their learning?
Mr. Harris:	Their learning? They are the only ones that can do the work for their learning. I can spoon feed them, but they are not going to learn it. So they do it.

Students feel inferior to the teacher because of the teacher's level of education attainment. Teachers and students argued that teachers were the upper echelons of the hierarchical system of knowledge by admitting that teachers were privileged in their thinking since they already had an education. Here, I found evidence of colorblindness since the teacher is the ultimate knowledge figure over the students. Colorblindness in itself is a thinking practice of the privileged. By choosing not to reflect on students of color and the educational inequalities that teachers need to address, teachers further keep students in a state of subordination, maintaining the status quo. As I was observing classes, I noticed that some of the teachers would make derogatory comments about students needing to get their education, which provides direct evidence of how teachers inadvertently participate in the establishment of subordinate positions.

I already have an education. For example, Craig has an interesting perspective about "caring" and how his teacher Mrs. Thomas demonstrates "care" for his science education. According to Craig, Mrs. Thomas does not need to demonstrate "care" because Mrs. Thomas already has an education and the students are trying to get their education.

Researcher:	Do you think that your teacher cares whether or not you learn science?
Craig (Mrs. Thomas):	Um, I don't know if she needs to care because she has the education and she has more students so she has to teach everybody.
Researcher:	So, you don't know if she cares or not?
Craig:	No, I don't know.
Researcher:	And why is that again?
Craig:	Because, for example, it is more students for her to care about and it is just one teacher. Plus, she already has the education. We are the ones that have to get the education.

Craig brings up two interesting points. First, he equates teachers' showing "care" to students as an option. He believes that since one teacher works with many students, the majority in this situation, the students, should illustrate the most "care" about their science learning. Second, Craig states that his teacher "has the education," also revealing that she has the epistemic privilege, a concept that we will further explore in the next chapter.

Daily sarcasm is not a form of caring. Teachers not only possessed an air about them because of their level of education, but some of them also demonstrated this belief in their daily attitudes. Stacy describes how her teacher Mrs. Thomas does not care about her science education. The reason she feels this way about Mrs. Thomas is because of Mrs. Thomas's attitude.

Researcher:	Okay, well let's go back a little bit. Do you think she cares that you learn science?
Stacy (Mrs. Thomas):	No.
Researcher:	Okay, what makes you say that?

Stacy:	Because towards me it's like the attitude. Some people she do show favoritism, but sometimes she pushes us off, don't want to say nothing, or have an attitude every, single day. And to me I just don't like that. That shows me that you don't care about me or my education. If I don't pay attention, that means I don't care either. But if I do pay attention, that just shows me that I care about my education, but you don't care about being here or teaching me.
Researcher:	So, how would a teacher who cares about your science education or education, how would they show you that they care? What kind of stuff would you want?
Stacy:	In them?
Researcher:	Yes. Or… If you wanted to change something about your teacher and you wanted her to show that she cares about you learning in science class, what would you do or what kind of stuff would you want her to do to show you "Hey, I care about you learning science?"
Stacy:	Just um, like, at least give out your time to the kids who don't understand or who even do understand, but just give out your time and show us the steps, give us respect, stay with us every day. Even at tutoring, but if you have something to do, then I understand that.
Researcher:	Okay, so. When she teaches science, what is it about her teaching that gives you the impression of "I don't care if you learn science or not?"
Stacy:	More to me is like the attitude. Attitude to me is not the most important thing, in your life you have to show some type of good attitude and then when you do have a bad attitude sometimes you need to just have to [briefly] have a bad attitude. But, when you are a teacher, and to be a student, and your teacher gives you a bad vibe, it just kills me, because it really says that you didn't really care to be here in the first place. And to me, I don't like that. It makes me willing to just go ahead and teach myself.

Mrs. Thomas's attitude, to which Stacy is referring, is something that I observed in Mrs. Thomas's classroom (see p. 44). From her students who participated in this study, and from interviews, one can deduce Mrs. Thomas's attitude stems from the students' low level of education in relation to Mrs. Thomas.

In conclusion, teachers described urban science students as childlike, babyish, and immature in nature. Teachers also insinuated that the students' juvenile demeanor was an essential reason why students struggled in their learning. The baby-sitters' complex demonstrated that some teachers possessed superior attitudes towards their urban science students and that those attitudes intersected with the overall infantilization of urban science students. Moreover, I found that the superior attitudes of teachers emulated the effect of colorblindness practiced in the classroom and the assignment of subordinate positions.

The principal illustrations of "care"

Teachers mainly demonstrated two illustrations of "care, " that I classified as "praise and whip." Teachers and students alike commented on characteristics of "praise and whip." Interestingly, neither participants considered "praise and whip" as separate entities, but rather a duo working together in different proportions.

The main characteristic of teachers' caring approach is more "praise than whip." The phrase "praise and whip" emerged from a teacher's interview, Mr. Rodriguez, but also perfectly labeled how other teachers participating in this study described their caring approach. "Praise" refers to the approach of applauding or complimenting students in relation to achieving academic goals. "Whip" refers to the

approach of getting students in line, in a tough manner, when they are unsuccessful or struggle to learn science.

Researcher:	How do you show students that you care whether or not they do or don't understand a topic in science?
Mr. Rodriguez:	Well, sometimes I praise and sometimes I take out the whip and show them that I am not happy with what they are doing. I've done that many times this year by telling them I am not happy and I know that you guys can do better.

From the data, I learned that teachers participating in this study did not possess solely a "praise" caring approach or a "whip" caring approach, but possessed both qualities in different ratios. In the "more praise than whip" category, teachers and students described an emotional care, physical illustration of care such as having an open door policy, physically being present at school, and designing lessons without much regard for the amount of time it took to design those lessons. Many teachers expressed "care" in a physical way.

Researcher:	How do you show students that you care about their science education?
Mrs. Johnson:	I come to work every day [*laughs*].

Mrs. Gonzales adds to the definition of "care" as caring for students' emotional well-being and for their academic success.

Researcher:	How would you define *care* as it relates to education?
Mrs. Gonzalez:	Um, I would say it is concern not only for students' academic success, but for their well-being in general. Their lives, their emotional well-being as they develop throughout.

Additionally, Mrs. Colbert states that "care" in education can be a physical illustration even without a verbal response.

Researcher: How would you define *care* as it relates to education?

Mrs. Colbert: Well, you have to care about the kids and their extra effort. I mean, like, I'm telling you that there are some teachers here who care about getting home as soon as school is out. Some of them miss so many days also. And then there are teachers that care about leaving their doors open so that kids can come in and talk to you during lunch or after school or something. And you know, there is a party I can be at right now, but I care about them getting their project done rather than going and eating a sandwich and cake with someone else.

Researcher: On your birthday?

Mrs. Colbert: On my birthday (laughs). Yes, even on my birthday I care about them.

Mrs. Colbert discusses physical illustrations of care, such as being available for students to answer questions and offer help on projects on assignments. She also discusses having an open-door policy so that students know that their teacher is available to help them. All Mrs. Colbert's students, or at least those who participated in the study, attested that she displays a positive, physical illustration of "care."

Marc: I can go to Mrs. Colbert anytime that I want. If she's leaving for a meeting or something, she always tells us we can come in the morning, lunch, or after school pretty much every day.

Along with being physically present in school and having an open-door policy so that students understood that teachers were available to help them with their science work, teachers said they showed care through lesson design. I found that teachers who portrayed a caring approach of more "praise than whip" were more likely to show "care" by designing lessons without regard to the length of time it took to design those lessons. I discussed in one of my first meetings with Mrs. Colbert that students would help prepare the activities for the lessons (see p. 45). In one of our conversations, Mrs. Colbert also

mentioned that teachers did not want to take the time to develop lessons to that extent because it required too much time.

The main characteristic of teachers' caring approach is more "whip than praise." During this caring approach, there was overwhelming agreement between the teachers who identified that their urban science students needed to be told the "truth" about the real world and that students must "care" before I can show "care."

Researcher:	How would you define *care* as it relates to education?
Mr. Harris:	Care? Um. It could be that they need care. It could be that the students need to care and I have to care. Um. I think it is more of the kids have care. It has to be more than the fictitious grades. At some point, they have to learn about the real-world.

Mr. Harris acknowledges that he needs to care, but he puts more ownership on the students needing to care.

Another interesting sub-theme that intertwined with the students' needing to care was teachers who made it their mission to tell students the "truth" about the real world. When teachers stated a caring approach of more "whip than praise," the word "whip" mostly referred to opening students' eyes about the world that exists outside of the classroom. According to teachers, the world outside of the classroom was unforgiving and did not give students multiple chances to turn in assignments. Here, I see evidence of microaggressions and stereotype threats, which also connects with the previously discussed categories. In the Baby-Sitter's Complex category, I introduced microaggressions from the data such as "childish," "bandits," and other juvenile descriptions that teachers used when referring to their urban science students; however, from the "Whip and Praise" theme, according to teachers, students were living up to

those microaggressions and thus needed a dose of "the real world." Shapiro and Neuberg (2007) suggest that negative stereotypes can lead to actual experiences relating to those stereotypes. For example, teachers used juvenile metaphors to describe students and some students lived up to those negative stereotypes through a self-fulfilling prophecy.

In conclusion, the principal illustrations of "care" demonstrated two main forms of "care" called "Praise" and "Whip." "Praise" refers to the approach of applauding or complimenting students in relation to achieving academic goals. "Whip" refers to the approach of getting students in line, in a tough manner, when they are struggling with learning science. I found that teachers did not use solely a "praise" approach or a "whip" approach when showing care for students. Instead, they used both elements in different ratios. Teachers who demonstrated a more "praise than whip" approach, also frequently displayed care in the form of an open-door policy for their students and created lessons without much regard for the amount of time it took to design those lessons. Teachers who demonstrated a more "whip than praise" approach, emphasized urban students' caring about themselves as a prerequisite for showing care and interestingly, were also more inclined to use microaggressions when referring to their students.

Summarizing the Results and Intersecting Themes

The grounded theory on care illustrated a veiled response to "caring." Using critical race theory, I found evidence of interest convergence, colorblindness, and microaggressions. In the "Moral Epistemology" category, teachers expressed their motivation for caring for students' science literacy. In their rationale of their motivation, I found evidence of interest convergence from critical race theory. According to Derrick Bell (1980), the terms *interest convergence* describes how the majority class will only

support legislation, or in this case curriculum, if it proves to also be beneficial to them. Some teachers described caring for students' science literacy as potentially being beneficial to them in the future and gave the rationale that students may choose health careers that could possibly put them in the position to take care of their health in the future.

Colorblindness asserts that teachers should not judge or evaluate students based on their race. As practiced in the classroom, colorblindness assumes that *all* students start at a neutral point. The problem with this ideology is that students of color frequently come in to the classroom with educational inequalities. Thus, practicing colorblindness in the classroom is not beneficial to *all* students. Teachers who acknowledged students' educational inequalities generally did not practice colorblindness in the classroom. I found colorblindness evident in themes such as "Topic is relevant to students' science literacy," where teachers discussed meaningful learning, real-life application, and helping students to develop their academic vocabulary.

I found evidence of the negative outcomes of colorblindness. Peery (2011) states that colorblindness assigns subordinate positions and it keeps students who are in inequitable positions in those same positions. I found a connection with this negative effect of colorblindness specifically with the teacher's role in the classroom. If the teacher displays a dominant role in the classroom, he or she also simultaneously projects to students that the teacher is the ultimate knowledge holder, or authority figure, in the classroom. When this relationship occurs, teachers assume an epistemic advantage over their students. One may argue that the teacher should be the authority figure and the dominant knower of knowledge in the classroom, but I contend that when teachers

excessively portray this representation to their students, an epistemic unjust environment forms. To aid in explaining this relationship**,** the structural center of *Figure 6* represents an unjust epistemic environment. The different color ribbons emerging from epistemic injustice represent the categories and themes that illustrate "care." In the next chapter, I describe how those categories and themes represent shades of "caring."

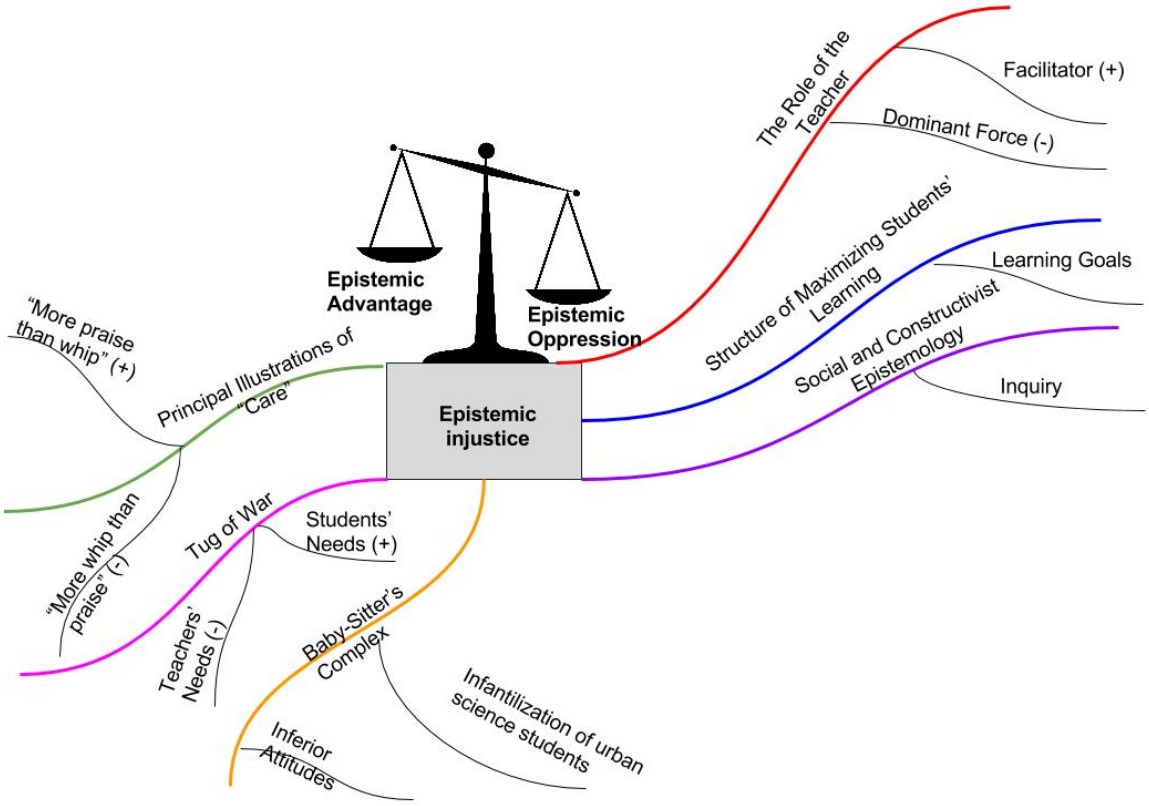

Figure 7. Emerged Grounded Theory on "Caring" for Urban Science Students' Science Literacy. (+) and (-) notates positive and negative attributes to "Caring."

Chapter 5: Shades of "Caring" in the Guise of Epistemological and Ontological Beliefs

The purpose of this grounded theory research study was to investigate how urban science teachers' epistemological beliefs, beliefs about the acquisition of knowledge, and ontological beliefs, beliefs about the nature of reality, influence how teachers demonstrate "care" for urban students' science literacy. I used the term *care* to describe serious attention or consideration applied to teaching effectively, so as to avoid damage and lower the risk of students failing to become science literate. I used the term *science literacy* to describe the readiness standards, supporting standards, and scientific process skills needed to read, write, and discuss science (biology).

Findings in Relation to the Research Questions

As the principal investigator, I constructed three sub-research questions. In the previous chapter, I presented the categories, themes, and sub-themes that emerged from the study. In this section, I summarize the research findings as they pertain to each research question. I then summarize the findings as they relate to other scholars' findings in their research.

Research Question 1

How do urban science teachers describe their epistemological and ontological beliefs as they relate to "caring" for their urban science students science literacy? Teachers described their ontological beliefs as aligned with *not* having a fixed set of "truths," a concept that I expand on in the third research question. They stated their role as a facilitator during classroom discussions and argued that students need to collaborate

in groups, which is what scholars have categorized as beliefs of Ontological Relativists (Schraw & Olafson, 2008).

Additionally, from the teachers' interviews, I found that teachers described their epistemological beliefs as aligning mostly with the social constructivist paradigm. Teachers believed in knowledge being constructed through meaning and within a social context. Teachers described their role in an effective learning classroom as a facilitator and cited inquiry, discovery learning, questioning, and hands-on learning as essential teaching methods for their students. The social constructivist beliefs and the accompanying strategies align with Powell and Kalina's (2009) study, in which teachers who identified with social constructivist epistemological beliefs also used the same learning strategies.

In addition to their social constructivist epistemological beliefs, some teachers described veering away from their curriculum to meet the essential learning needs of the students. For example, when I asked Mrs. Colbert, "How do you decide what to teach?" Mrs. Colbert replied, "I think part of it is based on our curriculum framework, but then you have choices to make. You have to look at your students and figure out what they need. For example, do they need scaffolding? Do they need additional material? What do they need to get to this point?" Mrs. Colbert's response aligns with beliefs of what scholars have categorized as Epistemological Relativists. In fact, Mrs. Colbert described her beliefs as not a "one-size, fits all" curriculum (Schraw & Olafson, 2008). She prefers to meet the individual needs of students, even if that means derailing from the standard curriculum. Here, I saw evidence of the critical race theory (CRT) theme colorblindness.

When a teacher acknowledges students' educational inequalities and addresses those needs, the teacher is not practicing colorblindness in the classroom.

Other teachers also described meeting the needs of their students with regard to advancing their science academic vocabulary. Both teachers and students described the importance of distinguishing science academic vocabulary from everyday vocabulary. Gee (2004) states that teachers should make this distinction through "situated meanings," which is another component of the belief system of ontological relativists. Increasing students' academic vocabulary is a best practice of inquiry and discovery learning, since students situate the meaning of the word in the context of their learning experience (Silva, Weinburgh, Malloy, Smith & Marshall, 2012). Teachers and students alike also described the benefits of an increased science academic vocabulary when students encounter End of Course (EOC) biology exam questions. Again, I found the colorblindness relevant since some teachers specifically addressed students' academic vocabulary needs.

Teachers discussed maximizing students' learning through the use of learning goals. Using learning goals and learning targets, smaller versions of learning goals, helps to provide focus and structure for the lessons. Teachers described developing learning goals that explained not only what students needed *to know*, but also embodied what students needed to be able *to do*. The revelation that learning goals are components of teachers' epistemological beliefs is synonymous with Duschl's (2008) work, which argues that incorporating what students should be able *to do* is a core foundation of science. He further comments that students who understand science learning goals in the context of what they need to be able *to know* and *to do*, such as generating explanations

and evaluating scientific evidence, promotes the development of science literacy for all students.

As a way to demonstrate "care" to their students, teachers incorporate real-life application or relevancy into lessons. Some teachers interpreted *relevancy* as incorporating enjoyment or adding "hooks" into the lesson to get students interested in the topic. Some teachers said they needed students to "care" about their science literacy as a pre-requisite for "caring" about science students. Here, I recognized the CRT theme interest convergence, which contends that the majority class will only support curriculum, if it proves to also be beneficial to them. Teachers prioritized their needs first as a pre-requisite for students to learn science. Teachers argued that they had requirements that needed to be met in teaching their urban science students. Since some teachers described a pre-requisite for "caring" about students' science literacy, this pre-requisite illustrated that some teachers did not see a personal, mutual benefit in caring about students' science literacy.

Research Question 2

How do urban science students describe their teachers' epistemological and ontological beliefs as they relate to "caring" for their science literacy? Students described their teachers through two principal illustrations of care: "Praise" and "Whip." The element "Praise" refers to approaching students in a manner that focuses on positive attributes of urban science students, while "Whip" refers to approaching students in a manner that focuses on the negative attributes of urban science students. Teachers showed care to their urban science students by using both elements of "praise and whip," in different ratios. Teachers either instituted "More praise than whip" or "More whip than

praise." The "Praise and Whip" finding aligns with the research of Alder (2002), who found remnants of "whip" as a caring attribute. Additionally, "The Praise" component of my findings aligned with research of other scholars, who say, "Expressing positive statements to encourage student effort, monitoring and assisting students during learning activities, and individualizing learning outcomes" are all ways to convey a caring attitude (Garza, Alejandro, Blythe, and Fite, 2014, p. 4).

As described by the students, within the "Praise and Whip" paradigm, teachers displayed a physical illustration of care. Teachers who aligned with the "More praise than whip" paradigm displayed physical illustrations of care such as being available to students, having an open-door policy, preparing lessons independent of time, and also demonstrating emotional care for their students. Garza (2009) found similar results in his research on students' perceptions of caring. In his study, students perceived teachers who care as being physically available to them, implementing scaffolding instructional strategies, consistently keeping a supportive classroom environment, and kind attitudes (Garza, 2009; 2013). Garza's finding that students perceived their teachers' attitude as a component of illustrating care aligns with my findings. Alder (2002) also found that students perceived teachers who made time for their students as caring. Also in the physical illustration of care, students described a caring teacher as one who walks around during teaching and does not solely sit at his or her desk. Synonymous with other research on caring teachers, Ferreira and Bosworth (2001) cite that students stated a teacher who cares "doesn't just sit at her desk and let you do the work" (p. 27). All students agreed that unprepared lessons or disengaging lessons conveyed to students that their teachers did not "care" about their science literacy.

Students also described their teachers' demonstrations of "care" as having attitudes of superiority towards them, which connected with the "More whip than praise" theme. The superior attitudes stemmed from students current level of education attainment and teachers' perceptions that students *needed* teachers help in order to achieve a level of education in comparison to the teachers. Alder (2002) also found the root of superior attitudes in teachers' statements that they had their education and students needed to get theirs. Here, I also found colorblindness relevant as evidenced through teachers' microaggressions and stereotypical threats. Teachers in the "More whip than praise" theme were more inclined to engage in microaggressions when describing their students. Furthermore, the use of microaggressions gave insight into how teachers actually demonstrated "care" in the classroom.

Research Question 3

How do teachers actually demonstrate their epistemological and ontological beliefs in the classroom as they relate to "caring" for their students' science literacy? The order in which I collected data was extremely important to this research. The findings in question three could have yielded different findings had I not conducted the teachers' classroom observations before conducting the teachers' and students' interviews. Because of the organization of the study, I found that teachers mostly demonstrated "care" to their urban science students in the adverse of their voiced epistemological and ontological beliefs. Although all teachers expressed epistemological beliefs that aligned with the role of a facilitator in the classroom, most teachers exhibited a more dominant, traditional role in the classroom. Teachers who demonstrated the traditional role in the classroom frequently had direct-teaching methods and these

methods revealed that students had few opportunities to show they understood the lesson. Additionally, when teachers in this role did do hands-on experiments, they brought all of the materials to the students, gave students step-by-step vocal directions, and dominated the follow-up discussion providing their rationale of the learned concept while students sat intently listening to the teachers' thoughts of the concept.

Initially, when teachers described their ontological beliefs, they mostly described beliefs that aligned with *not* having a fixed set of "truth," thus identifying them as relativists. However, as teachers began to demonstrate and explain their rationale, they really exhibited beliefs of ontological realists, thus having a fixed set of "Truth." As evidence, I used the example that teachers described the need to teach urban science students the "right" way. According to teachers, all students had one "right" way to derive an answer as opposed to many ways. A profound analysis of teachers who insisted that students learn the "right" way was that some of the teachers were the same race as the majority of the students in their class.

In addition to teachers' ideas about teaching students the "right" way, teachers also expressed the need to teach urban science students the "truth" about the real world. From the teachers' perspectives, the real world does not offer students chances as seen in an urban student's typical science classroom. For example, teachers discussed how the real world does not offer multiple chances for students to turn in late assignments or how the real world will not accept students' excuses as the typical urban science students' classroom.

Interpretation of Data Findings

The Knowledge-Holder and Epistemic Injustice

My findings correlate with those of scholars who have identified two holistic epistemological beliefs and two holistic ontological beliefs: Epistemological Relativists, Epistemological Realists, Ontological Realists, and Ontological Relativists (Schraw & Olafson, 2008; Olafson & Schraw, 2006). I argue that when science teachers demonstrate beliefs in the classroom that *mostly* align with being Epistemological Realists and Ontological Realists, two major events occur that relate to caring for students' science literacy. First, teachers exercise authority as the ultimate knowledge-holder and convey this authority to students. Second, when teachers represent themselves as the ultimate knowledge-holder, the teacher establishes an academically dependent, teacher-student relationship in the classroom. In this relationship, students' learning depends upon the teacher, who establishes a "right" method for thinking and solving problems, propagating the attitude that knowledge moves in a single direction—from the teacher to the student. Consider the direct-teaching method used frequently among Epistemological Realists and Ontological Realists. Initially, the direct teaching method served as a bridge between rote learning and critical thinking; however, consistent use of the direct teaching method is no longer adequate because it makes students dependent upon their teacher rather than independent in their own learning. Freire (1970) describes the one-way flow of knowledge the "banking model" in which teachers become the "depositors" and students become the "depositories" (p. 21). Moreover, the learning sought by the students is contingent upon the knowledge the teacher wants students to acquire, regardless of whether that knowledge has sufficiently quenched students' stated or unstated desire, for

more breadth and depth of learning. As long as the teacher is the knowledge-holder in the classroom, the flow of knowledge between the teacher and students becomes an unequal distribution. As long as there is an unequal distribution of a flow of knowledge, students are not privy to some knowledge creating an epistemic unjust environment.

Fricker (2007) describes one form of epistemic injustice *hermeneutical injustice,* as a situational injustice in which "some significant area of one's social experience [is] obscured from collective understanding owing to persistent and wide-ranging hermeneutical marginalization" (p. 155). Fricker further contends that hermeneutical injustice is structural, or systems-based, and those who hold epistemic advantage in the system exclude those affected by the marginalization from a knowledge of community, that could be beneficial to them. Moreover the dominant group exposes their thinking or ways of knowledge to the marginalized group, epistemically oppressing the marginalized group. Here, I want to interject how Fricker's ideas of *hermeneutical injustice* align with the CRT framework of colorblindness found in this study. Colorblindness is a systemic practice and a negative effect of its practice is to assign subordinate positions to marginalized groups (Peery, 2011). Fricker's ideas also suggest an assignment of subordinate positions targeting marginalized groups.

Dotson (2014) affirms Fricker's claim that knowledge exclusion creates epistemically advantaged and epistemically oppressed groups. In fact, she specifically defines *epistemic oppression* as the act of consistently excluding students from contributing to their knowledge production. She further comments that the act of epistemic exclusion occurs when oppressors infringe on students' knowledge contribution, which decreases students' ability to participate in the community of

knowledge. The epistemically oppressed group's decreased participation in the community of knowledge creates an academic dependent relationship.

As Andrews and Okpanachi (2012) state:

> Epistemic oppression leads to academic dependency in the sense that the inability of an individual to make knowledge claims leads to the reliance on already "established" knowledge. And the perpetuation of this trend tramps upon creativity, innovation, and the reflexivity needed to establish a viable intellectual independence. (p. 88)

Consequently, when teachers exercise authority as the ultimate knowledge-holders, teachers strip students of their power, which prohibits students from becoming stakeholders and co-contributors to their own science literacy. When teachers disempower students in their learning, they create an unjust environment of epistemic power in which students become epistemically oppressed and teachers become epistemically advantaged, making students academically dependent upon their teacher. The teachers I observed further illustrated academic dependency through the infantilization of urban students.

Infantilization

Levy (1943) first introduced the concept of *infantilization* to describe elements of maternal overprotection and, ironically, he also uses the term "care" in his explanation of the concept. He describes *infantilization* as " the performance of activities in the care of the child beyond the time when such activities usually occur. Infantilization refers also to the continuity of the same type of care ordinarily modified in later years" (p. 53). Since

Levy's initial definition, psychologists have expanded the use of *infantilization* to include other types of relationships.

Sharlin and Polansky (1972) define *infantilization* as the following:

> *Infantilization* refers to actions and communications by which we encourage another to remain, or to become, less competent and self-sufficient than he might otherwise be-to act as if he were a young child, e.g., helpless, fearful, selfish, at the mercy of his impulses. (p. 93)

Sharlin and Polansky's use of *infantilization* is in a general sense, but I also found another contextual use of *infantilization* within the literature, in conjunction with feminist theory.

Burman and Stacey (2010) describe patriarchy's infantilization of women, the process of treating women like children, as an illustration of a woman's dependence on a man. To expand on this argument, consider how society generally thinks of children. Society characterizes children as *dependent* on another human being to care for their daily needs. For example, children need a place to live; they depend on adults to buy and/or make their food, and for a means to get to and from school, etc. If one considers the infantilization of women, patriarchy frequently pairs women with children. When we pair the terms *women and children*, the implications that accompany those terms include defenseless, powerless, sub-par and in need of a man, who symbolizes the adverse of the aforementioned adjectives, to rescue "her" from extenuating circumstances (Burman, 2008; Sylvester, 1998). I see a similarly dependent relationship arising from urban science teachers' demonstration of "care" for their students' science literacy.

Teachers infantilized their urban science students through a multi-faceted complex I described as a "Baby-Sitters' Complex." Students heavily depended on their teachers for the knowledge necessary to achieve proficient science literacy. In the "Baby-Sitters' Complex," teachers emphasized that "students" need to learn responsibility and take ownership in their science literacy; however, teachers demonstrated the opposite of their claim that students needed to take responsibility in their science literacy by a process that I called spoon-feeding information, which in essence is the infantilization of urban students. When teachers spoon-fed information to urban science students, they watered down concepts, teaching students at the incorrect grade level expectation.

Shades of Caring

All teachers participating in this study said that they care for their urban students' science literacy. However, I found that expressing "care" to urban students' science literacy is multidimensional. Although all teachers stated that they "care," different meanings or shades of caring intersected with teachers' epistemological and ontological beliefs. In Figure 6, I have illustrated the different meanings of care. Each color represents an element of care. The intensity of the colors within the theme illustrates a negative effect of caring for urban students' science literacy. Moreover, the arrows on the figure represent that the further an element of care is located to the top, and to the right of the table, the greater the positive affect of caring for urban students' science literacy. Items at the bottom of the table illustrate where students are highly, academically dependent on their teacher and consequently indicate a lower level of care for students' science literacy. For example, a teacher who infantilizes urban science students, creates teacher-centered lessons, and assumes the dominant role in the classroom illustrates a low

level of care for students' science literacy. In comparison, teachers who empower students in their learning, prompt students to think and reflect, and assume the facilitator's role in the classroom illustrate a high level of care for students' science literacy.

(-) Display of Caring → (+) Display of Caring

(+) Display of Caring ↑ (-) Display of Caring

Teacher's Disposition	Physical Illustration	Bloom's Taxonomy	Teacher's Role in Classroom	Teaching Focus	Respect for Students' Cognitive Processes	Students' Well-being in Classroom
Appealing to Students' Learning Needs	Multiple opportunities to learn concepts	Synthesis	Facilitator	Learner-Centered	Prompted to think and reflect	Empowered
Students' Emotional Well-being	Lesson Planned Independent of Time	Problem Solving	Pseudo-Facilitator	More Learner Centered than teacher-centered	Open to different modes of thinking/methods	Activated
Inferior Attitudes	Open Door Policy	Application	Pseudo-Dominant	More Teacher Centered than Learner-Centered	Over-opinionated feedback on students	Enabled
Teachers' Needs Prioritized Before Students' Needs	Physically being present at work	Knowledge	Dominant	Teacher-Centered	"Right" Thinking/Method	Infantilized

Figure 8. Shades of "Caring" for Urban Science Students' Science Literacy. The arrows illustrate that the further up and to the right of the table, the stronger the display of care

Critical-Race Gendered Epistemologies

In this study, I attempted to answer the research questions by using critical race theory as a lens to interpret the data. The critical race theory lens helped me identify, within the actions of teachers who participated in the study, such behaviors as interest convergence, microaggression, and colorblindness. Interestingly, I also found an intersectionality between critical race theory and feminism as it relates to academic dependency through the concept of infantilization. Thus far, I have only discussed the effects of teachers symbolized as the ultimate knowledge holder in the classroom and how this symbol creates and academic co-dependency with students. Now, I will focus this discussion on how critical race theory and feminist epistemologies have the ability to counteract academic co-dependency, thereby permitting students to be co-contributors of knowledge in the classroom.

Bernal (2002) argues that students of color can be creators and knowledge holders in the classroom through their critical race-gendered epistemologies. She further contends that teachers, traditionally, have neglected the value of students' experiences, cultures, and languages in the classroom. Ladson-Billings (2000) expands Bernal's argument by explaining that epistemologies heavily relate to a person's worldviews, which encompass different situated meanings. If we, as teachers, acknowledge those epistemologies in the classroom, we will shift our approaches from a dominant epistemology toward a just epistemology.

Conclusion

The present study aimed to investigate the influence of urban science teachers' epistemological and ontological beliefs on "caring" for their urban students' science

literacy through the theoretical framework of critical race theory. Six teachers and 18 students (three students from each teacher) participated in this study until the emerged grounded theory exhibited saturation. Seven categories and 17 themes emerged from the analyzed collected data, revealing that there were different shades to caring for students' science literacy. The categories and themes pointed to an epistemic unjust environment between teachers and students. In this environment, teachers were epistemically privileged while the students were epistemically oppressed. The common denominator between the two groups in this unjust environment resided in academic dependency. In an effort to combat this academic dependency, I argued that teachers should acknowledge the critical race-gendered epistemologies that students bring into the classroom in an effort to move towards a just epistemic environment.

Implications for Teaching

Limitations and Future Research

Several recommendations and modifications emerge for future research into caring for students' science literacy. The number of participants was a limitation of the study. I used six teacher participants and three students from each teacher. The number of participants, both teachers and students, should increase in future studies. Specifically, the ratio of students per teacher should increase in order to generate a collective perspective on the students' teacher.

In addition to increasing the number of participants, extending the length of the study from six weeks of classroom observations to potentially a full academic year of classroom observations would be valuable to the results of the study. Conducting a full

academic year of classroom observations will allow researchers to see if teachers' epistemological and ontological beliefs evolve throughout the year.

This study took place in only the southern region of the United States. Therefore, future studies should examine participants from different parts of the United States to eliminate the possibility of region-based findings. Going to different regions in the United States could possibly present a further description of how teachers demonstrate care to their urban students' science literacy.

This study was limited to ninth grade teachers and students and limited to the course of biology. Researchers should expand future studies to include all high school grade levels of teachers and students as well as various science courses (i.e., chemistry, physics, etc.). Furthermore, it would be interesting to compare the shades of care from primary to secondary levels and compare the findings through a longitudinal study.

Implications for In-Service Teachers

The findings from this study suggest that caring for students' science literacy is a multi-layered effort and teachers may not be aware of the impact of their demonstrations of care. Furthermore, teachers may or may not be aware of the unjust epistemic environment, which causes academic co-dependency, when teachers illustrate a low level of care for students' science literacy. Such conversations on how teachers illustrate care can bring awareness to the teacher and influence their practice.

Implications for School and District Leadership

This study is valuable to school and district leadership who could initiate professional development two-fold. The first professional development should target teachers and should focus on eliminating academic co-dependency between teachers and

students. In the professional development for teachers, teachers would learn the unfortunate outcomes of students' decreased critical thinking skills when instituting classroom academic co-dependency. Moreover, professional development of this nature will show teachers how to incorporate students' critical race-gendered epistemologies in the classroom so that students become co-contributors of knowledge in the classroom.

In the contextual framework of the present study, I described teachers who do not help students to grow from a basic level of understanding to a critical level of understanding science, *Veiled Chameleons*, because they are able to blend into the environment and teach in a manner undetected by school administrators. Thus, the second professional development should target school administrators (i.e., principals, assistant principals, and deans) and teach them how to identify *Veiled Chameleons*. In this professional development, school administrators should learn how to move from the traditional classroom-monitoring role to the instructional leader role. Traditionally, in the classroom-monitoring role, administrators might have rewarded teachers for students' compliance in the classroom. For example, traditionally, if a school administrator walked into a classroom and observed students writing down notes, this observation might have indicated to the administrator that students were learning. However, a professional development about academic co-dependency, aimed towards building instructional leaders, would teach administrators how to effectively monitor classroom instruction when conducting classroom observations and how to ask teachers critical instructional questions. Both types of professional developments, for school administrators and teachers, could bring awareness to academic co-dependency and provide methods on ending it in the classroom.

Appendix A:

Teachers' Consent to Participate in Research, Parents' Permission and Students' Assent to Participate in Research

Texas Christian University
Fort Worth, Texas

CONSENT TO PARTICIPATE IN RESEARCH

Title of Research:

The Influence of Urban Science Teachers' Epistemological and Ontological Beliefs on 'Caring' for Urban Students' Science Literacy

Funding Agency/Sponsor:

- Not Applicable

Study Investigators:

- Dr. Molly Weinburgh College of Education
- Channa Barrett, PhD Student in Educational Studies: Science Education

What is the purpose of the research?

The purpose of this study is to analyze teachers' epistemological and ontological beliefs on how teachers' demonstrate care for their urban science students' science literacy.

How many people will participate in this study?

Ten teachers and three students from each teacher.

What is my involvement for participating in this study?

You will participate in two 15-20 minute interviews, complete one teacher survey, and the secondary investigator will conduct classroom observations (once a week for seven weeks). All interviews will be recorded and transcribed by the investigator. The investigator will also arrange with you for thee of your students to complete one 10-15 minute student interview, at a time that minimizes lost instructional time. Only three students will be chosen out of your class period to complete an interview.

How long am I expected to participate in this study and how much of my time is required?

You are expected to participate in this study for 11 weeks total. 7 weeks of classroom observations (one period per week), two interviews that will take place on the 8th and 10th week of the study, and one survey that will take place on the last week, 12th week of the study. Your participation will not be needed for the 11th week of the study.

What are the risks of participating in this study and how will they be minimized?
You might experience shyness when being interviewed by the researcher. To minimize this risk, you can stop the interview at any time and/or completely withdraw from the study at any time until the final report is submitted. Additionally, you may feel obligated to participate in the study since your principal is recommending you. To minimize this risk, you may decline to participate in the study without recrimination.

What are the benefits for participating in this study?
This study will allow you to reflect on your teaching. Moreover, it will contribute to the understanding of epistemological beliefs (the acquisition of knowledge) and ontological beliefs (the nature of reality) and how this impacts 'caring" for students science literacy.

Will I be compensated for participating in this study?
No compensation will be provided.

What is an alternate procedure(s) that I can choose instead of participating in this study?
There are no alternate procedures.

How will my confidentiality be protected?
All data and consent forms will be stored in a locked cabinet. Pseudonyms, in the forms of numbers, will be used to maintain participants' confidentiality. For example, a teacher whose real name is "Mr. Doe", may be given the identifying numbers of "168431".

Is my participation voluntary?
Your participation in this study is completely voluntary.

Can I stop taking part in this research?
You may choose to withdraw consent and/or withhold your research data at any time before the final document is published.

What are the procedures for withdrawal?
You can contact any of the following people to withdraw from this study up until the time that the research has been submitted for publication:

Channa Barrett, Ph.D. student in Educational Studies: Science Education
channa.barrett@tcu.edu

Dr. Molly Weinburgh TCU College of Education Telephone: (817) 257-67155
m.weinburgh@tcu.edu

Will I be given a copy of the consent document to keep?
Yes, you will be given two copies of this consent document. Keep one copy for your records. Return the second copy to me in person or by email.

Who should I contact if I have questions regarding the study?
Channa Barrett, Ph.D. student in Educational Studies: Science Education
channa.barrett@tcu.edu
Dr. Molly Weinburgh, Principal Investigator, College of Education
m.weinburgh@tcu.edu

Who should I contact if I have concerns regarding my rights as a study participant?
Dr. Tim Barth, Co-Chair, TCU Institutional Review Board, phone: 817-257-4320; email: t.barth@tcu.edu
Dr. Sally L. Fortenberry, Co-Chair, TCU Institutional Review Board, phone: 817.257.6752, email: s.fortenberry@tcu.edu

Your signature below indicates that you have read or been read the information provided above, you have received answers to all of your questions and have been told who to call if you have any more questions, you have freely decided to participate in this research, and you understand that you are not giving up any of your legal rights.

Participant Name (please print):
_____

Participant Signature: _____**Date:**_____

Investigator Name (please print):
_____

Investigator Signature:
_____**Date:**_____

Consent for Audio Recording of Interview

Record types. As part of this study, the following types of media records will be made of you during your participation in the research:

- Audio Recording

Record uses. Please indicate what uses of the media records listed above you are willing to permit by initialing below and signing the form at the end. We will only use the media records with your consent.

- The media record(s) can be studied by the research team for use in this research project.
  Please initial: _____
- The transcriptions of these media records can be used for scientific or scholarly publications.
  Please initial: _____
- The transcriptions of these media records can be used at scholarly conferences, meeting, or workshops.
  Please initial: _____
- The transcriptions of these media records can be used in classrooms.
  Please initial: _____

I have read the above descriptions and give my consent for the use of the media recordings as indicated by my initials above.

Name: _____

Signature: _____ Date: _____

If you have concerns regarding your rights as a study participant, contact Dr. Tim Barth, Co-Chair, TCU Institutional Review Board, phone: 817-257-4320; email: t.barth@tcu.edu
Dr. Sally L. Fortenberry, Co-Chair, TCU Institutional Review Board, phone: 817.257.6752, email: s.fortenberry@tcu.edu

Texas Christian University

Fort Worth, Texas

ASSENT TO PARTICIPATE IN RESEARCH

Title of Research:

The Influence of Urban Science Teachers' Epistemological and Ontological Beliefs on 'Caring' for Urban Students' Science Literacy

Funding Agency/Sponsor:

- Not Applicable

Study Investigators:

- Dr. Molly Weinburgh, College of Education
- Channa Barrett, PhD Student in Educational Studies: Science Education

What is the purpose of the research? The purpose of this study is to analyze teachers' epistemological and ontological beliefs on how teachers' demonstrate care for their urban science students' science literacy.

How many people will participate in this study?

The participants for this study will be 10 teachers and three students per teacher.

What is my involvement for participating in this study?
You may notice the researcher sitting in the back of the classroom, writing in a journal. You may also notice the researcher listening to students' dialogue when in a group setting. Additionally, three of you may be chosen to complete one 10-15-minute student interview. The interviews will be audio-recorded.

How long am I expected to participate in this study and how much of my time is required?
You are expected to participate in this study for a total of 8 weeks. In weeks #1-#7, the researcher will conduct classroom observations in which she may write down some of the dialogue between you and your teacher in the classroom. You will not need to participate in week #8-#10, or #12. You are expected to participate in week #11, in which the researcher will conduct one 10-15 minute student interview.

What are the risks of participating in this study and how will they be minimized?

You will miss a portion of your class to complete an interview. The researcher will make sure that you are missing a small portion of class that will not consist of instructional time.

What are the benefits for participating in this study?
You will be able to give your student experiences as a biology student.

Will I be compensated for participating in this study?
No compensation will be provided.

What is an alternate procedure(s) that I can choose instead of participating in this study?
There are no alternate procedures. If you choose, you may withdraw from the study at anytime. However, you will still participate in all classroom activities from your teacher.

How will my confidentiality be protected?
All data and assent forms will be stored in a locked cabinet. Pseudonyms, in the forms of numbers, will be used to maintain participants' confidentiality. For example, if your real name is "Mary", may be given the identifying numbers of "168431".

Is my participation voluntary?
Your participation in this study is completely voluntary. This means you can choose to participate or not to participate in this study.

Can I stop taking part in this research?
You may choose to withdraw assent and/or withhold their research data at any time until the final report is submitted.

What are the procedures for withdrawal?
You can contact any of the following people to withdraw from this study up until the time that the research has been submitted for publication:

Channa Barrett, Ph.D. student in Educational Studies: Science Education
channa.barrett@tcu.edu

Dr. Molly Weinburgh TCU College of Education Telephone: (817) 257-6155
m.weinburgh@tcu.edu

Will I be given a copy of the consent document to keep?
Yes, you will be given two copies of this assent document. Keep one copy for your records. Return the second copy to me in person or by email.

Who should I contact if I have questions regarding the study?
Channa Barrett, Ph.D. student in Educational Studies: Science Education

channa.barrett@tcu.edu

Dr. Molly Weinburgh, TCU College of Education Telephone: (817) 257-6155
m.weinburgh@tcu.edu

Who should I contact if I have concerns regarding my rights as a study participant?

Dr. Tim Barth, Co-Chair, TCU Institutional Review Board, phone: 817-257-4320; email: t.barth@tcu.edu
Dr. Sally L. Fortenberry, Co-Chair, TCU Institutional Review Board, phone: 817.257.6752, email: s.fortenberry@tcu.edu

Your signature below indicates that you have read or been read the information provided above, you have received answers to all of your questions and have been told who to call if you have any more questions, you have freely decided to participate in this research, and you understand that you are not giving up any of your legal rights.

Participant Name (please print):
_____

Participant Signature: _____**Date:**_____

Investigator Name (please print):
_____

Investigator Signature:
_____**Date:**_____

Students' Assent Form

Record types. As part of this study, the following types of media records will be made of you during your participation in the research:

- Audio Recording

Record uses. Please indicate what uses of the media records listed above you are willing to permit by initialing below and signing the form at the end. We will only use the media records with your consent.

- The media record(s) can be studied by the research team for use in this research project.
  Please initial: _____
- The transcriptions of these media records can be used for scientific or scholarly publications.
  Please initial: _____
- The transcriptions of these media records can be used at scholarly conferences, meeting, or workshops.
  Please initial: _____
- The transcriptions of these media records can be used in classrooms.
  Please initial: _____

I have read the above descriptions and give my consent for the use of the media recordings as indicated by my initials above.

Name: _____

Signature: _____ Date: _____

If you have concerns regarding your rights as a study participant, contact Dr. Tim Barth, Co-Chair, TCU Institutional Review Board, phone: 817-257-4320; email: t.barth@tcu.edu
Dr. Sally L. Fortenberry, Co-Chair, TCU Institutional Review Board, phone: 817.257.6752, email: s.fortenberry@tcu.edu

Texas Christian University
Fort Worth, Texas

PARENT'S PERMISSION TO PARTICIPATE IN RESEARCH

Title of Research: The Influence of Urban Science Teachers' Epistemological and Ontological Beliefs on 'Caring' for Urban Students' Science Literacy

Funding Agency/Sponsor: Not Applicable

Study Investigators:

- Channa Barrett, PhD Student in Educational Studies: Science Education
- Dr. Molly Weinburgh, TCU College of Education

What is the purpose of the research?

The purpose of this study is to analyze teachers' epistemological and ontological beliefs on how teachers' demonstrate care for their urban science students' science literacy.

How many children will take part in this study?
The participants will be 10 teachers and three students from each teacher.

What is my and my child's involvement for taking part in this study?
Your son/daughter may notice the researcher sitting in the back of the classroom, writing in a journal. Your child may also notice the researcher listening to students' dialogue when in a group setting. Additionally, your child may be chosen to complete two 15-minute student interviews. The interviews will be audio-recorded.

For how long is my child expected to be in this study, and how much of my child's time is required?
Your son/daughter can are expected to participate in this study for 6 weeks.

What are the risks of taking part in this study and how will they be minimized?
Your son/daughter will miss a portion of his/her class to complete an interview. The researcher will make sure that students are missing a small portion that will not consist of instructional time.

What are the benefits for taking part in the study?

Your son/daughter will be able to give his/her student experiences as a chemistry student.

Will I be compensated for taking part in the study?
No compensation will be provided.

What is an alternate procedure(s) that I can choose instead of having my child take part in this study?
Your child may choose not to participate. However, your child will still participate in all classroom activities from your teacher.

How will my child's confidentiality be protected?
All data and parent permission forms will be stored in a locked cabinet. Pseudonyms, in the forms of numbers, will be used to maintain your child's confidentiality. For example, a student whose real name is "Mary", may be given the identifying numbers of "168431".

Is my child's participation voluntary?
Your child's participation in this study is completely voluntary. This means that your child can choose to participate or not to participate in this study.

Can my child stop taking part in this research?
Your son/daughter may choose to withdraw consent and/or withhold their research data at any time until the final report is submitted and or the study is presented at research conferences.

What are the procedures for withdrawal?
You can contact any of the following people to withdraw your student from this study up until the time that the research has been submitted for publication:

Channa Barrett, Ph.D. student in Educational Studies: Science Education
channa.barrett@tcu.edu

Dr. Molly Weinburgh, TCU College of Education Telephone: (817) 257-6155
m.weinburgh@tcu.edu

Will I be given a copy of the permission document to keep?
Yes, you will be given two copies of this parent permission document. Keep one copy for your records. Return the second copy to me in person or by email.

Who should I contact if I have questions regarding the study?
Channa Barrett, Ph.D. student in Educational Studies: Science Education
channa.barrett@tcu.edu

Dr. Molly Weinburgh, TCU College of Education Telephone: (817) 257-6155
m.weinburgh@tcu.edu

Who should I contact if I have concerns regarding my child's rights as a study participant?

Dr. Sally Fortenberry, Chair, TCU Institutional Review Board, Phone 817 257-6752.
Dr. Bonnie Melhart, TCU Research Integrity Office, Telephone 817-257-7104.

Your signature below indicates that you have read or been read the information provided above, you have received answers to all of your questions and have been told who to call if you have any more questions, you have freely allowed your child to participate in this research, and you understand that you are not giving up any of your legal rights.

Child's Name (please print): _____ Date of birth: _____

Parent's Name (please print): _____

Parent's Signature: _____ Date:_____

Investigator's Signature: _____ Date:_____

Appendix B:

Classroom Observation Protocol

How will classroom observations be conducted?

- The teacher has the permission to introduce the researcher to the class at the beginning of the study. " This is Ms. Barrett. She is here observing our class and she is a student at Texas Christian University. She will be observing our class for the next seven weeks."

- The researcher will always sit towards the back of the class. The researcher will not interrupt class with questions towards the teachers or the students.

- The researcher will not respond to instances of student obscenity, classroom interruptions, and/or issues of discipline.

- The researcher will not be responsible for students if the teacher needs to step outside of the room.

- The researcher will make sure that all cellular devices are silent before entering the classroom

Appendix C:

First Interview: Teachers' Interview Questions (Epistemological and Ontological)

1. How do you maximize students' learning in your classroom? (learning)

2. How do you describe your role as a teacher? (knowledge)

3. How do you know when your students understand? (learning)

4. In the school setting, how do you decide what to teach and what not to teach? (knowledge)

5. How do you decide when to move on to a new topic in your classroom? (knowledge)

6. How do your students learn science best? (learning)

7. How do you know when learning is occurring in your classroom? (learning)

(Luft and Roehrig, 2007, p. 43)

Second Interview: Teacher Interview Questions

1. How would you define the term *care*, as it relates to education?
2. How would you define the term *care*, as it relates specifically to science education?
3. How do you show students that you care about their learning in science education?
4. How do you show students that you care whether they do or do not understand a concept in science?
5. How has your caring approach affected your relationship with your students?
6. What challenges have you found in implementing your caring-approach in to your classroom?

Appendix D:

Students' Interview Questions on their Teacher's Epistemological and Ontological Beliefs

1. How does your teacher help you learn science?"
2. How does your teacher know when you understand or don't understand a topic?
3. How does your teacher show you that he/she cares about your learning in science?
4. Do you feel like you have learned a lot of concepts in biology? Why or Why not?
5. Do you feel like you have learned enough to do well on your End of Course Biology Assessment? Why or why not?

APPENDIX E: First-Cycle Codes of Teachers' Interviews

Teachers' First Interview: Overview of First Cycle In Vivo Codes

Epistemological and Ontological Questions	In Vivo Coding according to Teachers' Responses
Teacher Question #1 How do you maximize student learning in the classroom? (Luft and Roehrig, 2007, p. 43)	Mr. Rodriguez: Focused Mrs. Johnson: Relevance Mrs. Thomas: Structure Mrs. Colbert: Structure Mr. Harris: Entertainment and Relevance Mrs. Gonzalez: Relevance
Teacher Question #2 How do you define your role as a teacher? (Luft and Roehrig, 2007, p. 43)	Mr. Rodriguez: Tool Mrs. Johnson: Baby-Sitter Mrs. Thomas: Facilitator Mrs. Colbert: Responsibility Mr. Harris: Facilitator Mrs. Gonzalez: Teach them the right way
Teacher Question #3 How do you know when your students understand whatever you are supposed to be teaching them? (Luft and Roehrig, 2007, p. 43)	Mr. Rodriguez: Facial Expressions Mrs. Johnson: Verbal Mrs. Thomas: Their Response Mrs. Colbert: Verbal/Oral Mr. Harris: Talk about it Mrs. Gonzalez: Verbal
Teacher Question #4 How do you decide what to teach and what not to teach? (Luft and Roehrig, 2007, p. 43)	Mr. Rodriguez: Time Constraints Mrs. Johnson: Students' Need Mrs. Thomas: Supplemental Mrs. Colbert: Students' Need Mr. Harris: Scope and Sequence Mrs. Gonzalez: Students' Need
Teacher Question #5 How do you decide when to move on to a new topic in your classroom? (Luft and Roehrig, 2007, p. 43)	Mr. Rodriguez: Scope and Sequence Mrs. Johnson: Assessment Mrs. Thomas: Assessment Mr. Colbert: Demonstrated Mr. Harris: Scope and Sequence Mrs. Gonzalez: Assessment
Teacher Question #6	Mr. Rodriguez: Hands-on Mrs. Johnson: Kinesthetic

How do your students learn science best? (Luft and Roehrig, 2007, p. 43)	Mrs. Thomas: Touch it Mrs. Colbert: Inquiry Objective Mr. Harris: Hands-on Mrs. Gonzalez: Inquiry labs
Teacher Question #7 How do you know that learning is occurring in the classroom? (Luft and Roehrig, 2007, p. 43)	Mr. Rodriguez: Good Responses Mrs. Johnson: Talking Mrs. Thomas: Million Questions Mrs. Colbert: Academic Language Mr. Harris: Behavior of the kids Mrs. Gonzalez: Language

Teachers' Second Interview: Overview of First Cycle In Vivo Codes

Questions relating to "care"	In Vivo Codes according to Teachers' Responses
Teacher Question #1 How would you define *care* as it relates to education?	Mr. Rodriguez: NOT GIVING UP ON STRUGGLING STUDENTS Mrs. Johnson: PRESENTING TO KIDS EVERYTHING Mrs. Thomas: RELATE TO YOUR DEMOGRAPHIC OF STUDENTS Mrs. Colbert: CARE ABOUT KIDS AND THEIR EXTRA EFFORT Mr. Harris: KIDS NEED TO CARE Mrs. Gonzalez: CONCERN FOR STUDENTS' EMOTIONAL AND ACADEMIC
Teacher Question #2 What about science education? How would you say care relates to science education?	Mr. Rodriguez: HOOK TO WHEEL THEM IN Mrs. Johnson: CARING ABOUT WHAT YOU [THE TEACHER] IS DOING Mrs. Thomas: SHOWING THEM THAT YOU HAVE A PASSION Mrs. Colbert: GOOD SCIENCE BACKGROUND Mr. Harris: SCIENCE HAPPENS EVERYDAY Mrs. Gonzalez: ACQUIRING SKILLS
Teacher Question #3 How do you show them that you care? What kind of things do you do in the classroom that shows your students that you care about their science education?	Mr. Rodriguez: BELL TO BELL Mrs. Johnson: I COME TO WORK EVERYDAY Mrs. Thomas: I TEACH, SO OF COURSE I CARE Mrs. Colbert: LEARN ON OWN Mr. Harris: MY INTEREST IN THEIR SUCCESS Mrs. Gonzalez: BEING PERSISTENT
Teacher Question #4 How do you show students that you care whether or not they do or don't understand a topic in science?	Mr. Rodriguez: PRAISE AND A WHIP Mrs. Johnson: MULTIPLE WAYS TO ACCESS THE LEARNING Mrs. Thomas: TUTORIALS Mrs. Colbert: OPEN DOOR Mr. Harris: APPROVAL/DISAPPROVAL Mrs. Gonzalez: CONTINUE TO REVIEW
Teacher Question #5 How has that caring approach affected your relationship with your students?	Mr. Rodriguez: CHALLENGING CLASSES Mrs. Johnson: 6% OF THEM ACTUALLY CARE Mrs. Thomas: CRAZY RELATIONSHIPS WITH UNSUSPECTING STUDENTS Mrs. Colbert: BUILD ON THAT RAPPORT Mr. Harris: GOOD RAPPORT

	Mrs. Gonzalez: TRUST
Teacher Question #6 Any challenges with that caring approach?	Mr. Rodriguez: TOO DIFFICULT TO REACH Mrs. Johnson: CANNOT FOLLOW SIMPLE INSTRUCTIONS Mrs. Thomas: EVERYBODY DOESN'T WANT HELP Mrs. Colbert: I CAN GET 90% OF STUDENTS Mr. Harris: TEACHER NOT PEER Mrs. Gonzalez: ESTABLISHING APPROPRIATENESS

APPENDIX F: First Cycle Codes of Students' Interviews

Students' Interview: Overview of First Cycle In Vivo Codes

Interview Questions	Students' views of a "caring" teacher	
Student Question #1 How does your teacher help you learn science?	Maria: EXAMPLES AND EXPLAINS Niko: EXPLAINS THINGS Juan: EXAMPLES AND EXPLAINS Carmen: POWERPOINTS Ashley: EXPLAIN Dante: GIVING US INFORMATION Stacy: VIDEOS AND TEXTBOOK Craig: GIVING US DIRECTIONS Mary: EXPLAIN	Marc: LOTS OF STUFF Lina: EXPLAIN ME EVERYTHING Serena: EXAMPLES AND EXPLAINS Gabriela: EXPLAINS Carlos: EXPLAINS EVERYTHING Julian: MOTIVATES ME Madison: ACTUALLY SHOWED ME Casey: EXPLAINS Lisa: BOOK WORK AND LABS
Student Question #2 How does your teacher know when you understand or don't understand a topic?	Maria: BY QUESTIONING US Niko: FACIAL EXPRESSIONS Juan: ASK US Carmen: WE ASK QUESTIONS Ashley: WHEN WE CAN'T EXPLAIN Dante: WE ASK QUESTIONS Stacy: BY QUESTIONING US Craig: REPEAT WHAT SHE SAYS Mary: FACIAL EXPRESSIONS	Marc: ASK QUESTIONS Lina: FACIAL EXPRESSIONS Serena: ASK US QUESTIONS Gabriela: WE ASK QUESTIONS Carlos: BY QUESTIONING US Julian: QUESTIONS QUIZZES/EXAMS Madison: WE ASK QUESTIONS Casey: WE ASK QUESTIONS Lisa: EXPLAINS STEP BY STEP
Student Question #3 How does your teacher show you that she cares about you learning science?	Maria: MAKING TIME Niko: GETTING ME ON TRACK Juan: BY HIS FACE Carmen: TEACHER KIND OF CARES Ashley: GIVE US A CHANCE Dante: STUDENT LANGUAGE Stacy: DOESN'T NEED TO CARE Craig: ATTITUDE TOWARDS US Mary: SOMETIMES CARES	Marc: PATIENT WITH US Lina: ALWAYS ASKING QUESTIONS Serena: ALWAYS WORRIED ABOUT US Gabriela: TEACHES STUFF FOR LIFE Carlos: GIVES US SPEECHES Julian: AVAILABLE TO US Madison: COMMON SENSE Casey: CONNECTS TO LIFE

		Lisa: CONNECTS WITH OUR FUTURE
Student Question #4 Do you feel like you've learned a lot of concepts in biology?	Maria: YES Niko: YES Juan: KIND OF Carmen: YES Ashley: KIND OF Dante: I DON'T KNOW Stacy: KIND OF Craig: NO Mary: NO	Marc: YES Lina: YES Serena: YES Gabriela: YES Carlos: YES Julian: YES Madison: YES Casey: YES Lisa: YES
Student Question #5 Do you feel like you've learned enough to pass your EOC exam?	Maria: YES Niko: I DON'T KNOW Juan: YES Carmen: YES Ashley: MAYBE Dante: I DON'T KNOW Stacy: YES Craig: I DON'T KNOW Mary: I DON'T KNOW	Marc: YES Lina: YES Serena: YES Gabriela: YES Carlos: YES Julian: YES Madison: YES Casey: YES Lisa: YES

(*Table Continues*)

APPENDIX G:
Categories, Themes, and Sub-Themes

Categories	Themes	Sub-Themes	Responses (N=24)	Coded References
Structure of maximizing students' learning	Focused learning goal of the lesson	Instructional time is *untouchable* time	14	26
		Learning targets within the learning goal	8	19
	Topic is relevant to students' science literacy	Real-life application	16	56
		Science literacy associated with developing students' academic language	22	53
Social and constructivist epistemology	Teacher uses inquiry as a key method for students' acquisition of knowledge	Best science learning practices	17	52
		Learner-centered	16	66
		Inquiry/Socratic questioning	14	47
		Teachers coach students through discovering the concept	14	32
	Learning is in the form of lab experiments, hands-on activities, or manipulatives	Students' summative assessments gauge their understanding of concepts, which either aligns or does not align with teachers' lessons	15	41

		Learning activities are purposeful and reinforces the concept	6	13
	Students' discover the concept and their teachers give them multiple opportunities and ways to access the concept	Students design the lab rather than step-by-step instructions	9	20
		Teachers prompt students to problem-solve the concept, rather than merely learning about the concept	8	15
Moral epistemology	Teacher has the responsibility to society to assure students' proficiency science literacy	Epistemic Oppression	20	56
		Epistemic Advantage	17	51
	Teacher has the responsibility to parents to assure students' proficiency science literacy	Earn my paycheck	8	17
		"Do unto others" mantra: Treating students as if they were the students' parents or Treating students the way they would want their own children to be treated by their teachers	15	43
The role of the teacher	Teacher has the role of the facilitator in the classroom	Less of the teacher "doing" more of the students "doing"	12	37
		The teacher takes a *neutral* position in students' critical thinking	16	46
	Teacher has the role of the dominant force in the classroom	As students engage in critical thinking, the teacher heavily sways their thinking to that of the teacher.	18	49

		Teach them the "right" way	18	62
Tug of war between the students' needs versus the teachers' needs	Teacher acknowledges and executes strategies for students' lack of foundation in science	Teacher knowledge of students	12	41
		A sense of meeting the students' learning needs	8	34
	Teachers prioritize their needs first as a pre-requisite for students to learn science	A sense of meeting the teachers' needs	16	56
		Teacher uses the students "academic need" title as a major reason for their students lack of success	13	31
Baby-sitters' complex	The teacher acknowledges the students' responsibility in their competent or incompetent science literacy	Overuse of students needing to learn responsibility	16	62
		Students are not physically prepared to learn (i.e. pencils, notebooks, homework, assignment)	15	52
	Infantilization of urban science students: The teacher views urban science students as child-like, childish, and/or juvenile in nature	Spoon-Fed Information: Students are given information to learn based on their teachers' perspective of if students can conceive information or strategically equipping students to handle information.	21	64
		Teachers' perspective of urban science students as having criminal intentions	16	36
		The central idea of training urban science	18	67

		students versus educating urban science students		
	Students feel inferior to the teacher because of the teacher's level of education attainment	I already *have* an education	14	24
		Sarcasm is not a form of caring	15	51
The principal illustrations of "care"	The main characteristic of teachers' caring approach is more "praise than whip"	Emotional care of students	22	60
		Physical illustration of care: open door policy, lesson preparation independent of time; physically being present at school	24	72
	The main characteristic of teachers' caring approach is more "whip than praise"	Students need to be told the "truth" about the real world	14	22
		The students must "care" before I can show "care"	18	32

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- " A Learning Progression Depicting How Preservice Elementary Teachers Construct Their Ideas About Energy", January 2015, The Association of Science Teacher Education (International), Portland, Oregon
- "A Quantitative Depiction of Preservice Elementary Science Teachers Conception of Energy", April 2015, Chicago, Illinois
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ABSTRACT

VEILED CHAMELEONS: ANALYZING URBAN SCIENCE TEACHERS' EPISTEMOLOGICAL AND ONTOLOGICAL BELIEFS ON "CARING" FOR URBAN STUDENTS' SCIENCE LITERACY

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The present study investigated teachers' epistemological and ontological beliefs and how those beliefs influence "caring" for urban students' science literacy. The grounded theory research involved six teacher participants and 18 student participants and collected the data using the following methods: Teacher and student interviews and six weeks of classroom observations. Using critical race theory (CRT) as a lens, the analysis of the data occurred simultaneously with the data collection. The findings revealed seven categories and 16 themes, which emerged from the analysis on "caring" for students' science literacy. From the CRT model tested in the study, the data illustrated a plethora of evidence relating to the themes colorblindness, interest convergence, and microaggressions. A negative effect of teachers who practiced colorblindness in the classroom revealed an assignment of subordinate positions, meaning the teacher assumed the role of the ultimate-knowledge holder in the classroom and the students assumed an academic co-dependency role in the classroom. Such an environment, allowed the teachers to become epistemically privileged while the students became epistemically oppressed. Implications for teaching suggest that there are different "shades" of caring

for students' science literacy and that teachers should acknowledge the vast critical race-gendered epistemologies that students bring into the classroom in an effort to move towards a just epistemic environment.