“Wake up all the teachers, time to teach a new way. Maybe then they’ll listen to what you have to say. Because they’re the ones who’s coming up and the world is in their hands. So when you teach the children, teach them the very best you can” (Whitehead, McFadden, & Carstarphen, 1975).
Mapping the terrain of culturally relevant science classrooms

Dissertation

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Abstract

Science education has undergone a number of reform efforts since the release of Sputnik in 1957 (DeBoer, 1991). Despite the many efforts, science achievement in the U.S. still lags behind that of other industrialized countries (IEA, 2007), and an achievement gap still exists between White and minority students (Monhardt, 2000). Several factors contribute to the persistent lag, one of which is science teachers’ ability to teach science in ways that are meaningful for and relevant to the diverse learners within their classrooms. This qualitative study examined middle school classrooms in which teachers used aspects of culturally relevant pedagogy to teach science. The researcher used portraiture methodology to search for the goodness (Lawrence –Lightfoot & Hoffman, 1997) with the aim of constructing portraits of what these classrooms could look like. The data revealed that teachers who have been prepared to use culturally relevant pedagogy are confident about using it, but find CRP difficult to integrate in science teaching. Parallels between culturally relevant pedagogy and reform based teaching are drawn, thus arguing that the two approaches are not mutually exclusive and all science teachers should be prepared to use both. Additionally, the researcher presents an incomplete portrait of culturally relevant science classrooms as they relate to promoting academic success among all students, and provides brief illustrations of what culturally relevant teaching could look like, drawing from the missed opportunities from the investigated classrooms.
Dedication

This dissertation is dedicated to all of the young people who inspired me to do more to bring quality science experiences to urban classrooms; my three beautiful children (Myles, Khadija, and Khalid) and husband (Mouritala); and my parents, Carolyn & Walter Cross, who encouraged me to follow my dreams.
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Finally, I want to thank my study participants. Thank you for allowing me into your school, classrooms, and lives. While each of you expressed some reservation about what I was seeing, what I saw had a profound impact on my thinking about science teaching and learning. It will definitely shape how I prepare future science teachers. You are truly an inspiration and I am thankful that you allowed me the opportunity to spend time in your classrooms.
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Chapter 1 Introduction

Statement of the Problem

The realization that an impending teacher shortage (Howard, 2003) is inevitable, and the fact that the teaching pool remains relatively homogenous as student diversity increases (Banks et al., 2005), has led to a number of studies and publications addressing the preparation of teachers for diverse classrooms (Banks et al., 2005; Barnes, 2006; Fox & Gay, 1995; Garibaldi, 1992; Gay, 2000; Howard, 2003a; Key & Shorb, 1999; Ladson-Billings, 1994, 1995; Lee, 2003; Lee & Luykx, 2006; Middleton, 2002; Miller & Fuller, 2006; Rodriguez & Kitchen, 2005; Tobin et al., 2001). With this continuing trend, major teacher education accreditation associations and education standards, specifically the National Science Education Standards (NSES), include standards requiring that preservice and in-service teachers are responsible for meeting the needs of diverse learners (Fox & Gay, 1995; INTASC, 1992; NCATE, 2008, NRC, 1996, TEAC, 2006). However, the question remains, what is the best way to prepare preservice teachers for diverse classrooms? Particularly, what is the best approach for preparing science preservice teachers for diverse classrooms?

The urgent reality for science education.

The need to prepare all preservice teachers for diverse classrooms is of great importance, but science is particularly important as the demand for students with scientific and technological knowledge continues to grow (Rangel, 2007). President
Obama’s emphasis on science, technology, engineering and mathematics (STEM) education in his 2011 State of the Union address bolstered further the importance of science education. Preservice teachers must be prepared to work with diverse learners, and science teacher education programs must prepare them for diverse classrooms. Without science teachers who can meet the needs of diverse learners, America will be unable to meet the demand of a scientifically and technologically knowledgeable workforce.

**Minority student performance in science.**

The realization that minority students are underachieving and underrepresented in science (Monhardt, 2000; Snyder, 2008) has made it urgent that classroom practices be altered to support the learning of all students. Recent Trends in International Mathematics and Science Study (TIMSS) data, shown in Figure 1.1, also illustrates that fourth and eighth grade Black and Hispanic students persistently lag behind White students in terms of science achievement. Studies have shown that this underachievement is of great concern as it can lead to minority students opting out of science courses, thereby limiting their future prospects (Parsons, Travis, & Smith-Simpson, 2005) and/or resulting in severe consequences for their life trajectories (Seiler & Elmesky, 2007).
If we view this stark reality, for minority students, in light of the goal of the National Research Council (NRC) of the attainment of scientific literacy by all students “regardless of gender, culture, or ethnic background . . . (p.2),” several issues are illuminated. Several issues include the following: a) the NRC’s science standards, may be inadequate for minority students (Rodriguez, 1999); b) classroom practices may not be supportive of the learning preferences and cultural capital aspects of their home and community lives that minority students bring to the classroom (Parsons et al., 2005); c) or science teachers lack the proper preparation needed to teach diverse students (Biachini, Cavazos, & Rivas, 2003). Despite the underlying cause of the problem, the reality is clear; minority and economically disadvantaged students are still struggling to keep up with their White or more affluent peers despite the NSES and state standards.

All of this leads one to wonder why the achievement of minority and economically disadvantaged students is low. It could be that science is traditionally
taught as Western science, which is described as a subculture of Euro-American culture (Aikenhead, 1998); or it could be the result of beginning and current in-service teachers not being prepared to effectively teach students whose culture differs from their own. Many factors contribute to this issue of underachievement and underrepresentation in science, but given the vast amount of research on pedagogical approaches to increase minority achievement, science teachers’ classroom practices should not be a contributing factor.

**Science teacher preparation for culturally diverse classrooms.**

The void of science teacher preparation for diverse classrooms is one of the critical issues contributing to students’ underachievement and lack of participation in science classes. Teacher candidates are not receiving adequate preparation necessary for effective teaching of various groups of students such as African Americans, Hispanics, and students from economically disadvantaged families, and those groups are not experiencing academic success in science (Darling-Hammond, 2000). Inadequate preparation for diverse classrooms allows the discontinuities between teacher’s and students’ culture, experiences, and science (Lee, 2005) to function as impediments to learning.

Despite the realities of science teacher preparation, the expectation is that teachers will effectively teach and interact with students who may differ from them. Cultural discontinuities between the teacher and students function as impediments to effective science teaching and learning as teacher beliefs shape their ideas about students’ abilities to learn science. Beliefs are powerful factors and indicators of behavior because they are
rooted in personal history and have an affective and evaluative component (Nespor, 1987). They have been shown to drive a person’s thinking and actions (Bryan & Atwater, 2002), and when these beliefs are overwhelming negative, particularly toward students, they compromise a teacher’s actions toward students. Subsequently these negative beliefs can place students’ science achievement at risk (Prime & Miranda, 2006). In essence, science classrooms in which teachers harbor negative beliefs about their students’ ability to learn science become places in which students’ ability to do science is underestimated, undervalued, and marginalized thereby squelching their opportunities for science engagement and learning.

**Purpose of the Study**

The purpose of this study is to gain insight into the functioning of culturally relevant middle school science classrooms, and to determine whether such classrooms include the use of reform-based teaching practices. The overarching aim of this study is to provide science teacher education with models of culturally relevant pedagogy that serve as examples for how teachers can organize, manage, and interact with their culturally diverse students in their science classrooms. Furthermore, this inquiry seeks to provide for science teachers reassurance that reform-based teaching practices as well as culturally relevant approaches can co-exist, harmoniously, within the science classroom.
Objectives of the Study

Culturally relevant pedagogy is a theoretical model that seeks to empower students to achieve, academically, using their culture and to provide opportunities for them to apply their learning in the context of their everyday lives. While such a pedagogical approach is prominent in multicultural, literacy, and social studies education, very few researchers have examined its merit within science education. One objective of this study is to present a fluid portraiture of what culturally relevant middle school science classrooms could look like. Specifically, the researcher will examine what is occurring between the teachers and the students in terms of their roles between and among one another, their interactions, and the types of learning tasks in which students engage.

Furthermore, anecdotal evidence from the researcher’s interaction with in-service and preservice teachers reveals that some science teachers do not believe they have time to incorporate aspects of students’ culture while still trying to utilize reform-based teaching practices to meet science standards. In essence, the argument is that both cannot occur in the same classroom. Close examination of the tenets of both approaches reveals pedagogical strategies that are similar. For instance, reform based teaching requires that teachers use students’ prior knowledge and preconceived ideas when teaching (Sawada et al., 2002); culturally relevant pedagogy encourages teachers to know their learners and to use their students’ culture as a basis for learning (Ladson-Billings, 2001). In order to use
students’ prior knowledge and preconceived ideas, the teacher must know the students and must understand that culture may have influences on their preconceived ideas. CRP and RBT overlap in other area, as depicted in Figure 1.2. Thus another objective of this study is to illustrate that culturally relevant science teachers can and do use reform-based teaching practices. The researcher’s expectation is that this line of inquiry will yield models of culturally relevant science teaching for preservice and in service teachers.

Figure 1.2. Comparison of CRP and RBT

Research Questions

To generate a portrait of what culturally relevant science classrooms could look like, the following research questions guided the data collection and analysis:
1. What do culturally relevant science classrooms look like, in terms of the role of the teacher and students, interactions between the teacher and students and among students, and the assigned learning?

2. Does preparation to use CRP make a difference in a teacher’s decision to use it?

3. What evidence of reform-based science teaching (as defined by Sawada et al., 2002) is observable in culturally relevant science classrooms? Is there alignment between teacher’s perceptions of the use of reform based science teaching and what is observed in the classroom?

**Significance of the Study**

The significance of this study is twofold; this study could potentially 1) shape what occurs in science teacher education, which subsequently affects the science classroom; and 2) influence the direction and topics addressed in science teacher professional development. Currently, teacher education accrediting units, such as NCATE, require that teacher candidates demonstrate their ability to utilize students’ cultures to connect lessons to their everyday lives (NCATE, 2008, p. 34). The data emerging from this study may reveal that culturally relevant pedagogy is a viable approach for meeting NCATE and NSES standards. Moreover, this inquiry may yield specific examples of how some teachers use culturally relevant pedagogy to connect science lessons to the everyday lives/cultures of their students.
Scope and Limitations

This inquiry will utilize naturalistic inquiry and portraiture to gather data about the functioning of culturally relevant science classrooms. However, in doing so, teachers who are familiar with culturally relevant pedagogy are the preferred participants for this study. Half of the teachers recruited for this study consistently participated in professional development that emphasizes the use of CRP. While the sample draws from a particular project, this inquiry is in no way an evaluation of that program, nor does it seek to evaluate the quality of culturally relevant teaching occurring in the science classroom. Instead, the aim is to describe what culturally relevant pedagogy looks like within these classrooms.

Moreover, the researcher is not arguing that culturally relevant pedagogy is a better approach for any particular population of students or better than any other approach, but rather that it is a viable approach to effective science teaching. The researcher plans to present this approach for teachers who are searching for ways to help all students become scientifically literate (NRC, 1996). The inclusion of teachers who have not had preparation to use culturally relevant science classrooms is not to argue that one type of classroom is better than another but rather to help determine if CRP preparation makes a difference in a teacher’s decision to use it. Furthermore, while the culturally relevant model purports to positively influence students’ achievement
positively (Ladson-Billings, 1994), the researcher is not examining student achievement as a part of this inquiry.

**Definition of Terms**

The following terms are used throughout this inquiry, and while they typically have one commonly known definition, the way in which they are used in this inquiry may vary slightly. Hence, the researcher must explain the terms in the context in which they are used. The following section lists both the terms and their associated definitions.

- Delgado-Gaitan & Trueba (1991) define culture as a dynamic system used to give order and meaning to our lives. This system includes social values, cognitive codes, behavioral standards that shape who we see the world and others around us. Culture, in essence, is responsible for determining how a person thinks, believes, and behaves (Gay, 2000), which influences interactions, discourse, roles and learning.

- Culturally relevant pedagogy as defined by Ladson-Billings (2001) is a theoretical model, which identifies three propositions that contribute to the success of African American students: (1) academic achievement; (2) cultural competence; and (3) sociopolitical consciousness. The model contends that teachers who focus on these three areas are able to help their African American students achieve.

- Economically disadvantaged is a term used by both the Ohio Department of Education and the United State Department of Education. The federal and state designation of economically disadvantage is a calculation of the
percentage of students who receive free or reduced lunch (FRL) or whose parents receive government assistance. Eligibility for free lunch requires that the family income be at or below 130% of the federal poverty level, and for reduced lunch it must be at or below 185% of the federal poverty level (ODE, 2011). While the percentage of students receiving FRL is a proxy for economically disadvantaged families or families with a low socioeconomic status, Harwell & LeBeau (2010) found it to be a weak measure of low SES as eligibility for FRL does not capture all the resources available within a household. However, they recognize that access to FRL data is relatively easy and inexpensive.

- Empowerment is the process by which students learn to critically use science knowledge that is outside their immediate experiences to broaden their understanding of science, themselves, and the world, and to realize the prospects for reforming the accepted assumptions about the way people should live in a scientifically diverse culture (McLaren, 1989). According to Cummins (1986), empowerment can be brokered by teachers’ incorporation of students’ culture and language into the teaching; collaborative participation of the community in schools classrooms; orientation of [science] pedagogy toward reciprocal interactions; and “advocacy for minority students rather than legitimacy of failure as being an intrinsic part of the student (p.21).”
• Multicultural science education (MSE) “is a field of inquiry with constructs, methodologies, and processes aimed at providing equitable opportunities for all students to learn quality science” (Atwater, 1996, 822). Multicultural science education focuses on the key elements in the education process: the science learner, science teacher, science curriculum, social instructional milieu or context of the science classroom, and assessment and evaluation of these elements (Novak, 1977; Schwab, 1978).

• Reform (standards) based teaching/learning in the context of this inquiry refers to instruction and learning that is a direct dichotomy from the traditional didactic practice (Anderson et al., 1994). Rather than students engaging in passive-receptive forms of learning (Parsons, 2003) such as listening to lectures, they are instructed in ways that promote the use of data to justify opinions, problem solving, and active learning (Sawada et al., 2002). Science education literature refers to reform based teaching in two other ways- inquiry based and standards based teaching. The researcher will use reform based teaching throughout this study in an effort to consistently reference this approach. However, for the literature review, reform based teaching will be referenced in the same manner in which the discussed research has referenced it.
Chapter 2: Review of the Literature

Introduction

Academic achievement in science by minority students is an ongoing issue within the literature and the field. Researchers, theorists, and educators have devised conceptual and theoretical approaches to address this issue, and each of these approaches has its proponents and opponents. In an attempt to situate this current study, I have reviewed the literature surrounding the problem, identified proposed solutions and their critiques, and identified the deep chasm that exists between the theoretical solutions and their practical application within secondary science classrooms.

Historical Background/Overview

Multicultural science education

As a pedagogical approach, school curricula have integrated multicultural education (ME) since the 1960’s (Carter et al., 2003). ME emerged in response to the perpetual mis-education, under-education, lack of achievement, and overt/covert discrimination against racial, ethnic, and cultural minorities. A subset of ME, which became prominent in the mid to late 1990’s, is multicultural science education. It arose in response to the failure of traditional paradigms, which neglected to consider the sociocultural context of the learners within science classrooms (Atwater, 1993).
Atwater (1996) stated that the primary aim of multicultural science education was to provide equitable opportunities for learning science to all students in K-12 schools, colleges, and universities. Access to equitable opportunities is promoted by focusing on the science learner, science teacher, science curriculum, and social instructional context of the science classroom with assessment and evaluation to monitor these foci (Novak, 1977; Schwab, 1978).

The MSE approach to science education also attempts to tackle the often-ignored issues of class, culture, disability, ethnicity, language, race, oppression, discrimination, and power that are endemic to both science and the teaching and learning of science in the K–12 science classrooms (Atwater, 1996). Proponents of this approach also see as it as a way to curtail the enigmatic problem of the achievement gap between black and White students (Steele, 2000). Specifically, Stanley and Brickhouse (2001) assert that multicultural science education can be helpful to students’ understanding of the nature of science because it allows them to see the embedded nature of science within culture.

Hodson (1994) argued that science is not a value-free or culturally neutral endeavor since science is embedded in culture. The sociopolitical milieu of every civilization uses science; therefore, it requires examination at that level. Hence, multicultural science education should examine the racism and hegemony that exists within the scientific enterprise (Hodson, 1994). Such an examination would not detract from science, but would aid minority students in understanding the nature of science and how to negotiate the scientific enterprise in order to experience success (Hodson, 1994).
The changing demographics of the student population in the United States, coupled with the multicultural science education movement, and the call for a more scientifically literate populace have led major science teacher organizations, such as the National Science Teachers Association (NSTA), to adopt a position regarding the use of multicultural science education. Their position is that “science educators value the contributions and uniqueness of children from all background” (p.1). In doing so, the following declarative tenets compose NSTA’s (2000) position:

- Schools are to provide science education programs that nurture all children academically, physically, and in development of a positive self-concept;
- Children from all cultures are to have equitable access to quality science education experiences that enhance success and provide the knowledge and opportunities required for them to become successful participants in our democratic society;
- Curricular content must incorporate the contributions of many cultures to our knowledge of science;
- Science teachers are knowledgeable about and use culturally-related ways of learning and instructional practices;
- Science teachers have the responsibility to involve culturally-diverse children in science, technology and engineering career opportunities; and
- Instructional strategies selected for use with all children must recognize and respect differences students bring based on their cultures (p.1).
Critics of multicultural science education

Although NSTA and those who are in favor of multicultural science education, seem to have put forth a bold, promising, specific agenda, critics of MSE exist. The arguments against multicultural science education have attempted to subvert the approach on an epistemological level as some see MSE as being outside of the realm of science. Epistemologically, Good (1995) argues that science, despite its roots in European culture, is universal and has reached all modern countries. Essentially, the argument is that the knowledge sought and discovered by science is universal and does not change from culture to culture. Additionally, Good (1995) conceded that those of different cultures have contributed to science but the examples touted by multicultural science educators are tired and worn, thereby devaluing rather than enhancing the contributions various cultures have made to science. Furthermore, many examples from various cultures fall outside of science and potentially broaden the definition of what is considered science, thus allowing areas such as creation science or spiritual explanations of science phenomena to fit the definition of science (Cobern & Loving, 2000).

Others contend that multicultural science education, which includes antiracists science education, is harmful to science and patronizes ethnic and cultural minorities (Williams, 1994). Specifically, MSE is thought to insulate minority students from exposure to new ideas that may be disturbing to their current understanding and knowledge, and illuminate the racist aspects of science which serve to reinforce negative attitudes toward science by minority students (Williams, 1994). Additionally, Williams (1994) asserts that allowing minority students to engage in cultural practices and beliefs,
under the auspices of science, only serves to marginalize them both economically and socially. Such an approach to science opens the proverbial door for other types of science, and particularly pseudo-science, to find a place within the scientific enterprise. The inclusion of alternative ways of knowing and doing science is unscientific and there is, according to Cobern & Loving (2000) no room for them. In addition, MSE is described as a vague approach that offers no ideas for practical application (Good, 1995). Cobern and Loving (2000) argue that MSE functions to distort science in an effort to support a particular political or social agenda by redefining science. Another glaring critique of multicultural science education is that it functions to distort science in an effort to support a particular political or social agenda by rewriting or redefining science (Cobern & Loving, 2000).

Alternatives to multicultural science education

As with most critiques, many of the opponents do not offer an alternative or revision to multicultural science education. Loving (1998), however, proposes the melding of two other models that will allow teachers to move students toward meaningful understanding in mainstream science. She purports coupling Wittrock’s model of generative teaching and learning with Cortes’ multicultural empowerment model; an effective approach for providing students with opportunities to bring aspects of their culture to the classroom would be to create personal connections to the learning and thus learning would be enhanced while still moving the students toward the mainstream understanding of science.
Cortes’ multicultural empowerment model, according to Loving (1998), goes beyond allowing students to bring their culture, encouraging them to feel that they are part of the classroom culture. It also advocates acculturation by acknowledging, honoring, and integrating the unique views and backgrounds of the students while utilizing effective pedagogy that holds students to high standards for mastering mainstream science concepts, skills, and notions of what science is and is not (Loving, 1998, p. 543). Wittrock’s model of generative teaching and learning, on the other hand, is situated in educational psychology and focuses specifically on cognition, with very little reference to culture. This model provides a definition of learning and the elements that are involved in the learning process. The model is based on the premise that “people tend to generate perceptions and meanings that are consistent with their prior learning” (Wittrock, 1974, p. 88). Learning, in this context, is defined as a constructive cognitive process which involves the following five elements: aspects of students’ background knowledge and alternative conceptions, motivation, attention, generation, and metacognition (Wittrock, 1974).

While Loving (1998) advocates the use of both of these models, one of the critical pieces that is missing from her position is the attention to the historical and socio-political positioning of culturally, racially, and ethnically diverse students. One goal of science education should be to help culturally diverse students gain an understanding of mainstream science. However, in order to do so, teachers must understand the sociocultural context in which their students live. Multicultural science education does bring the importance of this context to the fore but very few studies have examined the
influence of multicultural science education on science learning by diverse students. However, the examination of a theoretical pedagogical approach, which falls under the umbrella of multicultural science education, has occurred in other content areas. This approach is culturally relevant pedagogy. Culturally relevant pedagogy not only allows students to bring in their culture and learn the inner workings of the culture of the subject matter they are learning, but it also prompts students to critically apply and examine their learning within their sociocultural context.

**Culturally relevant/responsive teaching/pedagogy**

A pedagogical approach that is often used with P-12 students, particularly with African American students, emerged from the work of Ladson-Billings (1994). Her seminal study, published in *The Dreamkeepers: Successful teachers of African American children*, presents culturally relevant pedagogy as a theoretical model for increasing achievement while empowering students to critically examine the world around them. This approach is similar to that of critical pedagogy (Ladson-Billings, 1995) because it functions to empower all students who experience it. Culturally relevant pedagogy rests upon three propositions:

1. Students must experience academic success;
2. Students must develop cultural competence; and
3. Students must develop a critical consciousness through which they challenge the status quo of the current social order (Ladson-Billings, 1995, p.160).

In her study, Ladson-Billings determined that those teachers, who were most successful with African American students, were those who understood and could relate to the
culture of their students, and those teachers focused on Ladson-Billing’s three propositions.

Geneva Gay (2000), another scholar who has advanced the thinking and understanding about culturally responsive teaching, provides the characteristics of this approach “using the knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning encounters more relevant to and effective for them” (p. 29). Like Ladson-Billings (1994), Gay places an emphasis on the establishment of a caring environment in which all students feel comfortable and safe enough to engage in their learning. Merging these two models provides an approach to teaching that uses what students bring to the classroom, cultural capital (Norman et al., 2001; Parsons, 2005) as the key to unlocking student achievement by making the learning meaningful and relevant.

Research regarding the use of culturally relevant pedagogy is situated in multicultural education and literacy education. However, the researcher’s assertion is that CRP is applicable to all content areas and grade levels because it places the focus on learn and the learner. Thus, it is an appropriate and relevant approach to and for all students, despite their culture, race, gender, spoken language, or subject matter taught.

**Culture and the Science Classroom**

**Cultural conflict in the science classroom.**

Culturally diverse students’ engagement in science often differs from the way in which teachers conduct science lessons. As researchers have suggested, this mismatch occurs because science has its own distinct culture (Norman, Ault, Bentz, & Meskimen,
2001), which is a subculture of Euro-American culture (Aikenhead, 1996, 1998). This implies that teachers must not only understand the culture of science, but they must also understand the culture of their students and be able to negotiate this mismatch of cultures. Allen & Crawley (1998) illustrated that this mismatch, or incongruence, does not have to hinder students from being a part of a scientific community; they found that the mismatch of cultures could negatively affect students’ achievement in science. Cuevas et al., (2005), also demonstrated that culturally diverse students are capable of engaging in science, specifically scientific inquiry.

**Use of cultural practices in science classrooms.**

MSE appears to be an overlooked approach to science teaching and learning in light of the critiques and criticisms of multicultural science education, and other constraints. However, some researchers advocate the use of cultural practices rather than focusing on multicultural science education. Despite the focus, very few researchers have investigated the influence social and cultural experiences have on minority students’ engagement in and learning of science (Seiler & Elmesky, 2007). In fact, the literature on this topic is severely limited and in some cases quite dated.

Examination of the relevant literature revealed three categories involving cultural practices studied to engage minority students in science learning. These categories are:

1. Science learning, by minority students, without the use of cultural practices;
2. Minority students’ reflections on teacher practices; and
3. Science learning, by minority students that includes the use of cultural practices.
The use of cultural practices, through culturally relevant pedagogy, to engage minority students in science, is an important part of this inquiry. However, other effective approaches to teaching science to minority students substantiate the importance of using culturally relevant pedagogy.

**Science learning without the use of cultural practices.**

As previously outlined, the use of cultural practices serves as an entry point for students to engage and connect with the content (e.g., science), which they are expected to learn. The assumption is that these practices make learning encounters more relevant to and effective for them (Gay, 2000) as well as making instruction more effective (Rangel, 2007). However, lessons and activities that do not allow for the use of cultural practices, drawn from the lived experiences of minority students, further perpetuate the status quo and cultural discontinuity (Parsons, 2008). For instance, as a new teacher and researcher Tobin et al. (1999) endeavored to enact a relevant chemistry curriculum with a group of African American students attending an urban high school. He found that his attempt failed, and attributed it to issues related to the socioeconomic condition of the students, high absenteeism, and student resistance to learning via non-engagement. Although those factors, in fact, do affect student achievement, a closer examination of the study revealed that the lessons did not draw on students’ cultures or interests. Instead, the teacher/researcher provided assignments that he thought would be interesting (Tobin et al., 1999) and each time, the students resisted.

The use of cultural practices in classrooms functions to aid in the establishment of a classroom community or a family-like community (Howard, 2001) in which minority
students can engage. Norman et al. (2001) substantiated this claim by observing how the cultural conflict between African American students, their teachers and the culture of science, impeded their learning and eroded teacher effectiveness. Although the researchers did not explicitly focus on the use of cultural practices, they did identify the use of culturally responsive teaching as a solution to the cultural conflict that African American students often experience in science classrooms. Both Norman et al. (2001) and Tobin et al. (1999) examined, intentionally or unintentionally, classrooms that did not use cultural practices and illustrated that the lack of use proved to be detrimental to African American students’ engagement in and learning of science.

**Minority Students’ Reflections on Teacher Practices**

Students are valuable resources for evaluating a teacher's effectiveness; however their perspectives are often overlooked. In an effort to capture students’ perspectives, Russell & Atwater (2005) and Lloyd (2001) interviewed African American students regarding their experience in science. The students identified several teacher characteristics as being influential in their decision to remain interested in science; some of the characteristics were culturally-based, and included both teacher encouragement and discouragement, and having teachers who cared about their success. Russell & Atwater (2005) presented four themes identified by African American undergraduate science majors as being influential factors to their decision to persist in science. These themes included parental influence, teacher influence, precollege experiences in science, and their college pipeline experience. While all of these were significant for these students, teacher influence was the focus of this inquiry.
The students interviewed by Atwater and Russell (2005) revealed that their teachers’ high expectations, encouragement, motivation and personal interest in their success served as contributing factors to their persistence. These findings are consistent with aspects of Ladson-Billings’ (1994) model of culturally relevant pedagogy. The establishment of high expectations aligned with the emphasis on students experiencing academic success and encouragement and emphasis on student success are means by which teachers demonstrated their emphasis on caring (Ladson-Billings, 1995). Ladson-Billings (1994) indicated that successful teachers of African American students are those who care about their students’ academic success and their success as people. The teachers in Russell & Atwater’s (2005) study demonstrated their emphasis on caring by establishing genuine relationships with their students that continued into their college years. Howard’s (2001) study of elementary students’ perceptions about culturally relevant teaching identified this same emphasis on caring.

Lloyd (2007) examined the reasons African American students achieved or failed to achieve in science; he found that African American students identified their science teachers and their relationships toward them as being the contributing factors to their underachievement or achievement. As in his 2001 study, Lloyd found the most frequently cited factor for failure was the teacher’s inability to relate the content to students’ culture or experiences. Rangel (2007) also identified the use of students’ views and interests as helping make science instruction more effective. The students who attained academic success in science highlighted their teachers’ caring attitudes toward them and their ability to connect the content to the everyday lives of the students.
Science learning by minority students that includes the use of cultural practices.

The lack of employing cultural practices to engage African American students in science, and the factors identified as contributing factors to science students’ positive experience emphasize the urgent need for the use of cultural practices in science education. Despite the urgency, very little research has explored such an approach to science teaching, and exploration of this area is a necessity considering the renewed call to STEM education (Obama, 2011). Recent literature has focused on culturally congruent instruction, the use of students’ language and interest to infuse cultural practices into science learning.

Language as a cultural practice.

Culture, as defined earlier, is a very dynamic conception that includes beliefs, values, knowledge, and language. Aikenhead (1996) identifies science as having a culture of its own, and with this culture (of science) comes the language of science. To fully understand and participate in science, students must learn the language. However, Brown (2004) asserts that African American students might experience cultural conflict when they are expected to engage in discursive practices using the language of science. In lieu of this reality, Brown (2004) suggests that teacher use diverse discursive practices, which would allow students to appropriate and engage in science in multiple ways. Brown and Ryoo (2008) suggest the cultural practice of teaching scientific concepts using the everyday language of the students first; as students master the scientific concepts, the introduction of scientific language can begin. The researchers recognize, however, that
the use of this cultural practice requires the reconceptualization of science learning as a process that requires the learning of content first followed by the language.

**Culturally congruent instruction via Black cultural ethos.**

An approach identified initially by Boykin (1986) and applied to science learning by Parson (2003; 2008a) and Seiler & Elmesky (2007) is the Black Cultural Ethos (BCE). BCE draws on Western African culture, and is suggested for use with African American students. The nine dimensions of BCE make good teaching better and serve to culturalize instruction, which is the deliberate enactment of cultural values to change the context of learning (Parsons, 2003, p.23). By culturalizing instruction with the use of BCE, Parsons (2008a) discovered this approach not only altered the learning context but it improved achievement. In a controlled study of this teaching approach, she noticed the African American students who did not receive culturalized instruction experienced declines in their science achievement. Participants’ achievement was depressed by the passive-receptive instructional structure typified by traditional science teaching (Parsons, 2008a), while the experimental group, which received participatory-interactive instruction, showed an increase in their science achievement.

In a similar study, using three aspects of BCE (verve, communalism, and movement), Parsons et al. (2005) set out to determine how culturally congruent instruction influenced science achievement among African American students. The findings indicated that culturally congruent instruction influenced not only African American students but also the Euro-American students. This study also revealed cultural practices, such as verve, movement, and communalism, enhanced learning, by making
the content meaningful, thereby causing the students to be more attentive and motivated to engage in science learning (Parsons et al., 2005).

Seiler & Elmesky (2007) using an aspect of BCE conducted a study to determine whether communalism is applicable to science classrooms. Their interest in this aspect emerged because communalism is in direct opposition to the interaction patterns common in science classrooms (Seiler & Elmesky, 2007). With two African American male students as subjects, they presented a case study of how the students utilized communalism as they engaged in science learning. Not only did they engage in science, but also they engaged one another using communalistic behavior. They established a social bond that served as a method to hold one another accountable for their learning. Although the students brought this cultural practice into the classroom, the teacher had to support these practices. Subsequently both students were able to attain academic success in this science classroom.

Another cultural practice that draws directly from the minds of students is the integration of student’s interest in the teaching of science. In a study of an all African American male lunch study group, Seiler (2001) found that incorporating students’ interest increased their engagement in science. Such an approach may seem intimidating to teachers who believe that they must adhere, strictly, to the school curriculum. Seiler (2001) asserted that allowing students to explore their interests did not hinder their ability to meet the standards as outlined by the curriculum.

Although Seiler (2001) did not culturalize instruction, she did listen to the voice of the students to establish a community and select topics of study that served as a frame
of reference for these students. Despite the noted positive influence on student engagement, the study did not indicate whether student voice and interest is enough to affect their achievement in science.

Use of culturally relevant pedagogy in science classrooms.

The use of a culturally relevant pedagogical framework in P–12-science education is not prominent in recent literature. Studies in science education include culturally diverse participants (Cuevas et al., 2005; Norman et al., 2001; Seiler, 2001; Allen & Crawley, 1998) but not many of them explicitly attend to issues related to culturally relevant pedagogy or culture; they do provide useful insight for science teaching and learning, however. The focus of these studies is on a central understanding, which is the acknowledgement and use of students’ cultural capital in order to optimize their learning (Norman et al., 2001). Seiler (2001), for example, found that using students’ culture and current scientific understandings helped increase their interest in science. Thus, she advocated for students to have input in the development of science curricula and called for teachers to make room for the interests of their students in their lessons and classrooms.

Barton (2003), who conducted a case study with an African American homeless male student, further substantiated this idea of acknowledging and using students’ interests in science. Using critical ethnography, she explored and illustrated how restrictive is NSES’ goal of the attainment of scientific literacy for students possessing a culture that is in conflict with the Western culture of science. She, and other researchers, argued that attention must be paid to the lives and culture of diverse students because
they can and do engage in science (Allen & Crawley, 1998; Cuevas et al., 2005), but in ways not captured by the science standards (Barton, 2003, p.550), or that differ from the expectations of Western science (Aikenhead, 1996, 1998).

**Reform (standards) based teaching and culture**

Inquiry (reform) based teaching is a pedagogical approach that has been described as the “quintessential scientific endeavor” (Windschitl, 2004, p.482). It is used in a variety of content areas, however, its use in science is the central strategy for teaching science (NRC, 1996, p. 31). In the context of science education, inquiry as defined by the NSES is “a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations” (NRC, 1996, p. 23).

Although inquiry seems like a singular teaching strategy (Windschitl, 2002), it is not, and various interpretations and applications of inquiry exist.

Variations of inquiry, as shown in Figure 2.1, are placed on a continuum that includes confirmation experiences, which are very teacher directed, to open/independent inquiry, which are very student centered (Bybee, Powell & Trowbridge, 2008; and Windschitl, 2002).
Despite the forms of inquiry and the well-articulated definition, most preservice and in-service science teachers have not had opportunities to learn science through inquiry or to conduct scientific inquiries themselves (Melville, 2008; NRC, 2000, p. 87; Windschitl, 2002, 2004). In fact, most science teachers have experienced the typical lecture-based teaching of science which they in-turn use with their students (AAAS, 1993) and that approach does little to foster the learning or use of inquiry (Windschitl, 2004). Thus, teachers carry the presage variables associated with years of learning science without inquiry into the classroom.

The National Science Education Standards (NSES) (NRC, 1996), outlined what all American students in grades K – 12 should know and be able to do as a result of engaging in reform based science teaching and learning. However, many science educators, who are also proponents of multicultural science education, have noticed that
the standards do little more than offer “lip service” to diversity. In fact, Rodriguez (1999) contends that the standards threaten the educational opportunities of disadvantaged (minority) students because they ignore the social inequities that led to the emergence of educational reform and standards.

Within the NSES, language diversity is ignored. For instance, specific ethnic groups, such as Hispanic or African Americans, are not identified and their particular issues with science learning are not documented or highlighted in the standards. Instead, the standards use blanket terms such as “all Americans” without defining specific issues (Rodriquez, 2003). Despite this invisibility, the reform efforts and standards call for teachers to use teaching approaches that are student-centered collaborative, encourage active learning (Schneider, Krajcik, & Blumenfeld, 2005), and allow students to develop their own line of inquiry (Sawada et al., 2002), methods which have been shown to have favorable influences on minority students achievement in science (Kahle, Meece, & Scantlebury, 2000).

While some researchers (e.g., Rodriguez, 2003) are critical of the standards’ attention to minority students, others such as Kahle et al. (2002) have sought to explore how reform based teaching influences science achievement among minority students. Kahle et al. (2000) found that when teachers of African American students use reform based science teaching it positively affects students’ science achievement. Furthermore, when students of teachers using reform based science teaching practices were compared to those who did not, the gender gap between African American and White students was reduced (Kahle et al., 2000). Kahle et al. (2002) concluded that reform based science
teaching rather than cultural practices led to increased science achievement among African American students.

Given their findings, Kahle et al. (2002), suggested that reformed based instruction is the key to getting African American students to engage in and learn science. Closer examination of reform based teaching strategies revealed alignment between RBT and instructional strategies that draw on cultural practices and support the use of general learning preferences common among African American students. Moreover, reform based practices drastically deviate from the traditional approach of science teaching in which teachers load students with many facts and do not attempt to connect the content with their personal lives (Rangel, 2007). The teachers in Kahle et al., (2002) enhanced learning by allowing students to work in cooperative groups, use open-ended questioning and problem solving rather than enacting the passive-receptive structure (Parsons, 2003; 2008a) which is often depicted as students being inactive sponges soaking up knowledge. Kahle et al. (2000) have shown reform based teaching is important as it aids minority students’ achievement in science.

**Summary**

Although the research studies cited above did not employ the direct use of culturally relevant pedagogy, they all serve as a stark reminder of the realities faced by minority students as they attempt to learn science. The traditional approach of positioning students as hollow vessels waiting to receive knowledge has not and does not work. Kahle et al. (2000) have shown that reform based initiatives have an influence, but given the recent Trends in International Mathematics and Science Study (TIMSS) data, which
shows the persistent underachievement of minority students (IEA, 2007), either those initiatives are not effective, or teachers are not teaching in ways that are consistent with reform based teaching. The glimmer of hope, as exemplified through a handful of studies and narrative inquiries, lies in the experiences of minority students who have persisted in science. The solution also emerges from studies that have closely examined the use of cultural practices to engage minority students in science.

Unfortunately, the research studies on minority students’ persistence in science and/or their experiences of learning science are limited; however, the factors identified by students as having contributed to their persistence, achievement or underachievement, are valuable. Further examination of the factors would be beneficial to teachers as they seek innovative ways to engage minority students in science. Moreover, if a close examination of these factors occurs, the use of cultural practices, and possibly the use of culturally relevant pedagogy, to engage students is bound to become a more common practice in science classrooms.

Many arguments exist for the use of cultural practices throughout the education literature (e.g., Allen & Crawley, 1998), particularly in literacy, social studies and multicultural education. Researchers have developed theoretical models and approaches that function to alleviate the cultural mismatch that commonly exists in classrooms; however the application of cultural practices in the teaching and learning of science needs to be examined. Within the science education community, teachers are expected to elicit students’ prior knowledge and scientific conceptions or misconceptions and understandings to provide meaningful learning experiences. The use of cultural practices
goes beyond prior knowledge and actually requires that teachers learn, know, and use aspects of their students’ culture to engage them. However, many science teachers are reluctant to venture outside of the standards when teaching to incorporate aspects of students’ culture. Culturally relevant pedagogy provides the framework for the use of students’ culture and experiences within the learning environment, to meet science standards through reform based teaching.

**Contribution of the Study**

**Science Teacher Education**

The proposed study contributes to the field by providing science teacher educators with a range of portraiture of culturally relevant pedagogy “in action” within middle school science classrooms. It illustrates how culturally relevant science teachers are able to utilize such an approach while also using and meeting reform-based science teaching strategies as outlined by the National Science Education Standards (NSES). The contributions of this study can be used to aid in the preparation of science teacher candidates for diverse classrooms, which is a critical issue, not unique to science per se, but critical in light of the NRC’s goals of a scientifically literate populace (NRC, 1996).

**Science Teaching and Learning**

If science teacher preparation is positively influenced by this proposed study, perhaps gains in minority student achievement would result. The studies discussed in this literature review (e.g., Parsons, 2003) depict various approaches to science teaching that have had a positive influence on minority students’ success in the learning of science. With more teachers prepared to use such approaches, the goal of the NRC becomes much
more of a tangible reality. However, models that explicitly illustrate what culturally relevant science classrooms can and should look like are needed to prepare science teachers who are culturally, racially, ethnically, and economically different from their students.

**Theoretical Framework**

**Distributed cognition**

Culturally relevant classrooms function with the expectation that both teachers and students engage with one another by collaborating about content while building learning communities based on respect, diversity, and caring (Howard, 2001). With this in mind, teachers and students will collectively determine the norms, discourse, and ways of using cognitive tools (Cobb, 2007). Since one of the foci of this investigation is on the interactions within culturally relevant science classrooms, it is appropriate to view these interactions through the lens of distributed cognitive theory, which focuses on the distribution of cognition across minds, persons, and symbolic and physical environments (Cobb, 2007). The goal of this study is to describe the type of interactions occurring within culturally relevant science classrooms. Distributed cognition is appropriate for this context and question because it is through the interactions within the classroom environment that students will reason (Cobb, 2007) and thereby construct scientific knowledge. While the construction of scientific knowledge or science achievement is not the unit of analysis for this particular study, distributed cognition provides a framework for understanding how students and the teacher align and share, via interactions and learning tasks, within a distributed process (Flor & Hutchins, 1991).
Furthermore, the use of distributed cognitive theory will function to contribute to the field by providing the type of interactions that allow for the creation and maintenance of effective culturally relevant science classrooms. Although characteristics of effective culturally relevant classrooms have been identified, we must acknowledge that the interactions between and among teachers and students vary from classroom to classroom, thereby causing variation in the interactions, i.e. the discourse, norms, and practices. Distributed cognition will function to bring these interactions to the fore.

**Sociocultural Theory & Culturally Relevant Pedagogy**

The classroom is a social and cognitive space in which the teacher and students interact, make sense of, and process the exchange of knowledge. Merging the social and cognitive spaces requires the acknowledgment of the cultural milieu -the classroom, school, and community- in which the teacher and students must function. Undoubtedly, this cultural context influences decisions, classroom practices, and interactions. Additionally, it would be naïve to examine the interactions within the classroom without acknowledging the influence of the school culture, the historical and sociopolitical position of the students and teacher within their community (Hodson, 1994). According to Cobb (2007), the sociocultural perspective functions to frame individuals’ reasoning as they participate in a broad system of cultural practices. This allows us to question or in this case, acknowledge, that the students and teacher are situated within a larger sociocultural, and likely political, context that includes the school and community.
Social Constructivism and Reform Based Teaching

To examine the use of reform based teaching within culturally relevant science classrooms, a social constructivism perspective will undergird this aspect of the inquiry. Social constructivism places value on the construction of knowledge in terms of social interactions (Atwater, 1996). Students within a culturally relevant science classroom should have a keen sense of their self-identity as science learners and therefore interact with one another and the content in a way that allows them to challenge the positioning of scientific knowledge.

In addition, constructivist learning is the assumed mode of cognition within the reform based standards movement (Sawada et al., 2002). The NSES call for students to engage actively in inquiry based learning, which is epistemologically supported by constructivism, and defined as “a nonrepresentationist model of knowing in which the mental representations that people construct are regarded as learning” (Atwater, 1996, p. 827). In the case of culturally relevant science classrooms, students will construct their science knowledge by experiencing science, as outlined by the NSES, through their social interactions within the classroom. Therefore, social constructivism allows the researcher not only to examine the construction of knowledge, which is not the focus of this study, but also to examine the science-related social interactions, as they relate to science, and within the classrooms as they occur. The assumption is that these social interactions occurred, but they were viewed through the lens of culturally relevant pedagogy. In other words, the researcher observed these social interactions to determine how they did or did
not align with the Ladson-Billings’ (1995) three propositions of culturally relevant pedagogy.
Chapter 3: METHODOLOGY

Introduction

This chapter details the research methodology, which includes the research design, population and procedures utilized in this inquiry. This line of research attempts to illustrate the interactions, roles, and learning tasks that occurred in culturally relevant middle school science classrooms. It also functions to identify elements of reform based science teaching, which may be occurring in such classrooms. Specifically, this study seeks to address the questions outlined in chapter one, the answers which involve gathering data on how culturally relevant science classrooms function, determining the influence preparation to use CRP has on teachers’ decision to use it, and defining to what extent reform based teaching strategies are used within culturally relevant classrooms.

Research Methodology

Research Design

This study utilizes a qualitative research design, which allowed the researcher to gain insight into the functioning of culturally relevant science classrooms. Drawing from current literature regarding teaching, CRP should be applicable to any subject matter and grade level. However, science education literature and teacher preparation programs lack coherent examples or models of culturally relevant science classrooms, thereby making the description of such learning environments difficult. To gain a clear understanding of
the functioning of culturally relevant science classrooms, this study employed an
interpretivist paradigm, using naturalistic inquiry and portraiture methodology for data
collection, and analysis to construct portraits of culturally relevant science classrooms.

The overarching aim of this inquiry, as described in Chapter One, is to generate a
portrait of what culturally relevant science classrooms could look like. As described by
Lawrence-Lightfoot and Hoffman (1997), portraiture is an appropriate evaluative
instrument as it allows for the acknowledgement of the researcher’s, the portraitist’s,
voice and the voices of the participants to be heard. Portraiture also redefines the
orientation the researcher brings to the study site; instead of documenting and analyzing
the pathology in the field, a portraitist acknowledges the problem and documents how the
participants navigate or overcome the deficit (Lawrence-Lightfoot & Hoffman, 1997).
Portraiture moves the researcher away from the deficit paradigm in a search for the good
(Lawrence-Lightfoot & Hoffman, 1997). The use of portraiture contrasts to other
qualitative methodology, such as case studies, in that it strives to illustrate the
complexities and dynamic nature of the unit of analysis by searching for goodness
(Lawrence-Lightfoot & Hoffman, 1997). Rather than comparing and contrasting cases,
portraiture requires an examination of the cases as a whole (Lawrence-Lightfoot &
Hoffman, 1997), and the extraction and alignment of the goodness emerging from each
case to construct a dynamic portrait of the unit of analysis. The portraitist is not
cconcerned with how the individual cases differ, but how they work together to illustrate
the aesthetic whole (Lawrence-Lightfoot & Hoffman, 1997).
Throughout the study, the portraitist utilized the six voices of portraiture (Lawrence-Lightfoot & Hoffman, 1997) to collect, analyze, and construct a portrait of what culturally relevant classrooms could look like (Appendix A). The use of the voices, is seen where appropriate throughout the study. For example, within this chapter the portraitist must be explicit about the worldview she brings to this study. In acknowledging her worldview, the portraitist provides a brief snapshot of her familial, education, and cultural experiences (Lawrence-Lightfoot & Hoffman, 1997). This view into her life is heard through voice as autobiography.

**Naturalistic inquiry’s affect on the research place**

Gathering data to construct the portrait required access to the natural setting where culturally relevant teaching occurs, the classroom. Given the unpredictable nature of the natural setting, however, the researcher had to adjust the plan of inquiry (Schwandt, 1997) to accommodate the unexpected. The researcher entered the field site with a well-devised research plan, but remained flexible, as school events and teacher absences often required revisions to the plan. The research plan, outlined in Appendix B, highlights the data collection dates and unexpected changes. Merz (2002) called this flexibility emergent design, which allows the researcher to record unexpected events, alter and reflect on those aspects and continue to move forward. Emergent design also places the researcher at the helm of his or her own voice, allowing him/her to navigate unforeseen obstacles while “develop[ing] a more in-depth way of understanding and reporting the experience” (Merz, 2002, p.150).
Research Setting

The participating teachers and students were located within a school that is part of a major urban school district in the state of Ohio (ODE, 2007). The local school district’s student population, for academic year 2009 - 2010, was composed of 60.1% African Americans, 27.2% White, while the remaining 12.7% were American Indian, Asian, Hispanic and multi-racial; Hispanic comprised over half of the 12.7%. The percentage of students classified as economically disadvantaged was 81.9%. Therefore, the demographics of the school district reveal a district that is predominantly African American with a high percentage of economically disadvantaged families.

The school demographics differ significantly from the district, as it exhibited a higher percentage of White students and economically disadvantaged families. This difference did not garner the school’s participation in this study; rather the teachers’ participation in a professional development that focused on the use of culturally relevant pedagogy in science teaching led to their involvement in this inquiry.
Table 3.1. District v. School demographics and science achievement

<table>
<thead>
<tr>
<th>Student Race/Ethnicity</th>
<th>District</th>
<th>School</th>
</tr>
</thead>
<tbody>
<tr>
<td>African American</td>
<td>60.1%</td>
<td>21.7%</td>
</tr>
<tr>
<td>White</td>
<td>27.2%</td>
<td>74.1%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>6.0%</td>
<td>2.4%</td>
</tr>
<tr>
<td>American Indian/Native</td>
<td>0.2%</td>
<td>-----</td>
</tr>
<tr>
<td>Asian or Pacific Islander</td>
<td>1.9%</td>
<td>-----</td>
</tr>
<tr>
<td>Multi-Racial</td>
<td>4.6%</td>
<td>-----</td>
</tr>
<tr>
<td>Economically disadvantaged</td>
<td>81.9%</td>
<td>86.6%</td>
</tr>
<tr>
<td>Percent passing (8th grade Science Achievement Test)</td>
<td>34.3%</td>
<td>31%</td>
</tr>
</tbody>
</table>

Note: The source of the data was omitted to maintain anonymity of the research participants.

Participant Selection

To examine the range of interactions, roles, and learning tasks within culturally relevant science classrooms, teachers who utilize CRP were identified. It would have been advantageous to utilize a community nomination process, as used by Foster (1997) and Ladson-Billings (1994), however time constraints limited the researcher’s ability to use such a process. Hence, the researcher sought nominations from the director and teacher on special assignment for a project that focused on the use of CRP in middle school mathematics and science classrooms.

Teacher Quality Enhancement Project (TQEP) and researcher’s assumptions.

The Teacher Quality Enhancement Project (TQEP) was a federally funded program designed to assist middle school teachers acquire the knowledge, skills, and dispositions needed to teach mathematics and science using culturally relevant pedagogy. TQEP teacher participants have been exposed to the Ladson-Billings model of culturally
relevant pedagogy, and have had the opportunity to develop and implement culturally relevant lessons in mathematics or science during a ten-week professional development course. The participants used the lesson plans were with urban middle school students during a three-week mathematics and science summer camp for five consecutive years. Since the Ladson-Billings model of culturally relevant pedagogy serves as part of the theoretical framework for this study, teacher participant practices had were required to reflect the model. The researcher’s assumption was that TQE participants who had participated consistently in the program were familiar with, and capable of, using the model to structure their culturally relevant teaching. However, the researcher understood that each would implement culturally relevant pedagogy differently. Therefore, the researcher is not attempting to construct a static image of culturally relevant science classrooms, but rather to gather data that may yield a more fluid model of what such classrooms may look like.

**Teacher Selection.**

Since the inception of the TQEP in 2005, there have been 53 participating in-service teachers. Of these teachers, six have participated for four consecutive years. These teachers were the only ones considered for this inquiry, as their consistent and consecutive involvement demonstrated their willingness to embrace culturally relevant pedagogy; the researcher also inferred that such longevity had a significant influence on the classroom practices of these teachers. Although the researcher’s assumption is that the use of culturally relevant pedagogy is consistent with Ladson-Billings (1994) model and occurs in the classrooms of these six teachers, the researcher also solicited the
opinions of the Teacher Quality Enhancement director and the teacher on special assignment to increase the likelihood that culturally relevant pedagogy would be observable.

In addition to asking teachers who participated in the TQEP to participate, the researcher also sought non-TQEP middle school science teachers within the same building who were willing to participate. Participation of the non-TQEP participants enabled the researcher to explore whether CRP preparation makes a difference in a teacher’s decision to use it.

The researcher contacted the six TQEP teachers nominated and asked to participate in the study, and two teachers from the same school consented. Contact for permission to conduct the study in the school was made with the school principal of the two consenting teachers; the researcher also asked for recommendations for two non-TQEP participants. The principal’s recommendations for the non-TQEP participants were important as she was the only person knowledgeable of the teachers’ classroom practices. Four consenting teachers—two sixth-grade teachers, one seventh-grade teacher, and one eighth-grade teacher, were accepted into the study.

**Student selection.**

Participating students were those students enrolled in the one science class of each of the participating teachers. Each participating teacher typically taught five science classes per day with the exception of one teacher who taught one science class and four language arts classes. Each teacher selected one class for participation and each suggested that I observe to the most diverse class.
The students were enrolled in grades six, seven or eight, during the 2009 – 2010 academic year, and attended Deer Middle School¹ (DMS). Table 3.2 shows the participating student demographics by grade level.

**Table 3.2. Participating student demographics**

<table>
<thead>
<tr>
<th>Classroom Demographics</th>
<th>Grade/Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6&lt;sup&gt;th&lt;/sup&gt;/Life Science&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Total Students</td>
<td>22</td>
</tr>
<tr>
<td>Race/Ethnicity (%)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>68.2</td>
</tr>
<tr>
<td>Black</td>
<td>27.3</td>
</tr>
<tr>
<td>Hispanic</td>
<td>4.5</td>
</tr>
<tr>
<td>Gender (%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>40.9</td>
</tr>
<tr>
<td>Male</td>
<td>59.1</td>
</tr>
</tbody>
</table>

*Note: <sup>a</sup> Represents classroom in which the teacher participated in the TQEP.*

**Data Collection**

**Instrumentation**

**Teacher profile.**

The researcher used the teacher profile (Appendix C) to collect teacher demographic information and to determine agreement with CRP. The collection of demographic information was at the beginning of the study period, but administration of CRP survey occurred at the study mid-point. The researcher had planned to provide the entire survey at the beginning of the study period, however, after learning the study was about CRP during the recruitment phase, one of the teachers shared an assignment that she planned to do that incorporated culture. This led the researcher to believe that

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¹ Deer Middle School is a pseudonym assigned to maintain the anonymity of the participants.
administering the survey at the onset may influence teacher’s decision making. Therefore, only the demographic portion of the survey was collected at the beginning of the study period.

**CRP survey**

The CRP items on the teacher profile survey were adapted from Ladson-Billings text *Crossing over into Canaan* (2001), and rewritten as Likert scale items. The survey items were divided into three scales that correspond with the three tenets of culturally relevant pedagogy—academic achievement, cultural competence, and sociopolitical consciousness.

**Academic achievement subscale**

The academic achievement subscale contained five items and it measured teachers’ agreement with the academic achievement tenets of CRP. According to Ladson-Billings (1995), culturally relevant teachers demand, reinforce, and produce academic excellence in their students. Culturally relevant teachers demonstrate this by:

- Presuming all students are capable of learning;
- Clearly delineating what achievement means in the context of their classroom;
- Knowing the content, the learner, and how to teach the content to the learners;
- Supporting a critical consciousness toward the curriculum; and
- Encouraging academic achievement as a complex conception not amenable to a single static measurement (Ladson-Billings, 2001, p.74)

**Cultural competence subscale.**
The cultural competence subscale contained four items and it measured teachers’ agreement regarding the use of culture in teaching and learning. The use of students’ culture allows students to maintain their cultural integrity and culturally relevant teachers utilize students’ cultural as a vehicle for learning by:

- Understanding culture and its role in education;
- Taking responsibility for learning about students’ cultural and community;
- Using student culture as a basis for learning; and
- Promoting a flexible use of students’ local and global culture (Ladson-Billings, 2001, p.98)

**Sociopolitical consciousness subscale**

The final four-item subscale measured teachers’ agreement with the tenets of sociopolitical consciousness. This subscale included the following indicators:

- Knowledge of the larger sociopolitical context of the school-community-nation-world;
- Investment in the public good;
- Planning and implementation of academic experiences that connect students to the larger social context; and
- Belief that students’ success has consequences for his or her own quality of life (Ladson-Billings, 2001, p. 120-121)

**Reformed Teaching Observation Protocol (RTOP).**

Teachers’ use of reform based teaching was measured using the reformed teaching observation protocol (RTOP) (Appendix D). The RTOP measured the extent to
which teachers used various reform based teaching strategies of (1) lesson design and implementation; (2) content; and (3) classroom culture (Sawada et al., 2002). Scale one, lesson design and implementation, focuses on the student-centeredness of the lesson and questions whether the teacher considers what students bring to the classroom as they design and implement the lesson. In an effort to give allowance to the important of content knowledge, the second scale, the content scale, is divided into propositional or conceptual understanding, and procedural knowledge, or what students are doing. The third and final scale shows the relationship to the classroom culture; a reform classroom should include communicative interactions between students in which they discuss and make sense of the course content. This three-point scale also encompasses student-teacher relationships in which the teacher functions as a resource person and engages in active listening.

Field test data for the RTOP indicated that the instrument is reliable, with each scale having a Cronbach alpha of 0.80 or higher (see Appendix E for statistical information for each scale). Face validity was established through the consultation of a number of science education reform organizations (e.g., NSTA) and documents (e.g., NSES) to ascertain specific reformed based teaching strategies that were, subsequently, included in the instrument (Sawada et al., 2002). Furthermore, Sawada et al., (2002) established norms for the use of the RTOP for various grade-levels. The norms for the middle school level, the focus of this inquiry, yielded a mean of 50.0, with a standard deviation of 14.1 across the 15 middle school teachers who field-tested the instrument.
The RTOP was chosen for this inquiry because of the predictive and inductive nature regarding student learning (Piburn et al., 2000). The RTOP also allows for description of what occurs in the classroom, followed by a ranking of the extent to which the teacher’s practices utilized reform based teaching strategies. While this instrument does enable quantitative measurement of reform based teaching, the data from this instrument were used only to ascertain whether reform-based teaching is observable in culturally relevant science classrooms. Thus, the researcher used the instrument in a qualitative manner, yielding descriptive information only. During the study period, the researcher used the RTOP during classroom observations and provided a copy to the teachers; they reflected on their teaching and rated how often they used specific reform based teaching strategies.

**Classroom observations**

The researcher observed each participating teacher’s selected classroom once per week for nine weeks. The intent was to yield nine observations, or seven and half hours, of classroom time with each teacher over the study period. However, several factors interfered with the nine observations, including unexpected teacher absences, school assemblies, fire drills, and other events that prevented teachers from conducting class. The number of observations varied from teacher to teacher, and the research plan (Appendix B) outlines the number and dates observations that the researcher completed for each participant.

During the observations, the researcher paid particular attention to assigned learning tasks, student/teacher roles, and interactions between the teacher and students
and among the students. Specifically, the researcher recorded roles, and interactions to
determine how they contributed to academic achievement and cultural competence, while
she used the learning tasks to determine how they aligned with the three tenets of
culturally relevant pedagogy: academic achievement, cultural competence, and socio-
political consciousness. Detailed descriptions of classroom events were recorded in the
field notebook using Geertz’s thick description (Geertz, 2006).

**Document collection, teacher interviews and conversations**

In addition to observations, the researcher copied and analyzed documents such as
handouts, tests, and project descriptions used by the teachers and students during the
observation period, and wall hangings, and other artifacts to determine if either tenets of
culturally relevant pedagogy or reform based teaching were evident.

At the conclusion of the study period, the researcher conducted one individual
interview with each participating teacher. The interviews were audio recorded and were
used to gain insight into the teacher’s understanding of, preparation for, and decision to
use CRP. The decision to conduct the interviews at the end of the study period served to
ensure that the questions did not influence teachers’ classroom practices. The interview
protocol (Appendix F) elicited information regarding teacher preparation to use CRP,
well as giving specific examples of its use within the classroom.

Throughout the study period, the research and participants had conversations
regarding classroom practices and school issues. These conversations did not specifically
address CRP and science teaching and learning, however they did serve as a data source
by providing insight into the issues that the teachers thought were important and had an
impact on their teaching. Unlike the interviews, these conversations were not audio recorded but the researcher recorded a synopsis of these conversations and personal reflections in the field notebook. Conversations between the researcher and the participants typically occurred before or after classroom observations, but also occurred during lunch or during school-wide events.

**Data analysis**

Analysis of the profile sheet involved the use of descriptive statistics. The analysis indicated teachers’ agreement with various aspects of the three tenets of culturally relevant pedagogy and their self-reported reflection on their use of reform based teaching practices. Quantitative data gathered from the teacher profile sheets was used qualitatively to gain an impression of classroom dynamics from each teacher’s perspective. The researcher used these perspectives as comparisons with her actual classroom observations. The quantitative data gathered from the teacher profile sheets also enabled the calculation of measures of central tendency regarding agreement, or disagreement, with the various aspects of the tenets of culturally relevant pedagogy. The Likert scale construct was used, thus the score range for each statement was one to five; a lower score closer to one indicated a strong agreement with the specified statement, while higher score closer to five indicated a strong disagreement with the statement. Scores lower than two indicated agreement with the statement. The design of the RTOP instrument is to yield an overall score that could be compared to the field tested mean norm of 50.

**Observations, document analysis, and interviews**
Field notes provided data from classroom observations of student and teacher roles, interactions, and learning tasks. The field notes and the interviews were transcribed and uploaded into Nvivo v. 9 and coded using an a priori coding scheme based on CRP and RBT (Appendix F). The coding of document analysis of classroom handouts and wall hangings was also according to the a priori and emergent codes.

**Establishing trustworthiness**

In the 1970’s, educational research shifted toward qualitative research as measuring educational significance was difficult given the many interactional effects (Lather, 2004). Debates regarding researcher bias and subjectivity are, at times, insurmountable hurdles for critics of qualitative research (Denzin & Lincoln, 2003). However, social science research and the National Science Foundation (NSF) (Ragin, Nagel, & White, 2004) clearly defined the rigor, validity, reliability, and trustworthiness of qualitative research.

Often criticized for their small sample size, qualitative studies yield in-depth intensive knowledge about the unit of analysis (Ragin et al., 2004). Nevertheless, qualitative research has its own set of criteria by which to evaluate studies to determine their trustworthiness. These criteria include credibility, transferability, dependability and confirmability (Lincoln & Guba, 1985). Credibility, which is an analog to internal validity (Lincoln & Guba, 1985), refers to the extent to which the researcher accurately depicts the participants’ reality which they [participants] deem credible (Schwandt, 1997). Although it is not possible to generalize qualitative research results, transferability refers to the “degree of fit” (Lincoln & Guba, 2007 p. 19) or the transferability of this...
study to other settings. To determine transferability, the researcher must provide thick descriptive data regarding the context.

For this study, credibility was established by triangulation of the data, peer debriefing, and member checks. Specifically, several data sources (e.g., classroom observations, interviews, teacher conversations, and document analysis) were used to triangulate the data. Peer debriefing, coding, and member checks were used to ensure that the coding was consistent. Three external coders, knowledgeable of CRP and RBT coded excerpts from the field notebook as well as the interview transcripts. Each external coder, for CRP, were given two excerpts from the field observations and one interview to code. The external coders for RBT, were given two field observation excerpts to code. After receiving their codes, a comparison was made between the researchers coding and the external coders. Individual peer debriefing, with each external coder aided in the negotiate of coding agreement. During the peer debriefing sessions, both the researcher and external coder discussed aspects of the data that supported their coding. However, the researcher shared with the external coder the context under which certain observations were conducted, and through discussions about the context the external coder and researcher came to a consensus.

Member checks were conducted during the teacher conversations and interviews. During those conversations and interviews data from the field notes was referenced to see if there was agreement between the researcher’s coding and the teacher’s perspective. A final member check will be conducted by providing the teachers with the final portraits of their classrooms, and having them respond to the constructed image. Their feedback will
be used to refine the portrait so that it accurately portrays their story. Transferability was established through use of thick descriptive data regarding the community, school, and classroom context in which the study took place.

**Researcher voice as autobiography**

The use of portraiture methodology provides an opportunity for me, the researcher, to have my voice heard throughout this study. In exposing my voice, I must be explicit about the history- familial, cultural, ideological, and educational- that I bring to this inquiry (Lawrence-Lightfoot & Hoffman, 1997). Understanding who I am as the researcher aided me as I endeavored to keep a clear vision of the actors (participants) in this inquiry.

I am a Black mother of two who has been a number of stereotypes. I have been the single mother, the food stamp and title XX\(^2\) recipient, the Christian turned Muslim, the critical theorist, the conspiracy theorist, the proud mama, the happy wife, the shining star, the one that acts White (Fordham & Ogbu, 1986), and now, the budding scholar.

Who am I? I am me, a Midwestern raised Black woman who is the only child my parents had. I am the middle child in terms of age among my cousins. I am the child who chose books, learning, school and solitude over jumping rope and riding a bike. I liked solitude; it was my quiet place, my oasis. A place I could go anytime, and while I was there, I would map out my future. I never shared those plans, but in retrospect, they had a profound effect on me as they allowed me to escape from the chaos that filled my world.

\(^2\) Title XX are block grants given to states and local government to fund various social services, such as childcare in this case. Source: http://www.ssa.gov/OP_Home/ssact/title20/2000.htm
I spent my early childhood in what most people would call a traditional home; I lived with my mom and dad. However, we were a working poor family that struggled to make ends meet, as my mother would say. I could hear the arguments over money at night as I lay in my bed, and I would quietly creep to my oasis and dream about going to college and getting a good job so I would not have to struggle like my parents. Before long, I would drift off to sleep, morning would quickly arrive, and I would eagerly prepare for school.

School for me was and has always been my escape from the realities of life. As a child there were up-to-date books, Apple™ computers, and tetherball. Despite all the nice stuff at school, I preferred the classroom. All of my urban teachers seemed to go out of their way to make the classroom ours; it was our little community, complete with our private space/our desks and community center, the round carpet near the window. It was not until fifth grade that I realized I had a passion for science. I will never forget my fifth grade teacher, Ms. Goldstein. She was just out of school, or at least that is what she told us, and had the most elegant cursive handwriting. She also enjoyed teaching science, and I remember the spring afternoon when she gave us a plate of various candies, and bread and taught us all about plant cells as she walked us through constructing a plant cell.

Other teachers and counselors along the way inspired and pushed me to do more and they all hold a special place in my memory. However, it was not until I arrived at Wittenberg University, as an eager biology major, that I realized just how much I did not know. At Wittenberg, I began to wonder if I had learned anything because every class I took really challenged me. Nevertheless, I navigated those hurdles but still harbored a
sense of resentment about my urban school experience because I just did not feel it was adequate. Before graduating from Wittenberg, I decided that I wanted to do something to help other students in urban schools who get to college and hit the same roadblocks that faced me. I decided to become a teacher, but not just any teacher – a science teacher!

I spent two years preparing to be a teacher at Purdue University, after which I relocated to Portsmouth, Virginia, where I took my first teaching position at an urban high school. The students, the staff, and administration were friendly and good people, but I was appalled at the glaring disparities in school resources among the three high schools in the district. I was disturbed also by the obvious racial separation between the school boundaries. My school was an even mix of black and White students while the other two schools were either predominantly White or black, and each of those schools seemed to have more resources than my school. The collective student bodies did not seem bothered by the disparities, but the difference bothered me so I took on leadership roles within the school and district and was able to secure various resources for the science teachers and students. When I relocated from Virginia to Baltimore, Maryland, I encountered what I considered the most savage inequalities in education.

I found myself teaching among other science teachers who were not certified, and who were not concerned with the well-being or the teaching of students. The day before school was to begin I had no books and desks for my students, yet when the bell rang the following morning, my classroom as filled with talkative teenagers whom I was able to inspire and convince that learning science is fun. Despite the lack of resources, I networked with community members and was able to establish a partnership with a local
junior college that willingly donated resources and funds to help me purchase the materials I needed to engage my students in science.

The disparity among the human resources, the teachers, my colleagues, inspired me to pursue a doctorate in science education. I believed, and believe, that our students deserve quality teachers of science, and I was and am determined to do my part to ensure that happens.

Here I am today, still Black, still a mother, a happy wife, a daughter, a Christian turned Muslim, a critical theorist, an educator, an advocate for urban education, and still a budding scholar. All of this, plus some, is who I am and what ultimately shapes what I see when I enter the field. However, I engage in constant self-reflection and self-critique in an effort to ensure that I stay focused on telling the actor’s story (Lawrence-Lightfoot & Hoffman, 1997), and not my own.
Chapter 4: Results

Introduction

This is the story of four middle school science teachers’ use of culturally relevant pedagogy (CRP) and reform based teaching (RBT). This dissertation argues that in order to make content comprehensible, the teacher must present the content in a way that is relevant to the students. Based on the literature as presented in chapter two, CRP is a viable pedagogical strategy that can help students understand more readily understand the content being taught. It rests on the proposition that in order for students to experience success, teachers must believe all students are capable of learning (Ladson-Billings, 1994), and teachers must demonstrate this by setting, maintaining, and articulating high expectations for academic success. Culturally relevant teachers also understand their cultural biases and experiences, and that the cultural capital that students bring to the classroom has an impact on learning. These teachers help their students make connections between the community, national, and local identities (Ladson-Billings, 1994).

Furthermore, this dissertation contends that reform-based teaching and culturally relevant pedagogy are not two mutually exclusive pedagogical approaches. Instead, the two can function in tandem to further support students’ academic achievement. In an attempt to support the arguments for which this dissertation posits, I present four middle school science classrooms in which CRP and reformed based teaching may be in practice.
The theoretical lens through which the data were collected and analyzed are the three tenets of CRP. Additionally, I focused on three particular aspects of the classroom during the observations, learning tasks, roles of the teacher and students, and the interactions that occurred in the classrooms. I looked for evidence of CRP within each of these aspects. I used the reformed teacher observation protocol (Sawada et al., 2002) to search for evidence of reformed based teaching within these classrooms as well.

The second aspect of this study involved reflection on the analysis of the data to determine whether preparation to use CRP makes a difference in a teacher’s decision to use it. Two of the four participating teachers were selected because of their previous involvement in a professional development opportunity that provided experiences using CRP. I selected the remaining two teachers because of what I believed to be their limited exposure to CRP. I also interviewed each participating teacher to examine fully the influence of preparation. Finally, I explored the difference between the teacher’s perceived use of RBT and what was actually observed in this classroom.

This chapter presents the data collected, analyzed, and used to construct the composite portrait of an ideal culturally relevant science classroom. Specifically, each classroom portrait begins with an introduction to the teacher, the physical classroom and students, the assigned learning tasks, roles, and interactions. While the unit of analysis, for this study was the teacher, the classroom must be situated within its proper context. Therefore, in addition to presenting the data collected, I also described the community in which the school is situated, and the school in which the classrooms are situated, as both
have an influence on the classroom environment. After presenting each classroom, I then offer a portrait of what culturally relevant science classrooms could look like.

**Community and School Context**

**Historical perspective on the community**

Deer Middle School (DMS) is located in the southeastern region of one of the largest school districts in Ohio. Demographic and economic data for the families of students attending DMS were difficult to compile, as the community data is grouped according to zip codes, and the school boundary includes parts or all of certain zip codes. Furthermore, the school boundary extends beyond the city limits to include students from an adjacent affluent community. Those students, however, do not attend DMS (P. Reed, personal communication, 2010). Given the school’s state report card rating, DMS students are eligible for a school voucher to attend the school of their choice.

To describe the school community, only data grouped by zip codes were used. Specifically, I only considered community data containing the same zip code as DMS to provide a perspective on the socioeconomic status of the community. The average median household income, within the DMS zip code, was $34,712, with an average household size of 2.55. The per capita income was $16,305, and 15% of the population lived in poverty. In terms of education, 38% of the 25 and older population have graduated from high school, while 2% did not complete elementary school or have no formal schooling and 11% did not complete secondary school, 18% attended college but

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3 The source of the data, in this section, has been omitted to maintain the anonymity of the research participants.

4 Per capita income refers to the average income earned by an individual.
did not graduate, and the remaining 12% posses degrees. The source for this data did not address the remaining 19% of the population in the 25 and older age bracket. During the 2000 census, the population of this community reported working in various industries. The industries in which the highest percentage of the population worked were manufacturing 12%, retail, 15%, education and social work at 14%, and food at 11%. The remaining industries, agriculture, construction, wholesale, fire, professional, information, transportation, and public administration were eight per cent or below. While the percentage of families living in poverty appears low, 15%, the reality is census data does not always capture an accurate picture of the community as many families may fail to report. Nevertheless, based on the federal poverty guidelines, and the percentage of students receiving free or reduced lunch, the Ohio Department of Education has labeled DMS as a high poverty school (ODE, 2011). This indicates that a number of families who qualified for free and reduced lunch, which is based on federal poverty guidelines, likely exceeds the number of those who reported living in poverty for the 2000 consensus.

The residents in this community are predominantly White descendents of European and Appalachian immigrants, who settled in the area in 1800. Census data from 2000 indicates that 71.1% of the 47,480 residents are White. Over the past century, the community has undergone periods of economic growth and decline. The first settlers to arrive in this area were farmers and agriculture was the main source of income, but by the late 1800’s, factories, such as iron casting companies, later known as steel mills, opened and attracted European immigrants who settled near and worked in the local industries. By the end of World War I, many of these factories became steel mills, which led to the
migration of Appalachian immigrants to the area for work. During the earlier period of the community, seventy-four per cent of the residents were homeowners and few households were low income. As of 2000, sixty-four per cent of the residents were owner-occupants of their homes.

In addition to steel mills, the area is known for other industrial businesses such as glass factories, railroad terminals, salvage yards, and commercial and retail businesses. While many of the original industries and retail shops do not exist today, their remnants remain. In fact, in the late 1990’s, the residents of this community pushed to have the Environmental Protection Agency (EPA) investigate what they thought were a disproportionate number of cancer cases in the community. The residents believed there was a link between the incidences of cancer in the community and the toxic chemicals emitted into the local environment by former companies. The EPA investigated the incidences of cancer, determined they were not disproportionate, and ceased any further action.

A steel mill, the largest business in this area, opened in 1881 and filed for bankruptcy and reorganization in 2002. During the reorganization, many of the employees went without pay, and over 700 employees were in jeopardy of losing their income as well as their pensions. A group of investors eventually purchased the company, and it is still in operation under a new name today. The business model has changed, however, and individual employees’ contributions are rewarded. Despite the reorganization, the local economy was weakened by the flailing of the largest community

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5 The definition of low income, in this context, is a household income of less than $3,000/year.
employer. Many of the retail businesses in the area saw a decline in sales and eventually closed; however, some were able to persevere due to corporate backing. Today, the community contains a number of vacant retail and commercial real estate, as well as several major fast food chains, a public library, modest sized homes, and a few locally owned community restaurants, and adult entertainment establishments.

**Deer Middle School**

Two major roadways, an interstate, and a major state route, surround the residential area in which DMS is located. To the west of the community, and along one of the major roadways, is a commercial area of businesses such as DOT's Clothing Store and Lowes Home Improvement, fast food restaurants such as Burger King and McDonald's, and occupied and unoccupied office spaces. The residential areas are interspersed among the industrial, retail, and commercial businesses. Many of the students attending DMS, live within the community. However, zoning parameters for the school district include areas beyond the school/city boundary, where the percentage of students/families living in poverty is considerably less than those living within the school community.

Built in the early 1960’s, Deer Middle School began as a junior high school and today is a middle school serving students in grades six through eight. The demographics of the school reflect those of the community, with the majority of the students being White. Table 4.1 offers comparisons of the school, the district, and the community racial demographics.
Table 4.1. School, district, and community racial demographics

<table>
<thead>
<tr>
<th></th>
<th>School (%)</th>
<th>District (%)</th>
<th>Community (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>74.1</td>
<td>27.2</td>
<td>71.1</td>
</tr>
<tr>
<td>Black</td>
<td>21</td>
<td>60.1</td>
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</tr>
<tr>
<td>Hispanic</td>
<td>2.4</td>
<td>6.0</td>
<td>1.4</td>
</tr>
<tr>
<td>Other</td>
<td>Not reported</td>
<td>6.7</td>
<td>5.9</td>
</tr>
</tbody>
</table>

Data sources & analysis

This study utilized the data sources highlighted in Table 4.2.

Table 4.2. Data Sources

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Collection method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field notes</td>
<td>Classroom observations</td>
<td>9 observations (7.5 hrs)</td>
</tr>
<tr>
<td>Science RTOP</td>
<td>Instrument used during classroom observations</td>
<td>6 per teacher</td>
</tr>
<tr>
<td>CRP Profile Survey</td>
<td>Teacher completed</td>
<td>Once</td>
</tr>
<tr>
<td>Classroom handouts</td>
<td>Teacher generated; collected during classroom observations</td>
<td>As provided</td>
</tr>
<tr>
<td>Teacher Interview</td>
<td>Individual</td>
<td>Once; following the observation period</td>
</tr>
</tbody>
</table>

Note: a Nine observations were planned, but teacher absences and school assemblies limited the number of observations possible. b The RTOP should have been used nine times with each teacher. However, the number of times reflects cancellation of planned observations and lessons that were not conducive to the use of the instrument.

To preserve the qualitative nature of this study, the data were analyzed using Nvivo v.9. This software allowed me to enter data from my field notes, documents, and interviews, and to code them based on the current literature and/or assumptions as well as the theoretical constructs.

Each classroom was very different in terms of the teaching style, students, content, and grade level. Table 4.3 exhibits the general characteristics of teachers.
whereas Table 3.2 references the classroom level demographics.

Table 4.3. Teacher demographics

<table>
<thead>
<tr>
<th>Grade Level/Content</th>
<th>Teacher Gender</th>
<th>Race of Teacher</th>
<th>Teaching Experience (years)</th>
<th>Live near the school</th>
</tr>
</thead>
<tbody>
<tr>
<td>6th grade Life Science</td>
<td>Female</td>
<td>White</td>
<td>28</td>
<td>Yes</td>
</tr>
<tr>
<td>7th grade Earth &amp; Space Science</td>
<td>Female</td>
<td>White</td>
<td>15.5</td>
<td>No</td>
</tr>
<tr>
<td>6th grade Life Science</td>
<td>Female</td>
<td>White</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td>8th grade Physical Science</td>
<td>Male</td>
<td>Black</td>
<td>8</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Each classroom portrait begins with a description of the physical classroom and a description of the teacher and the presage variables that he or she brings to the classroom. The remainder of the portrait includes the learning task, roles, and interactions occurring in the classroom, respectively. Each portrait ends with a summary; after presenting each portrait, a brief summary of the findings are highlight and a composite portrait is present in chapter five. Pseudonyms were assigned to all participants to protect their anonymity.

Pseudonyms were assigned to all participants to protect their anonymity.
Mrs. Boyle & Her Class

Mrs. Boyle’s classroom

Upon entering Mrs. Boyle’s classroom I noticed that the room was designed as a science lab. The back and sides of the classroom had lab stations equipped with a sink and gas valves, all of which were non-functional. All of the sinks were boarded and the water was turned off. The opposite side of the classroom contained cabinets and drawers for science equipment. At the front of the classroom was a demonstration bench, cluttered with papers and books, and, like the other lab stations, complete with a non-functional sink and gas valve. Behind the lab bench was a White board dotted with tape marks and permanent ink spots. To the right of that board was the Smart Board™. Mrs. Boyle’s desk was on the left side of the White board; it was a composition of stacks of papers, some photocopied class materials and others supplemental resources.

Who is Mrs. Boyle

Mrs. Boyle is a 52-year old White woman who has 28 years of teaching experience. She has been teaching at Deer Middle School for the past four years, and indicated that she lived near the community in which the school is located. Her class demeanor was very relaxed and the students displayed a great deal of respect for her. Mrs. Boyle’s interactions with the students were very motherly; she often expressed a genuine concern for their well-being. She often used terms of endearment as she referred to students as honey or sweetheart.
In addition to showing a genuine interest in the well-being of her students, Mrs. Boyle also lightened the atmosphere with the use of humor. For instance, during one of the observations, the class was preparing to use the clicker system\(^7\). All of the clickers were located near the front of the classroom, and she had not distributed them. A student picked up one of the clickers, and instead of yelling or forcefully telling the student not to touch the clicker, Mrs. Boyle responded, in a jokingly manner, “Back away from the clicker, you dirt bag.” The student put the clicker down and began laughing with the rest of his classmates. Although she used humor to correct misbehavior, there were times when a firm directive was necessary to redirect, quickly, student behavior. Her firm directives gentle, caring, no-nonsense fashion, termed by Irvine and Fraser (1998) as warm demander, a form of classroom management that is firm yet reaffirming for the students, and indicates that Mrs. Boyle genuinely cares about them.

**Mrs. Boyle’s use of CRP.**

Mrs. Boyle was one of the two teachers who had previous exposure to CRP through the TQEP. During the interview she shared that she participated in a CRP workshop sponsored by her school district. During this workshop, she received an overview of CRP and presented a lesson with other participating teachers that utilized CPR. The data from her CRP teacher profile survey revealed that she agreed with the tenets of CRP; her mean score for agreement was 1.77\(^8\), greater than the mean for all

---

\(^7\) The clicker system includes individual hand-held devices that allow the students to respond to posted questions  
\(^8\) A mean score closer to one indicates a close alignment between teacher’s beliefs and CRP related statements. The Likert scale ratings were assigned a point value that ranged from one to five; with one being strongly agreed and five being strongly disagreed.
participating teachers (X=1.63). Despite displaying an agreement with CRP, Mrs. Boyle focused on one aspect of CRP, cultural competence, during the interview. When asked how she would describe CRP to a friend, she stated:

I would describe it [as] using a child’s experience to get them to better understand material. [It] definitely keep[s] them interested by using something they can relate to. I think those are the biggest ones, I think mostly to keep their interest and to make them realize that what I teach does have some bearing on their lives.

(Interview, June 11, 2010)

I asked Mrs. Boyle how she finds out about students’ interests, and she said that she just talks to them. When I asked her follow-up question, “How do you incorporate culture into the classroom,” she shared she could not remember specific ways beyond two projects she had them complete. She did recall that she does incorporate culture around the holidays or at the beginning of any big unit. Known as the contributions approach to multicultural education (Banks, 1988), this approach encourages teachers to integrate multicultural themes around holidays, but those themes are not part of the curriculum.

Mrs. Boyle displayed an understanding and agreement with sociopolitical consciousness, yet her classroom practices did not corroborate her understanding or agreement. In response to a question that elicits the teachers understanding of sociopolitical consciousness, she articulated that she believed that her quality of life was tied to her students’ success. Despite understanding the connection between student success and her quality of life, Mrs. Boyle discussed how she wanted to teach her students that middle class life is a good life and is attainable (Interview, June 11, 2010); her response focused on teaching students about culture, and middle class in particular.
From her perspective, becoming middle class is a form of success for her students.

Beyond seeing connections between student success and her quality of life, CRP also strives to make connections between learning opportunities and students’ local community (Ladson-Billings, 1994). Mrs. Boyle shared that she provides students with interesting science facts, such as where to go to see bald eagles near the school, but conceded that she could not think of how she has related the content to their community.

**Mrs. Boyle’s reformed based teaching.**

The extent to which Mrs. Boyle used reformed based teaching methods varied depending on the learning tasks. The use of reformed based teaching methods was not consistent during the study period, but Mrs. Boyle employed more reformed based teaching methods than she perceived; both of our ratings were higher than the normed mean of 50 for middle school teachers. Mrs. Boyle rated her use of RBT as 67, while the average rating across the observations was 72%. Table 4.4 displays the difference, per item, in our RBT rating; only items with a difference greater than one are highlight in the table. Appendix C provides a complete comparison of all items.
Mrs. Boyle rated items four and seven higher than the researcher did. The observations showed the lack of opportunities for the students to seek and value alternative solutions to problems; often, the students were in pursuit of the correct response to Mrs. Boyle’s questions. Additionally, not all lessons promoted coherent conceptual understanding; instead, many lessons focused on the skills that students needed to complete a task or on an understanding of vocabulary. These components were not brought together to assist in the construction of conceptual understanding.

I rated the remaining items, 15, 18, and 19 higher than Mrs. Boyle rated herself. During two observations, students challenged one another’s responses (answers) to Mrs. Boyle’s question. For example, a student came to the board to order a food chain; he

### Table 4.4. Difference of reform based teaching ratings

<table>
<thead>
<tr>
<th>Lesson Design &amp; Implementation</th>
<th>Mrs. Boyle</th>
<th>Researcher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 4: Seeking alternate modes of investigation and problem solving</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Content: Propositional Knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 7: The lesson promoted strongly coherent conceptual understanding.</td>
<td>4</td>
<td>2.8</td>
</tr>
<tr>
<td>Content: Procedural Knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 15: Intellectual rigor constructive criticism and the challenging of ideas were valued.</td>
<td>2</td>
<td>3.6</td>
</tr>
<tr>
<td>Item 18: There was a high proportion of student talk and a significant amount of it occurred between and among students.</td>
<td>1</td>
<td>2.25</td>
</tr>
<tr>
<td>Item 19: Student questions and comments often determined the focus and direction of classroom discourse.</td>
<td>2</td>
<td>3.25</td>
</tr>
</tbody>
</table>
misplaced two organisms and a student said, “That’s not correct!” (Observation, April 28, 2010). Others began to chime in and another student volunteered to fix the food chain. Mrs. Boyle allowed the other student to correct it. While she did not encourage the challenge, she seemed to value it as she allowed the students to carry on the debate. It was usual for the students to challenge incorrect responses to Mrs. Boyle’s questions and she supported the challenge by not ending the debates prematurely.

I rated Item 18 higher because the students often engaged in group work that required them to interact and talk. However, while working together there was little talk about content and conversations were more procedural or product oriented. For example, students discussed who would complete various parts of their project, but rarely discussed the content being learned while engaging in the project.

Item nineteen involved posing questions that directed the classroom content conversation, the classroom discourse. Class discussions were driven by the teacher’s questions rather than student questions; however, students determined the focus of questions and conversations while participating in group work.
Learning Tasks: Just what is it that the students do?

Within Mrs. Boyle’s classroom, students completed a variety of learning tasks. The type, frequency, and examples of said tasks are displayed in Table 4.5. Discussions and warm-ups were the most frequent learning tasks, as they occurred daily. Upon further examination, classroom discussions were not genuine discussion; instead they were quests for the correct answer. Mrs. Boyle would pose a question for students to answer correctly. For example, Mrs. Boyle pointed to a picture of a community and asked, “What type of community is this?” A White female student, Sarah, responded, “A mature community.” This was not the response Mrs. Boyle was looking for so she asked, “What is another name for that?” Again, Sarah responded, “Climax community” (Observation, March 19, 2010). Mrs. Boyle accepted her response and moved on.

While incorrect responses did generate a follow-up question by Mrs. Boyle, rarely did they stimulate further discussion nor were they used to probe student thinking. At times, students did pose questions, but rarely did they determine the direction of the class discussion, an integral aspect of reform-based teaching. The question and answer task followed what Lemke (1990) identified as the triadic or initial, respond, and evaluate (IRE) model. The warm-ups were daily questions that students completed at the beginning of class and segued into the first round of question and answer.

During the observation period, I did not witness the students engaging in a laboratory investigation. However, Mrs. Boyle referred to a bacteria lab students had previously done by displaying Petri dishes containing bacteria cultures students had grown. Projects occurred approximately every other week, and there were a total of four
completed during the observation period. Students were assigned and completed the following projects: create-an-arthropod, create-a-protist, White tail deer population newscast, and the succession project. The first two projects were individual and required students to create a product; the latter two projects required student collaboration.

The remaining learning tasks, handout, film, and assessments were the most infrequent. There was only one observation in which Mrs. Boyle had the students complete a worksheet unaccompanied by any other task. Two occasions that required worksheet completion accompanied the viewing of science related films. Both films contained science content and seemed to capture students’ attention. Assessments, a necessary component of instruction, happened twice during the observation period. One was formative and involved the use of the clicker system, and the other was the district-wide quarterly assessment.
### Table 4.5. Learning tasks assigned in Mrs. Boyle’s class

<table>
<thead>
<tr>
<th>Learning Task</th>
<th>Frequency</th>
<th>Example/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm up</td>
<td>Daily</td>
<td>Students complete these short problems/questions at the beginning of class. E.g., Describe a population of Gila monsters.</td>
</tr>
<tr>
<td>Lab</td>
<td>1</td>
<td>Hands-on activities in which students formulate hypothesis and collect and analyze data. E.g., Bacteria collection</td>
</tr>
<tr>
<td>Projects</td>
<td>4</td>
<td>Independent student work and/or collaboration between students to create a product. E.g., Create-an-arthropod activity.</td>
</tr>
<tr>
<td>Discussions</td>
<td>Daily</td>
<td>Teacher posed questions and students answered. Sometimes the questions were designed to lead students through a problem solving activity (E.g., creating a graph)</td>
</tr>
<tr>
<td>Presentations</td>
<td>1</td>
<td>Students use and present content they learned (e.g., student talk show about handling the White tail deer population problem)</td>
</tr>
<tr>
<td>Handout</td>
<td>3</td>
<td>In-class worksheets in which the students had to complete and submit for grading</td>
</tr>
<tr>
<td>Film/Movie</td>
<td>2</td>
<td>In-class videos that students view; typically, they were expected to complete an accompanying handout.</td>
</tr>
<tr>
<td>Assessment</td>
<td>2</td>
<td>Student evaluation to determine student learning.</td>
</tr>
</tbody>
</table>

### Roles: Whose job is it anyway?

Mrs. Boyle’s and her students held various roles that were often determined by the learning task in which the students were engaged. During all observations, Mrs. Boyle served as a question poser and the students were the respondents. The students were also collaborators as they were allowed to work together on various learning tasks. The students completed four projects during the study period and these projects required the students to collaborate. While students collaborated, Mrs. Boyle’s role was to motivate, encourage, mediate, and monitor the students.

Mrs. Boyle also served as the disciplinarian, a role very familiar to many teachers.
Over the nine observations, there were three incidences during which Mrs. Boyle disciplined the students. The entire class was addressed in one incident that involved a few students being disrespectful during the Pledge of Allegiance. This resulted in Mrs. Boyle telling the class,

> I have not told you [that] you have to recite the pledge but if you want respect you have to give it. Not standing until you see me looking at you, huh-un. If you don’t respect the country you live in you better fake it. It is not a personal decision to show respect in this classroom.

(Observation, May 5, 2010)

The other incidences occurred when students spoke out of turn or touched materials or equipment that they should not have. Mrs. Boyle typically gave students a sharp look, which caused them to stop or be quiet, or used humor to bring attention to their inappropriate behavior.

**Interactions**

**Teacher-student.**

The dominant interaction within Mrs. Boyle’s classroom is closely associated with the most frequent learning task, question and answer. This daily interaction originated with her posing a question to the class followed by a single student’s response. If the response was incorrect, Mrs. Boyle would ask another student or other students would interject that the response was incorrect and would offer his response. Other teacher generated interactions occurred, but the focus of those interactions were either discipline related or not content specific. For example, Mrs. Boyle used the first 10 – 15 minutes of class to remind students about due dates and upcoming events unrelated to specific content.
Student-Student.

The amount of student-student interaction was very low. The majority of class time on a typical day was dominated by teacher directed questioning. When students worked collaboratively there were some student-student interactions but often, these interactions mirrored the interactions that Mrs. Boyle had with the class; one student would tell the other student the answer or provide instructions, or the students’ interactions were unrelated to the content. While collaborating on projects, student interactions focused on procedural issues such as who would draw the pictures or write the definitions, rather than a discussion of the content. Other interactions between students occurred whenever one student served as a peer teacher to catch up another student after an absence. These interactions consisted of the student telling the other about assignments completed during his absences and the missed homework assignment.

Student-Teacher.

Interactions originating with the students directed to the teacher were rare. There were two instances when students posed clarifying question, i.e., “Is insectivore a real word?” (Observation, March 31, 2010). There was no substantive student–teacher interactions related to content beyond clarifying questions.

Summary

Mrs. Boyle’s perceived and actual use of RBT conflicted. While she did not perceive much RBT in her practices, it was inconsistently evident during the observations. She selected learning tasks that required student collaboration but many of them lacked the rigor indicative of RBT. Regarding CRP, Mrs. Boyle articulated one
aspect of CRP and agreed with all aspects, however her practice did not support that. She discussed integrating culture during holidays (Interview, June 11, 2010), but did not evidence its inclusion. Sociopolitical consciousness was non-existent, but, through her non-academic interactions, she did show that she was concerned with students’ academic success. Throughout the study period, Mrs. Boyle continually encouraged students to do their best on class projects, indicating that if they did well, their grades could improve.

Ms. Herman & Her Class

Ms. Herman’s Classroom

Upon entering Ms. Herman’s classroom, I noticed that the room once served as a home economics class. There were four kitchenettes, complete with sinks, cabinets and non-functional stoves around the perimeter of the room. There was also a washer and dryer behind the Smart Board located at the front of the room and three computers located behind the Smart Board. The students sat in pairs at tables in the center of the room. Two students sat at individual desks. In the rear of the classroom there was a door leading to what appeared to be a small storage area that connected Mrs. Herman’s classroom to another science classroom. However, the area was designated for a special education classroom. When noise from the class interfered with Ms. Herman’s teaching, she ignored the noise and continued teaching.

Who is Ms. Herman?

Ms. Herman is a 38-year old White female who has 15.5 years of teaching experience. She has been teaching seventh grade science at DMS for 13 years and she does not live near the school community; during a post observation conversation she
mentioned a location near her home, which is on the north side of the city (Personal communication, 2010) that is a predominantly White middle class community. She is an avid traveler and, after agreeing to participate in my study, she informed me that she would be absent for a week as she was going on a cruise (Personal Communication, 2010).

Ms. Herman’s very demanding style was apparent as soon as we met. Her voice is very loud and her speech pattern is fast and difficult to understand at times. She quickly addresses off task behavior with a no nonsense attitude. Her expectation seemed to be that students would do what she has instructed or would be punished. For example, during one observation she instructed students to focus on completing the task or they would be unable to leave for lunch. A White male student, Ashton, was talking and was not working on the task. Ms. Herman approached him and said,

[Herman] Okay, so you’re not done? So, you’re not leaving until you’re done!
[Ashton] I’m done, see.
[Herman] All right, good. Clean up. You’re not leaving until you clean up!

(Observation, April 28, 2010)

Ms. Herman’s style is very direct and demanding, however students appeared comfortable approaching her with questions.

Ms. Herman use of CRP.

CRP was not a novel pedagogical approach for Ms. Herman. Like Mrs. Boyle, she had participated in the TQEP, which focused on CRP. Her participation involved mentoring new teachers, and taking various courses and attending conferences and meetings at which CRP strategies were presented. Prior to this program she had not heard
of CRP. Ms. Herman indicated that her participation, in the program, was helpful because it

    Make[s] you more mindful. . . about the learner and try to connect more to their lives. It makes me consider. . . their perspective and my own perspective.

    (Interview, July 19, 2010)

I probed more and asked Ms. Herman to tell me how she would describe CRP to a friend, and she replied:

    I would describe it as trying to get [pause] the kids to connect to content through something that they are used to. It could be [pause] well, you know one of the things I’ve always wanted to do is have the kids. . . look at just the things around them and how science is related to it.

    (Interview, July 19, 2010)

Her description focused on relevance through the use of the students’ frame of reference and experiences and was devoid of cultural references. Essentially, student culture was not used as a basis of learning (Ladson-Billings, 1995). Furthermore, everyday experiences do not necessary depend on student culture as they may not draw from cultural capital or have cultural significance. Ms. Herman’s description was not congruent with her teacher CRP profile survey, which indicated that she agreed with the tenets of CRP. Her mean was slightly higher than the mean for all of the participants (x=1.54; z=1.69), which indicated that she agreed with Ladson-Billings’ (2001) CRP indicators. Ms. Herman was selected for this study based on her previous experiences with CRP, but neither the observations nor her interview revealed a strong understanding or use of it. When I asked her about her use of CRP she replied,
I say I try. I’m not saying I’m 100%, but I think there are some things that are more so . . . [pause] it’s like a strategy I try to incorporate. It’s not something I use every time I teach.

(Interview, July 19 2010)

For Ms. Herman, some science content did not align well with CRP. In response to my question about how she incorporates CRP she replied,

I do, some of the content . . . we are made to teach is so far removed from what our kids life experiences are, where they’re coming from, sometimes it’s hard to make connections . . . with everything. Some things are easier to connect, from my perspective.

(Interview, July 19, 2010)

Again, her focus is on the connections to the student’s everyday life, and not necessarily their culture. One could argue that connecting to everyday life automatically integrates culture, but I posit that is not necessarily true because people negotiate daily between various cultures and, in order for those connections to everyday life to be culturally relevant, they must align with student culture rather than the everyday routine experiences that possess no cultural significance.

While connections are a part of CRP, they are not the only aspect, however, to make relevant connections, a teacher must know his or her students. This led me to inquire about how Ms. Herman learns about her students’ culture and community. She shared that she has done homes visits, and having taught at the school for 13 years, she has gotten to know a lot of people. Talking to the kids during class or lunch is a way to get to know the students (Interview, July 19, 2010).

Ms. Herman mentioned having the students complete the Draw-A-Scientist test (DAST) (Chambers, 1983), and follow up with a discussion about the students seeing
themselves as scientists as an example of how she integrates student cultures. The other two tenets, academic achievement and sociopolitical consciousness, were not evident in the interview. She did agree that her quality of life is connected to her students’ success, yet she admits to not doing anything recently to connect the students their local community.

**Ms. Herman’s reformed based teaching.**

An examination of Ms. Herman’s use of reformed based teaching revealed that her perception of her usage was much higher than what the researcher actually observed and higher than the mean norm of 50. Her RTOP overall scores was 78, while the mean score from the classroom observations was 47, just below the mean norm. There were some aspects of Ms. Herman’s teaching that drew on students’ prior knowledge, but students rarely reflected on their learning as the rigid classroom structure coupled with frequent bookwork and direct questioning did not allow for the creation of a classroom that supported the reflection aspect of reform based teaching. Appendix D shows the comparison between Ms. Herman’s rating and the average rating from the observations. The ratings varied across several items, therefore the table reflecting the difference was placed in the appendix. The observations revealed that her practices were not consistent with RBT as the selected learning tasks did not allow for the types of hands-on, minds-on learning advocated by the NSES (NRC, 1996).

**Learning tasks: Just what is it that the students do?**

Ms. Herman’s students engaged in several different learning tasks. Table 4.6, highlights the various learning tasks, frequency of use, and their description.
Table 4.6. Assigned learning task in Ms. Herman’s class

<table>
<thead>
<tr>
<th>Learning Task</th>
<th>Frequency</th>
<th>Example/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm up (Bell ringer)</td>
<td>Daily</td>
<td>What causes the seasons? Questions related to previously studied content</td>
</tr>
<tr>
<td>Projects</td>
<td>4</td>
<td>Projects involved two or more students working together to produce a specific product that contained Earth &amp; Space Science content. Some of the projects completed included: Creation of a movie, ABC book of everything; Foldable life cycle of a star; and moon phase game</td>
</tr>
<tr>
<td>Questioning</td>
<td>Daily</td>
<td>This followed the triadic (Lemke, 1990) model of initiate, respond, evaluate</td>
</tr>
<tr>
<td>Book work</td>
<td>3</td>
<td>An assignment in which students were given a set number of pages to read, from the textbook, followed by questions to be answered.</td>
</tr>
<tr>
<td>Assessment</td>
<td>2</td>
<td>Quizzes</td>
</tr>
</tbody>
</table>

The two most frequent learning tasks were warm ups and questions, both of which occurred daily. All but one of the observed warm-ups was content related and served as reviews of previously learned content. Ms. Herman called warm-ups bell ringers, but the purpose of the learning tasks did not change. All of the bell ringers were knowledge level (Bloom, 1956) questions that required one correct response.

Questioning also occurred daily and it was brief, lasting no longer than five minutes. Ms. Herman followed the IRE model (Lemke, 1990); she initiated all of the questions, which were followed by a student’s response, then an evaluative response from her. All responses, both correct and incorrect, were accepted and she often rewarded students with candy or stickers for simply answering the questions. However, Ms. Herman clearly identified and rewarded those students who provided correct answers with additional candy or stickers.
Each day’s first question was related to the bell ringer. Ms. Herman gave the students time to record their responses to the bell ringer and then asked them to share their answers. Frequently questioning was used, but rarely did it stimulate divergent thinking among the students, an essential element of reform based teaching. Furthermore, no response, correct nor incorrect, led to further classroom discussion.

Bookwork, a typical learning task in urban schools (Haberman, 1991), was also used repeatedly during the observation period. During one observation, Ms. Herman assigned a project, the A-B-C book, for which students were to go through the textbook and find scientific concepts for every letter of the alphabet and define them in their A-B-C book; essentially, their project was to create a book of science concept definitions. While discussing the project with Ms. Herman she shared that she wanted to give the students something more interesting to do; many of the students, however, simply went to the glossary and picked one word per letter and defined it in their A-B-C book.

Bookwork also accompanied test and quizzes. After quizzes, traditionally 15 minutes in length, students completed readings and questions from the text. Bookwork was also used as a punishment when students did not meet the expectation of working quietly on their assigned projects.

There were also four projects assigned over the observation period and they required two or more days to complete. During the first observation on March 12, 2010, the students worked on a project that involved using Windows Movie Maker™ to create a movie of selected Earth Science content. Ms. Herman shared during the pre-observation discussion that this project was designed to help the students review the content they
learned during the year, and the movies would be given to the eighth graders who had to prepare for the state science achievement assessment.

The students seemed to enjoy making the movie. Many of the groups worked together and kept one another on task. For example, a group of girls had the following exchange,

[Amy; White female] I’m getting my haircut. [Kary; White female] Ummmmm… that’s not about what we are doing. [Anne; White female] Yeah, what does that have to do with erosion?  

(Observation, March 12, 2010)

Although the students, in this particular group, stayed on task their work focused more on the product, i.e., what pictures to use, than actual content, i.e., what the pictures mean or how they represent the scientific concept.

**Roles: Whose job is it anyway?**

Ms. Herman role and her students’ roles varied and were often determined by the learning tasks in which they were engaged. The students often worked in pairs, so the most frequent role of the students was collaborators. In this role, the students worked together to complete assigned learning tasks. Individually, students also served as respondents to questions, task masters, and peer teachers when collaborating.

During all observations Ms. Herman served as the disciplinarian. Her expectation was that students would adhere to the classroom structure and she moved swiftly to correct behavior that did not conform to her standards. These standards, in the observations, were not posted but included the students working quietly, being seated, and on task. Ms. Herman quickly addressed and corrected any contrary behavior; Ms. Herman also monitored the classroom and provided academic assistance to the students.
as needed. Additionally, she posed questions, kept students on task, and provided instruction. Motivating and encouraging students, handing out stickers for giving correct or making attempts to answer questions correctly were also Ms. Herman’s common roles.

Ms. Herman’s approach to discipline is very similar to her commanding style. As the disciplinarian, she was demanding. With just a look students would immediately know they were off-task or had been caught doing something that violated her classroom rules. When a look was not sufficient to catch a student’s attention, Ms. Herman would ask the misbehaving student a rhetorical question related to their behavior and that usually corrected the behavior. For example, a White male student was turned around talking to the students behind him. Ms. Herman approached him and said, in her loud voice, \textit{Help me understand why you are turned around?} The students immediately turned around and began working on his warm-up (Observation, March 26, 2010). Other times, her disciplinary action was directed toward the entire class. For instance, the students were working on book work assignments, but were engaged in a lot of off task talking. She announced to the class that everyone would stay for lunch detention if they did not get quiet and complete the task.

\textbf{Interactions}

\textbf{Teacher-Student.}

Many of the teacher-student interactions were related to the discipline component of classroom management. The second most frequent type of teacher-student interaction were content related questions posed by Ms. Herman and answered by students. The

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\textsuperscript{9} Instruction is defined as directions for students to follow in this context.
questions, as described earlier, followed the IRE model (Lemke, 1990). Again, the question answer sessions that occurred in this class were very frequent, and they constituted a great deal of the teacher-student interaction. However, the questions posed were framed in a way to solicit one correct answer, and were knowledge level (Bloom, 1956) relying on student recall.

**Student-student.**

Within Ms. Herman’s class there was a great deal of student-student interactions. Unfortunately, not all of the interactions were about the content students were learning. The type of learning tasks Ms. Herman assigned supported the student-student interaction. When working in groups or pairs, students were required to communicate and collaborate with one another. During this collaboration, however, there were times in which frustrated students had to act as taskmasters keeping their peers on track. Students also interacted with one another to teach content. During a project to create a board game on the moon phases, students were playing the game and one of the students answered the question incorrectly and the following exchange occurred,

[Felicia; African American female] Nope! You’ got that question wrong! [Tony; White male] No, I didn’t. [Felicia] Yes, you did. You said waxing and it’s waning, look!

(Observation, March 31, 2010)

Felicia then began explaining the concept to Tony using the textbook illustrations.

**Student-Teacher.**

Little substantive interaction originated from the students directed toward the teacher. In one occurrence, a student asked about planets, but the inquiry was not directly related to what was being studied at the time. Students often asked Ms. Herman for
answers for assignments, but she would typically respond by saying, “Look it up! That's not my job; it's yours!”

Summary

Ms. Herman did not explicitly use culturally relevant pedagogy within her classroom. She did employ learning tasks that required creativity and allowed students the opportunity to infuse their culture, but CRP was never an explicit part of the project criteria. In that regard, there was no evidence of cultural competence originating from Ms. Herman, nor did any of the projects encourage or require that students apply the content to their everyday lives outside of the school building; therefore, sociopolitical consciousness was not explicitly addressed either. Ms. Herman was very clear with students on what they needed to do to be successful (i.e., completing the learning tasks) on their various projects and she was clear with each class about what needed to be completed and what behavior was expected. She held students accountable for their behavior, progress, and work. In that regard, she illustrated her commitment to ensuring that students knew what they needed to do to be academically successful. However, the frequent use of bookwork and/or using it as a threat is contrary to the intellectual rigor that characterizes culturally relevant and reform based classrooms. Furthermore, it was difficult to ascertain the extent of her content knowledge as the students often engaged in project-based activities that did not include formal presentation of concepts.
Mrs. Cole & Her Class

Mrs. Cole’s classroom

Mrs. Cole’s classroom was not a traditional science classroom; in fact, it looked more like a Reading/Language Arts class complete with a small library and reading posters. There were three functional computers in the classroom and a working sink. Students were seated two per table and tables were grouped in pairs. There were also two individual student desks in use by the students. In the interview (June 7, 2010), Mrs. Cole informed me that she taught reading and writing and only one class of science, which explained the classroom layout.

The intent of the first observation on March 5, 2010, was for me acquaint myself with the classroom culture and community. I arrived early and entered before the students arrived. The students entered the classroom laughing and talking but following the routine of picking up their assignment for the day. As students settled and took their seats, Mrs. Cole began explaining their assignment for the day, which was a continuation of a project from the previous day in which the students were to create their own protist. All but three of the students worked on their project; the three students who refused to complete the task talked to one another and others, made inappropriate comments through the period, and monopolized Mrs. Cole’s attention the entire period. This prevented her from interacting with students who really needed her attention.
The following week, Mrs. Cole informed me that what I had observed last week was an anomaly and attributed the students’ behavior to their documented disabilities. She shared with me that many of the students were diagnosed with ADD, ADHD, bipolar and/or behavioral disabilities (Pre observation, March 12, 2010). When asked if her class was considered a mainstream or self-contained course, she told me it was a mainstream; during the study period, I did not witness a special education tutor or intervention specialist assisting the students with documented disabilities. During the second observation, the class was very calm and it was markedly different from the previous week; however, the three disruptive students were absent.

**Who is Mrs. Cole**

Mrs. Cole is a 35-year-old White female who is a first year teacher. Her exceptional performance as a student teacher in the same building the previous year was the key to her being hired for her position (Personal communication, 2010). She does not live near the community in which the school is located, but rather she lives in one of the adjacent predominantly White middle to upper middle class suburbs located northeast of the city. She indicated in the interview that she did have experience with CRP, said experience attained during her teacher education program. She shared that her program placed a large emphasis on CRP and the message was clear that successful teaching requires the use of it (Interview, June 7, 2010). Her overall mean agreement with the CRP portion of the teacher profile was 1.69, which was greater than the average for all participating teachers. This score indicates that she more likely agrees with the tenets of CRP, rather than strongly agreeing.
Mrs. Cole’s use of CRP.

During her teacher education program (TEP), Mrs. Cole read books about CRP, wrote papers and incorporated the approach into her methods coursework and student teaching (Interview, June 7, 2010). She found the exposure to CRP very valuable, particularly in the urban setting. In fact, Mrs. Cole mentioned that while doing her student teaching, she spent part of her time in an affluent suburban district and CRP was not as useful there (Interview, June 7, 2010). Despite her explicit exposure to CRP, Mrs. Cole still found it difficult to use in the teaching and learning of science. During the interview, I asked her to share some ways in which she uses CRP in her science class, but she focused on the attributes of her students rather than answering the questions.

Yeah, I ummm… [pause] I taught the one science section and it was a pretty difficult group of kinds. [A] high percentage were ADD, ADHD, and ummm bipolar and behavioral disability and so I tried to get them up and moving and active as much as I could.

(Interview, June 7, 2010)

Her response made no mention of using students’ culture; instead, it focused on students’ documented disabilities and not the cultural capital they bring to the classroom. Realizing that she had not referenced any aspect of CRP, I asked a follow-up question that specifically addressed student culture;

[Researcher] What were some of the ways you used resources from the community and/or the students’ culture within your classroom? How did you bring that in?

[Mrs. Cole] Ummm… I’m not sure with the science . . . I found it was a little more difficult in science because it is so concept based and I am not sure that I [pause]. . . I mean when we talk to them about where they come from and . . . their neighborhoods and try as best I could to relate that to . . . what we were talking about in the classroom.

(Interview, June 7, 2010)
Mrs. Cole went on to mention a couple of science concepts that could be connected to student culture, but she never provided specific examples. She did mention, however, that in her Reading/Language Arts class, she incorporated culture by allowing students to write about and analyze rap music that is relevant to their culture (Interview, June 7, 2010). She displayed a limited understanding of academic achievement and sociopolitical consciousness. I asked Mrs. Cole if she thought her quality of life depended on her students’ success. She said,

I would hope so. I always. . .[pause] communicated how high of expectations I had of those kids and I didn’t expect anything less than what I knew they were capable of doing. I think that a lot of times, especially in the urban areas, is that kids [pause] they accept low levels of success and achievement and in my classroom that just wasn’t acceptable. And I tried to get them to see that there’s a whole other world out there than just you know their little neighborhood and that ummmm…they can if they work hard and stay focused, they could do what they want in life.

(Interview, June 7, 2010)

On the surface, it appeared that Mrs. Cole answered the question and substantiated it by stating that she holds high expectations for her students. However, in her response her word choice seems to draw a clear line of demarcation between her and those students rather than a personal connection to the students in her class. She also made an assumption regarding success and achievement in urban settings; she stated that she believed that they accept low levels of success without describing or demonstrating how she knew or understood their circumstances. Finally, she described the community in which her students live as their little neighborhood (Interview, June 7, 2010).
In addition to finding it difficult to incorporate CRP into science, Mrs. Cole did not articulate a clear understanding of what it means to connect students their local community and larger society, a fundamental aspect of sociopolitical consciousness. When I inquired about how she had done this, Mrs. Cole mentioned conducting on-premise field trips and shared that going off the school premises was not possible. While an on-premise activity could be helpful, she failed to mention how the activity aided the students in challenging the status quo, especially considering the majority of the students live around the school.

**Mrs. Cole use of RBT.**

Mrs. Cole’s perception of her use of reform based teaching methods was higher than what the researcher actually observed. She rated her use of reform-based teaching as 61, which was above the mean norm, while the average across all observations was 43, below the mean norm of 50. The comparison between Mrs. Cole’s and the average ratings from the observations (Appendix E) support the researcher’s observations that her teaching practices did not support RBT. While Mrs. Cole did engage the students in two laboratory-like learning tasks, these labs did not precede formal instruction nor did they require the formulation of hypotheses. Furthermore, students were not engaged in content discussion nor were they reflective of their learning. The difference between Mrs. Cole’s perceptions and researcher’s observations varied across several items, and thus the table showing the difference was placed in the appendix.

**Learning Tasks: Just what is it that the students do?**
Mrs. Cole and her class engaged in seven different types of learning tasks. Table 4.7, displays the various learning tasks, their frequency of use, and their description or example of how they were used in class.

Table 4.7. Assigned learning task in Mrs. Cole’s class

<table>
<thead>
<tr>
<th>Learning Task</th>
<th>Frequency</th>
<th>Example/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questioning</td>
<td>Daily</td>
<td>Posed a question to the class and called on students to respond (triadic model)</td>
</tr>
<tr>
<td>Discussion</td>
<td>1</td>
<td>An image or question was posed that led the students to talk with one another about it.</td>
</tr>
<tr>
<td>Demonstration</td>
<td>1</td>
<td>Teacher set up a demonstration to illustrate a concept being taught.</td>
</tr>
<tr>
<td>Movie</td>
<td>1</td>
<td>Finding Nemo, segments were shown and questions were asked related to the segments.</td>
</tr>
<tr>
<td>Games</td>
<td>2</td>
<td>Served as fun way to review content that had been taught.</td>
</tr>
<tr>
<td>Lab</td>
<td>2</td>
<td>Activities that involved the student setting up conditions and making observations and/or collecting data.</td>
</tr>
<tr>
<td>Note taking (guided notes)</td>
<td>Daily</td>
<td>Teacher provided notes on concepts being taught and students recorded the notes by filling in the missing blanks on the note sheet.</td>
</tr>
</tbody>
</table>

The two most frequently used learning tasks were questions and note taking, both of which occurred daily. The questioning would typically begin with Mrs. Cole posing a question to the class, such as *What is photosynthesis?* (Observation, March 12, 2010). Students raised their hands and Mrs. Cole selected a respondent who answered the question; then she would evaluate their response by stating, “*Very good,*” if the response was correct or she asked another student for an answer if the first was incorrect.
Note taking followed a specific format; first, students were given a guided note sheet. Then Mrs. Cole posed a question, or read a sentence from the sheet and asked students to fill in the blank. Students answered, and everyone recorded the correct answer in the appropriate blank on the guided note sheet. Mrs. Cole often used PowerPoint to post questions or notes that were similar the sheet students were using. In discussing this instructional practice, Mrs. Cole shared that this made it easier for the students to follow along.

Over the course of the study period, I observed the students working and/or discussing with Mrs. Cole five different projects. One of the projects required students to work as a team to create a newscast about the overpopulation of deer in their community. The other four projects were individual and required the students to generate a product to represent the concept that they had learned. All of the projects followed Mrs. Cole’s instruction on the concepts. In essence, these projects did not serve to aid students in learning the concepts, per se, but rather functioned as a way to measure their learning. However, the research required for completing a project often served as a learning task for students.

The researcher observed five remaining learning tasks, discussion demonstrations, movies, games, and labs during the observation period but observed no method more than twice. At the beginning of the March 5, 2010 observation, Mrs. Cole had the students read the conditions for a class demonstration and they made predictions about what they expected to happen. Mrs. Cole set up four Erlenmeyer flasks containing a small amount

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10 Guided notes are pre printed, teacher-designed sheets that contained blanks that students filled in as they listened to the teacher’s lecture.
of yeast and water. To each set up she added varying amounts of flour and attached a deflated balloon to each one. When change was not immediately noted, she stated, “Hmmm…well these are starting to inflate so we will give it a little more time” (Observation, March 5, 2010). She then moved on to the guided notes and did not return to the set up before the end of the period. There was a small inflation of the balloons, but it was not as dramatic as she had anticipated. I encouraged her to try it again, setting up the flasks before class, and having the students observe the changes half way through the period. I followed up the next week, and she informed me that she did not have time to re-do the demonstration.

Two labs that were completed during the observation period began during class periods in which I did not observe. While observing the continuation, students had to retrieve their set up and make and record their observations. One lab involved growing mold on an orange or slice of bread; this type of lab usually follows or is completed when discussing fungi. The other lab involved growing and observing bean sprouts. This lab accompanies or is completed with units that focus on plant growth or life cycles and includes the exploration of plant parts. The use of bean sprouts, in this lesson, accompanied the study of photosynthesis. However, the students were not taking direct measurements of raw materials for or products of photosynthesis so this lab did not aid in the conceptual understanding of photosynthesis.

Both the games and movies served as review for previously taught content. The games contained knowledge level (Bloom, 1956) questions that students competed to answer. They seemed to be genuinely interested in the games and were eager to play. The
movie also stirred some enthusiasm among the students; when Mrs. Cole told the class they were watching *Finding Nemo* (2003), they all expressed how much they enjoyed the movie. I felt some reservations about the use of a movie, as my previous experience with popular culture movies in the classroom setting tended to be a waste of instructional time. Much to my surprise, Mrs. Cole prefaced the movie by reminding students that although this is a light day, they were to focus on the types of symbiotic relationships they saw in the movie. Throughout the movie, she stopped the movie and posed various questions. Two excerpts from this observation illustrate how Mrs. Cole used the movie as a learning task. Excerpt 4.1 followed the scene in which Nemo, the title character, swam off the reef and into open water and was captured by the humans.


(Observation, March 19, 2010)

Excerpt 4.2 occurred just after Marlin and Dorie met the sharks:

[Mrs. Cole] What do you think the impact of human influence on natural resources is? [Tasha; African American female] They can destroy the habitat. [class amongst themselves] [Billy; White male] They’re retarded! [Mrs. Cole] Maybe they are not so conscientious, they could destroy the shelter for fish or small animals. They could stop the cycle of life if they continue to take the fish out.

(Observation, March 19, 2010)

The students were unable to complete the movie during the class period, so Mrs. Cole promised to finish the movie the following class period.

**Roles: What’s your niche?**
The roles played by Mrs. Cole and her students varied based on the learning tasks in which the students were engaged. However, on a daily basis Mrs. Cole served as the questioner and the students were the respondents. Class typically began by Mrs. Cole addressing the entire class with either a question about what they had done the previous day or by explaining the learning assignment for the day. If class began with directions, Mrs. Cole followed up by posing a content related question. As previously mentioned, the questions, were posed to elicit correct responses and correct responses were validated; incorrect responses elicited a very brief follow up question by Mrs. Cole which was posed to the entire class. For example, during a question and answer session the following occurred:

[Mrs. Cole] What would be on the bottom of an energy pyramid? [Kory; African American male] A fox? [Mrs. Cole] Not a fox, why wouldn’t a fox be on the bottom? [Carl; White male] because nothing else eats a fox and the thing at the bottom is eaten by other animals.  

(Observation, May 14, 2010)

While Carl’s response was correct, there was no discussion of crucial content about the base of an energy pyramid, such as where the energy originates. Mrs. Cole accepted Amir’s response and moved on without further elaboration.

Other roles held by Mrs. Cole included demonstrator during lab set up, evaluator of student responses, knowledge disseminator when directly telling students content, guide/resource as students worked on their projects, motivator when students struggled with assignments or making sense of questions, and disciplinarian which required Mrs. Cole to closely monitor student interaction and progress and listen to student
conversations. While Mrs. Cole’s roles varied, daily she posed questions and in some context served as the disciplinarian.

The students’ roles also varied with the learning task, but ultimately were connected to what Mrs. Cole was doing. For instance, as she posed questions, the students were the respondents; if she demonstrated a concept, students served as volunteers, and/or observers. Only once in the observation period, did the students serve as discussant in which they exchanged ideas about content.

The second most prominent student role was that of creators; they were expected to create a project or product based on a set of criteria. This creator role was coupled with class projects and occurred four times during the observation period.

Interactions

Teacher-students.

As the roles were linked to the learning tasks, so were the interactions. Mrs. Cole invoked the IRE model (Lemke, 1990). The dominant interaction originated with Mrs. Cole; she directed that interaction to the whole class, which then stimulated an individual response from a student directed back to her. When Mrs. Cole was the disciplinarian, she interacted one-on-one with a student. At times, this interaction was very discreet as she approached the disruptive student(s), speaking in a very low tone, inaudible to me, and redirected their attention to the learning task. Other times, her disciplinary interactions were very commanding as noted by her command, “Don’t come up in here like that!” (Observation, March 12, 2010). This command, directed to a group of African American
girls who entered the class yelling at one another, immediately quieted the girls and they took their seats.

**Student-Teacher.**

Student-initiated interactions rarely occurred. There were instances, however, of student initiated interactions based on learning tasks, such as the beanie baby lab\(^\text{11}\) observations. Student-initiated interaction was exemplified when, Aaliyah, an African American female, approached Mrs. Cole and said, “*My baby’s roots are growing!*” Mrs. Cole responded by saying, “*Ah, look at that! It’s being born!*” (Observation, March 12, 2010).

The students also displayed their enthusiasm for the content by posing questions or pointing out their observations to Mrs. Cole. Student-initiated questions often generated direct content related answers from Mrs. Cole but at times, she turned their questions into learning opportunities as seen in the following exchange:

[Mika; African American female] Mrs. Cole, how could a fish defend itself from a lamprey? [Mrs. Cole] That’s a good question; you can do your project on that. (Observation, March 26, 2010)

Despite the suggestion to research a topic that stemmed from the observation of a picture, the student(s) selected a different topic.

**Student-Student.**

Content specific interactions occurred between and among students when they were provided with an opportunity to work collaboratively on projects and assignments.

\(^{11}\) The beanie baby lab was a learning task in which the students place seeds in a sandwich bag with a moist paper towel and made observations over a period of three weeks as the seeds began to sprout. Thus the name, beanie baby.
or allowed to communicate with one another while working on an independent assignment. These interactions centered on things the students thought were surprising and/or unexpected. A hearty conversation between students ensued when a group of students saw an image of a fish that had been injured by a lamprey. The students were amazed that such a small animal could cause so much damage to a much larger fish.

Another instance of student-student interaction occurred when students began working on their niche project. The conversations involved the students sharing their ideas about the project. They asked one another questions such as *What are you doing?* and *What’s that?* (Observation, May 5, 2010). This discussion was not an explicit part of the project, but it did help the students think about the direction of their project.

**Summary**

Mrs. Cole’s classroom practices did support hands-on approaches, but the discussions that aid in the building of conceptual understanding were missing. The hands-on activities allowed students an opportunity to do science, but sense making was non-existent. Additionally, there was no explicit connection to student culture in the assigned learning tasks, and none of the learning tasks moved beyond the classroom. Furthermore, the roles and interactions were consistent with the learning task. The various projects provided students with some autonomy of how they wanted to complete their projects, but they had little choice in what projects they completed. Moreover, all of the projects followed formal presentations, which is counter to RBT as it does not allow for student exploration.

**Mr. Richardson and His Classroom**
Mr. Richardson’s Classroom

Mr. Richardson’s classroom was not a traditional science classroom. It was equipped with tables and three computers, but there were no lab benches, sinks, or any other scientific equipment indicative of science lab. The students were seated two per table, with the exception of one student who sat alone. A door appeared to connect his classroom to another science class, however, the walk through was used as a special education classroom; there was no class in that area during period in which observations were conducted.

Who is Mr. Richardson

Mr. Richardson is a 38-year old African American man who has been teaching for eight years. He has spent the last four years teaching at DMS, but this was his first science teaching assignment. On the teacher profile sheet, Mr. Richardson indicated that he does not live in or near the school community, but during the interview he shared that he does live close enough to the school and he frequents the businesses in the school community (Interview, Aug. 3, 2010). He also spends a great deal of time interacting with the students and families of DMS as he coached the boys’ basketball team. Mr. Richardson’s familiarity with the students seemed to aid in the construction of positive relationships with the students, as he rarely had classroom management problems. In fact, during several observations, teachers sent students from other classrooms to Mr. Richardson for misbehavior. He had a very calm demeanor; not once did he raise his voice or scold students. Instead, he stared at those who misbehaved and they either corrected their behavior, rolled their eyes or mumbled something inaudible as teenagers
are apt to do. Mr. Richardson rarely responded to their reactions and he continued about the business of teaching.

**Mr. Richardson’s use of CRP.**

Mr. Richardson was one of the participants who had not had any formal introduction or experience with CRP and I expected him to lack familiarity with it. However, as indicated on the teacher profile sheet, his understanding of CRP revealed that he is in agreement (x=1.54; X=1.69) with the tenets of CRP. During the interview, Mr. Richardson shared that he had not heard of CRP prior to being asked to participate in this study, and observations of classroom practices supported his lack of familiarity.

When asked to define culturally relevant pedagogy, Mr. Richardson responded,

Ummm…for me. . . to me. . . it is teaching students from their culture or their perspective. I could be right or wrong but that’s what I think of it as [pause] Well, I didn’t define it as culturally relevant. I defined it as far as teaching students. Meeting students where they are, I guess that does include their culture, but to me it’s more than just their culture. It’s meeting them where they are educationally, I guess including their culture as well. But that’s something that if they need that to succeed as a teacher you kind of automatically throw that in.

(Interview, Aug. 3, 2010)

While his responses did not indicate a formal understanding of Ladson-Billings’ (1994) CRP, he did equate it with doing what is necessary to help students succeed. Mr. Richardson seemed unsure as to whether or not culture has a place in teaching and learning. This compelled me to ask him to define culture. He stated,

Culture is ummm…language. That’s pretty much what it means to me. Also, I look at culture as race as well. I don’t know if that is the correct answer but I think culture kind of involves race as well.

(Interview, Aug. 3, 2010)
Mr. Richardson’s definition of culture seemed quite narrow, but I asked him how he learned about his students’ culture. His response indicated that while his articulation of culture was narrow, he knows that it encompasses more than language and race.

I learn their culture just [pause]. Well, one I coach basketball. So that helped me learn a little bit more about students and what I mean by that is by going through the neighborhood. Here often, I end up taking students home and things of that nature and you just learn about how they grow up and what they know. Also, I talk to them a lot. Cause you’d be surprised when you’re talking to students and some of the things they’ll tell you as far as you know how they were raised and how they moved from house to house and neighborhood to neighborhood. Things of that nature.

(I Interview, Aug. 3, 2010)

I then inquired about how he uses the students’ culture in his teaching. He responded,

Ummm…. I [pause] you know, a lot of my students are into hip hop and things like that. So any time I can infuse some type of hip hop into the lesson, it makes it clear for them to understand. Even if it is in a comical way, I mean sometimes it doesn’t always fit the lesson but it will help them understanding what I am talking about.

(I Interview, Aug. 3, 2010)

No definitive examples emerged from his response, and based on classroom observations there was no integration of culture into the teaching of the content. However, his definition and/or understanding of culture was consistent with his practice; moreover, he admitted that he had not done anything recently to connect the content being taught with students’ culture or community.

Another interview question asked if Mr. Richardson saw a connection between what he is doing as a teacher and students’ success. His response was quite interesting:

Ahhhh…. I would say no. I don’t think that their success has anything to do with the life I live. I guess I don’t know. I guess I can see it both ways [pause]. I would
say no without thinking about it. When I start thinking about it more, I can see how it does.  

(Interview, Aug. 3, 2010)

If was not clear if Mr. Richardson fully understood the question as originally stated, so I rephrased it and recorded the following the exchange:

[Researcher] If students are successful in your class, go on to high school, and graduate and become productive citizens, do you think that [their success] is connected to your quality of life?

[Mr. Richardson] oh, I know what you’re saying. Ummmm yeah? That does directly affect my quality of life. The better they do in life, the better my quality of life is as well because they [pause]. Basically we’re teaching the future. They’ll be the decision makers.  

(Interview, Aug. 3, 2010)

Mr. Richardson’s reform based teaching.

Mr. Richardson perceived that he utilized reform based teaching practices. While he reflected on his teaching and using RTOP, he rated his RBT use as 79, which is higher than the mean norm of 50. The classroom observations show that Mr. Richardson rarely, if ever, used reform based teaching; Mr. Richardson’s average RTOP rating was 38.

A comparison of Mr. Richardson’s ratings and those obtained from the classroom observations showed a number of items in which his perception diverged from that of the researcher. Across these items, the average rating was no higher than 1.71 out of five. Mr. Richardson’s ratings ranged from two to four. (Appendix F) Ever scale contained one or more items that differed between Mr. Richardson and the researcher. For that reason, the table displaying the difference in rating is found in the appendix.

Mr. Richardson indicated that student exploration preceding formal presentation was descriptive of his classroom, but the researcher did not make such observations.
While student exploration did occur in his class (e.g., the rocket project), formal presentation of content did not occur at all. The project, however, occurred toward the end of the academic year after course content had been covered, but there was no reintroduction or review of content necessary to effectively connect to or engage in the project. For instance, when designing their rockets, students should have considered the various forces that would act on it, yet students created rockets without making connection to consider those forces; Figure 4.1 shows an illustration of a rocket designed with those forces in mind, and an example of the student-created rocket from Mr. Richardson’s class. Formal presentation had preceded the students’ exploration, but neither the students nor Mr. Richardson returned to the content to inform the project.

![Image of rocket with forces labeled](http://www.onlyiflinks.com/pop-soda-water-bottle-rockets/)

*Figure 4.1. Comparison of model and student constructed rocket*

Over the study period, there was only one instance in which the teacher’s questioning attempted to link the content to real life. This occurred when students were giving a presentation about the states of matter. After the students presented, Mr. Richardson asked, “*Can you give an example from real life?*” (Observation, Feb. 26, 206...
One of the presenters responded, “I don’t think about this in my life” (Observation, Feb. 26, 2010). Mr. Richardson did not follow up or ask other students to provide examples.

Aside from the rocket project and occasional presentations, the students did not engage in laboratory investigations or demonstrations. Every observation involved some degree of lecture, question positing, independent work, or student led presentations. With this in mind, students did not engage in what Sawada et al (2002) characterized as activities related to procedural knowledge. Mr. Richardson, however, thought that his instruction supported those activities. He also thought that his classroom practices supported communicative interactions. While there was time for activities such as sharing ideas and creating a climate of respect, Mr. Richardson’s questions did not trigger divergent modes of thinking nor did students’ questions determine the focus of classroom discourse.

The last subscale measured by the RTOP was student-teacher relationships. Mr. Richardson was quite familiar with the students, as previously mentioned his work both in and outside of the classroom. However, there seemed to be an unspoken power dynamic in the classroom. He was clearly the leader and in charge of every aspect of the classroom; he was the authority. Mr. Richardson thought his relationship with the students encouraged them to come up with alternative solution strategies and ways of interpreting evidence. During the majority of the observations, this was not an accurate description of what took place in his classroom. Students never collected nor interpreted data; they also did not examine previously collected data to interpret. Instead, students
looked to Mr. Richardson for validation of correct answers when answering questions, or for accurate description of content when presenting. During the rocket project, there were opportunities for students to devise alternative solutions, but they still looked to Mr. Richardson for validation instead of testing their ideas. The organization of the project prevented Mr. Richardson from directly responding to student inquiries, which caused some frustration and led the students to construct their rockets without considering the content.

**Learning Task: Just what is it that students do?**

Four types of learning tasks and their frequency in Mr. Richardson’s class are shown in Table 4.9.

*Table 4.8. Mr. Richardson's Learning Tasks*

<table>
<thead>
<tr>
<th>Learning Task</th>
<th>Frequency</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student presentations</td>
<td>2</td>
<td>Students conducted research, using their textbooks and/or computers, to gather information about specific topics and created presentations of the information.</td>
</tr>
<tr>
<td>Bookwork</td>
<td>2</td>
<td>Students read a set number of pages and responded to associated questions.</td>
</tr>
<tr>
<td>Questioning</td>
<td>2</td>
<td>Mr. Richardson would pose a question to the students, and call on one student to respond.</td>
</tr>
<tr>
<td>Rocket Project</td>
<td>1 (ongoing over 5 weeks)</td>
<td>Ongoing, hands-on project that lasted three weeks. Students designed, constructed, and launched their own rockets.</td>
</tr>
</tbody>
</table>

The student presentations required that student research assigned topics using the Google™ search engine, design a poster or PowerPoint that they presented to the class.

Mr. Richardson posed questions to the students as they presented, but often the students were unable to answer the questions, possibly signifying that they did not know or
understand the content. During one presentation, the group displayed an image of a body with various colors around it. The following exchange illustrates Mr. Richardson’s question and the group’s response to his question:

[Student Presenter] *This* is thermal energy. [Mr. Richardson] How do you know? There was three seconds of silence as the students looked around and then said, [Wendy; White female] It was just on the computer.

(Observation, March 12, 2010)

There was no follow-up by Mr. Richardson or the students to define thermal energy. Also in the presentation, groups were to share an activity that could be done to illustrate the concept that they presented, but none of the presenting groups did so.

Bookwork was another learning task in which the students engaged. During the second observation on March 5, 2010, they were tasked with correcting their answers on a worksheet that had been completed the previous day. Mr. Richardson informed me that today would be a silent work day as the students spent the previous day misbehaving in his absence, and did not adequately complete the assignment. Students worked on the worksheet for 30 minutes, and then he lectured them about the importance of test taking as a justification for the given assignment. His lecture was as follows:

I have to prepare you for the OAT. I know you may not enjoy it but I don’t care. I’m not a good test taker, but it is a part of life no matter what you decided to do. When I graduated from high school, I applied for a job working on the turnpike, and I had to take a test. I didn’t do well and they never called back. So I had to come up with a place for success. I went to Cleveland to enlist in the Air Force, but I had to take a test. I didn’t pass all of the test so I decided to try college. I had to take the ACT and I scored high enough to get in and decided to become a teacher. But in order to continue in education, I had to take a test and to teach. If I

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12 OAT is an acronym for Ohio Achievement Tests, which has been renamed the Ohio Achievement Assessment.
want to become a principal, there are more tests for me to take. The point is, you will be taking tests for the rest of your life no matter what you want to be. (Observation, March 5, 2010)

The point of his lecture was to encourage and motivate students about their upcoming achievement assessment.

The other learning tasks observed in Mr. Richardson’s classroom were questioning using the IRE model (Lemke, 1990), drill and practice involving answering multiple choice questions and sharing answers, and a project (rocket building). Questioning was observed twice and whenever drill and practice was used. The rocket project began after statewide standardized testing ended and continued until the end of the school year. The purpose of this project was for students to use their content knowledge to build, design, and launch their rocket. Additionally, students had to use math skills to generate a budget and to keep track of their spending. (Appendix J)

Roles: Whose job is it anyway?

The roles of the teacher and students in Mr. Richardson’s class were very distinct despite the learning task students were assigned. Mr. Richardson was the content expert; when students were skeptical of each other’s work or answers, they consulted Mr. Richardson for the correct answer. This was particularly evident when he used drill and practice. Although students had already answered the questions, he asked them for their answers and often their answers were incorrect. Mr. Richardson then gave the students the correct answer. If students indicated that they did not know the answer, he sought out another student to answer the question. Ultimately, he provided the correct answer and moved on.
In addition to being the content authority, Mr. Richardson was also the disciplinarian, the supervisor, the questioner and the evaluator. He was required to be a disciplinarian in a very few instances because a quick glance or a sarcastic comment worked to redirect misbehaving students. During the rocket project, Mr. Richardson, served as the supervisor and handed out requested supplies and kept the students on task. His roles as the questioner and evaluator went hand in hand; whenever he posed questions to the class he also functioned as the evaluator, clearly letting students know if their responses were correct or incorrect. During student presentations he also informed them if their content was accurate or not.

**Student roles**

The student roles followed the assigned learning task, however, the researcher did not observe students serving as the content expert. During the presentations, I expected them to serve as the content experts in light of the amount of research completed in preparation for the presentation. Despite their preparation, the students still looked to Mr. Richardson for validation, as he was clearly the content expert to them. For example, as students presented their phases of matter posters during the first observation, they continually asked, . . . *Ain’t that right?* (observation, Feb. 26, 2010). In this case students served simply as presenters of information.

Mr. Richardson’s students also seemed to take on the role of sponges (Lawton, 1991), students who passively received information from the teacher. Outside of the presentations which required students to find information, and the rocket project, which was devoid of explicit content, students did not actively engage in any hands-on activities.
that aided in their construction of knowledge. Instead they answered written questions, verbalized their answers, and Mr. Richardson evaluated those responses. It seemed that Mr. Richardson expected students to gain the knowledge from selecting or writing down the correct responses. Therefore, in addition to being sponges, students were also respondents during questioning sessions or during drill and practice. There was at least one instance in which students posed questions to Mr. Richardson, however those questions were not related to the content being studied and were not taken seriously by Mr. Richardson.

The other role held by students was that of collaborators, specifically for the rocket project. Although the project was supposed to have been collaborative, within each group students performed specific roles such as project manager, budget director, or team member. The design of the roles was to divide the labor associated with the project. The project manager functioned as the liaison between Mr. Richardson and the group and all requests from the group to Mr. Richardson had to come from the project manager.

**Interactions**

Most if not all of the interaction in Mr. Richardson’s class was unidirectional, originating from Mr. Richardson and directed toward the class or toward one student. These one-way interactions involved conversations about student behavior or part of the learning task of question and answers. It did appear that during discipline related interactions, Mr. Richardson insisted on having the final say. The following exchange occurred on March 12, 2010 during the third observation:
[Mr. Richardson] Chill. [Samantha; White female] I ain’t even doin’ nothin’. [Mr. Richardson] Good, just chill! [Samantha] I am chillin’ [Mr. Richardson] Good, thank you (with an air of sarcasm).

The reciprocal unidirectional interaction from student to teacher occurred during the observation period; such interactions usually were ignited by logistical questions students had about assignments. Student-student interactions and questions occurred daily, but it rarely related to content. Students discussed things such as grooming habits or other non-content related discussions.

**Summary.**

Mr. Richardson had control or at least a handle on student behavior in his classroom. The chosen learning tasks and interactions, however, were not indicative of reform based teaching or culturally relevant pedagogy. Beyond conducting research in preparation for class presentation, no opportunity to engage in what NSES defined as *minds-on* and *hands-on* learning (NRC, 1996) was afforded to students. Additionally, the learning tasks were devoid of cultural references, including those identified during the interview (i.e., the use of hip hop).

Mr. Richardson’s admission that he was not comfortable teaching, as this was the first time he has had to teach it illuminated his lack of content knowledge. Both CRP and RBT require that teachers know the subject matter that they teach. Lacking content knowledge presented challenges for Mr. Richardson as he was unable to craft the content in a way that made learning meaningful to and relevant for the students.

**Summary**
It is often easier to highlight flaws or those less than positive things occurring in a classroom. Through her portraiture methodology, Lawrence-Lightfoot (Lawrence-Lightfoot & Davis, 1997) encouraged researchers to search for goodness. As I reflected on each teacher and their classroom, I felt as if I had highlighted those things that were not occurring in the classroom, those things which I would consider not “good.” However, the data always has a story to tell, be it good, bad or indifferent. With that in mind, I intend to highlight the data despite the emotive value it invokes in the reader.

Through this study, I examined the use of two pedagogical approaches, culturally relevant pedagogy and reform based teaching and teachers’ preparation to use CRP. I focused specifically on the teachers’ and students’ classroom practices such as their respective roles and interactions, and the assigned learning tasks. I looked for evidence of CRP and RBT within these practices. The data in each portrait showed that each teacher used a variety of learning tasks. Students were assigned, and expected to successfully complete, projects, presentations, and lab investigations. It was these learning tasks that promoted and supported student-student and student-teacher interactions. In addition, these learning tasks also put the responsibility of learning on the students.

Despite the variety of learning tasks, many of them followed formal presentation of the content by the teacher which is counter to RBT (Sawada et al., 2002). Used in this manner, the projects became a method for assessing what students knew. However, students still struggled to complete the project(s) and/or did not draw from their prior knowledge while doing the learning task. Furthermore, while student-student interaction is an inherent part of these types of learning task, most of those kinds of observed
interactions were not content related; instead the interactions were conversational in nature and focused on procedural tasks such as what design or graphics should be placed on the rocket, or what pictures to use in the movie. Other conversations were off task and not recorded.

All of the teachers used the IRE model (Lemke, 1990) of initiating a question, students responding, and the teacher evaluating. The teacher’s use of this model sent students on a quest for the correct answer and, supported the pedagogy of poverty (Haberman, 1991) in which students focus on correct answers rather than thinking conceptually. The dominant interaction in each classroom, originated from the teacher toward the class or a specific student. Specifically, the teacher was asking questions (Haberman, 1991, p.16) and students were responding.

In regards to CRP and RBT, very little of either were found in the classroom practices of the participating teachers. There was an attempt to integrate culture into the teaching, but this evidence was obvious in only two of the classrooms. The first instance of cultural integration involved the teacher, Mrs. Boyle, adding a culturally based criteria to a class project. The other instance involved both Mrs. Boyle and Mrs. Cole describing an assignment in which students were to create a newscast about deer overpopulation. Mrs. Boyles’ cultural integration, on the surface, appeared to add that cultural dimension but it also has implications for development of scientific misconceptions. The second instance, deer over population, clearly had a cultural component but the teachers chose to focus on the creation of the newscast as the cultural component rather than highlighting the deer hunting or over population as the cultural component.
In varying degrees, all of the teachers supported academic achievement in their classroom and clearly articulated what students were expected to do in order to experience success. At least one teacher went further by providing students with additional opportunities and encouragement to be successful. Sociopolitical consciousness was not a part of any of the teacher’s classroom practices.

The teachers rated their RBT higher than the mean norm (50), yet only one teacher displayed classroom practices that supported this higher rating. The remaining teachers had mean scores that were lower than the mean norm. The data also revealed that although teachers did not consistently use RBT, two teachers, Mr. Richardson and Ms. Herman, utilized practices that were non examples of RBT. In other words, their practices were diametrically opposed to the practices espoused Sawada et al., (2002). For example, RBT supports the practice of hands-on student exploration that involves the students exploring content before being formally introduced to it. In Mr. Richardson’s class, the students were told to read and outline content they did not know; this learning task was devoid of any exploration. In Ms. Herman’s class, students often engaged in exploration by working on projects but there was rarely any formal presentation of content.

The lack of formal presentation either before or after exploration represented non-examples of pedagogical content knowledge (PCK) and teacher content knowledge (TCK). It was difficult to determine whether teacher’s understood the content, particularly since formal presentation was minimal. Pedagogical content and teacher content knowledge are both essential aspects of CRP and RBT. Without either, PCK nor
TCK, teachers are unable to teach science in ways that are meaningful to and relevant for students.
Chapter 5 Discussion

The Portrait

Conception: Why this? Why now?

“I wouldn’t say I use it 100% of the time, but I try to use [CRP] when I teach; I’m confident and comfortable enough with [CRP], but I just don’t know how to integrate into science.” (Teacher Interviews, July 19 & June 7, 2010)

Science is important in American education, particularly when viewed in tandem with President Obama’s 2011 State of the Union speech in which he stated that “. . . [now] is our generation’s Sputnik moment (Obama, 2011).” In other words, now is the time for the American government to make an investment in scientific research and development as well as STEM Education. This renewed call for an emphasis on STEM education, and science in particular, is not new. Early reform efforts focused at the elementary level and progressed into the secondary level (Bybee, 1995). These reform efforts led to the development of science curricula, new strategies for science teaching, and examination of how people, particularly children, learn science. Despite the fervor about science education, science achievement data still shows that science education has not reached the pinnacle for which the American government has been striving since 1957. For many populations of students, the acquisition of necessary science and technological skills remains elusive. Science achievement data clearly illustrates that something is amiss in science classrooms populated by minority and poor students.
The goal of this portrait is to illustrate the story of what has occurred in culturally relevant science classrooms of one urban middle school. This particular middle school, Deer Middle School, is located in a large Midwestern city that has a range of families from various socioeconomic levels. Deer Middle School, however, is one school whose racial demographics vary greatly from that of the entire district, but serves as a representative sample of the lower socioeconomic status of families within the district.

**Setting the stage: Bringing DMS into view**

Like many urban schools, DMS experiences low academic achievement in science as measured by the state standardized test scores. When I walked to the building, I observed a school that was built in the late 1950’s, and, while not dilapidated, the architecture and fixtures serve as a tell tale reminder that this 20\textsuperscript{th} century building must find a way to function and to accommodate 21\textsuperscript{st} century learning (Shaw, 2010).

Upon entering the building, the hum of fluorescent lights and low murmur of teachers and students talking inside their classrooms created a comforting cacophony for me. Displayed artfully throughout the hallway was student work, and motivational banners lined the common areas. A table just outside the main office contained the local African American newspaper. While the sight of the newspaper brought a sense of familiarity to me, I was quickly jogged back to reality as I wondered why this particular newspaper is readily available in a school that is 74\% White. The thought quickly dissipated as I remembered that a small percentage of students are African American, and it was reassuring to see that a relevant resource for diverse students was readily available.
The purpose of my presence at DMS was to capture science teachers using culturally relevant pedagogy, but also gain an understanding of how the school operated, who the students and teachers were, and what their classrooms were like. Initially, I focused on the data that would be helpful in constructing a portrait of culturally relevant science classrooms, but I quickly noticed that there were some obvious underlying issues that may impact what I saw. Those issues included classroom functionality for science teaching and learning, teacher investment, school climate, and teacher understanding of culturally relevant pedagogy and science teaching.

**Culturally relevant pedagogy in science classrooms.**

Culturally relevant classrooms, according to Ladson-Billings (1994), are places in which children are empowered to succeed by their teacher’s use of their culture as a basis for learning and supporting them as they use their newfound knowledge to challenge the status quo. Culturally relevant science classrooms are no different. They, too, empower students to succeed, using their culture and support as they, the students, critically examine their local, national, and global community.

Culturally relevant science classrooms are distinguished as places where cultures converge and are used as a basis for learning science content. Teachers and students are constantly negotiating their respective roles, and using their culture as assets rather than deficits. An atmosphere of mutual respect epitomizes these classrooms and value is placed on the experiences, understandings, and cultural capital (Parsons et al., 2005) that each classroom member brings.
The NSES calls for science to be taught using inquiry, which puts students at the helm of their learning, and is similar to CRP. The Figure 1.2 clearly illustrates the alignment between CRP and RBT; however, neither approach was used consistently throughout the observation period, thereby rendering an incomplete portrait of what culturally relevant science classrooms could look like. Academic achievement was the only tenet of CRP seen within these classrooms. There were some attempts at integrating culture (cultural competence), but they were superficial at best and do not represent meaningful integration of culture into science teaching and learning.

**Academic achievement**

Culturally relevant science teachers function as motivators, nurturer, encouragers, and supporters of academic success. Students are unable to sit idle in class; CRP teachers quickly draw them into lesson. If met with resistant, the teacher will interact with the students to get to the root of the problem and encourage them to take an active role in science learning. The articulation of expectations regarding assignments and what students should expect to do in order to be successful in their classrooms are daily occurrences. Assignment rubrics are commonplace, and teachers willingly clarify or amend the rubric to meet the needs of their students. Culturally relevant science teachers constantly remind students of upcoming due dates and assignment expectations, and are sure to monitor student progress on these assignments before the due date.

There are teachers who verbalize the belief that, *All students are capable of learning*, yet often practices reveal something to the contrary; such is not the case with culturally relevant science teachers. They demonstrate this belief by ensuring that all
students are given opportunities and are encouraged to take advantage of those opportunities to learn. For instance, in Mrs. Boyle’s classroom, assessments are used as opportunities for learning, and during a district-wide assessment she observed two White male students who sat idly, not working on the assessment; she discreetly approached both students and asked why they were not working. One indicated he was sleepy and hot, so she fanned him and opened the window. The other one indicated that he did not have a pencil, she provided him with one.

Moreover, culturally relevant science teachers recognize that summative assessments are not the only way to measure students’ understanding and learning. Project based assignments are often used to measure students’ understanding, while also allowing students some level of autonomy in choosing their projects, and encouraging and reinforcing the notion that science is a creative process (NRC, 1996).

**Cultural Competence**

Culturally relevant pedagogy also requires the use of student culture and students critical examination of the current social order (Ladson-Billings, 1995). There was no critical examination of the curriculum or current social order by the teacher or the students noted during the study period. In fact, teachers and students alike adhered to the curriculum without any deviation.

Each participating teacher demonstrated knowing the students or at least an awareness of the environment in which they live. All of the teachers believed that part of their job included showing the students that a better life exists beyond what they have experienced; in other words, the teachers used their platform to teach culture instead of
using culture to teach (Ladson-Billings, 2001). For instance, Mrs. Boyle spoke of helping the students understand that being a part of the middle class is a good life and is attainable (Interview, June 11, 2010). Mrs. Cole spoke of getting the students to recognize that there is life beyond their little neighborhood (Interview, June 7, 2010). In casual conversations, both Ms. Herman and Mr. Richardson discussed sharing their personal experiences on vacation with their students. Mrs. Cole, during the interview shared that she often brings her experience from industry into her teaching (Interview, June 7, 2010). While each teacher seemed to have an understanding of the environment and community in which the students live, they did not know how to use that knowledge as an aid in the teaching of science.

During the observations, none of indicators of cultural competence were evident in the teachers’ practice. The teachers discussed how they got to know the students’ culture and community, yet none of them could recall how they used that information as a basis of learning. Mrs. Boyle attempted to integrate culture into science by having her students add an element of their culture to a project that involved them creating their own arthropod. On the surface, this seemed like an interesting way to bring in aspects of student culture, however, doing so negated the content she intended for the students to learn; arthropods have very distinct characteristics, thus their classification. Having students add a feature from their culture may mean that the arthropod could no longer be classified as such. Furthermore, the example given by Mrs. Boyle was an arthropod that contained a pouch in which to carry knitting supplies; this added feature made her arthropod biologically inaccurate. This could speak to her understanding of content;
however, she understood that real arthropods would have no such pouch. Therefore, her attempt to integrate culture was superficial, at best, and detracted from the expected accurate scientific content students were to learn.

Another attempt to infuse culture was unintentionally done, as the teachers who implemented the learning tasks did not consider the cultural element when selecting the activity. While studying ecological limitations on populations, Mrs. Cole shared with Mrs. Boyle, and implemented a learning task, that involved the students creating a newscast about deer overpopulation in the community and how to solve it. The cultural connection between the students and this assignment was that many of the students or their family members hunt deer. Therefore, the organism being studied in this project was animals with which some of the students are familiar, and one of the choices for solving the overpopulation is hunting, a method familiar to some of the students. Both teachers selected the activity because they thought it would be fun for the students to create a newscast as opposed to placing an emphasis on the cultural connection of hunting.

Mr. Richardson and Ms. Herman did not integrate culture into the teaching of science in their classrooms; Ms. Herman did assign a variety of project-based tasks that allowed for student autonomy, and opened the door for cultural integration, but it was not an explicit part of the learning task rubrics. Consequently, only one of the projects, the movie project, provided an opportunity for students to integrate aspects of their culture such as music, but not as an explicit part of the project.

The other project based learning tasks required the restatement of content from the textbook in their own words. The indicators of cultural competence, as Ladson-
Billings (2001) posited, essentially were nonexistent, unintentional, or implemented superficially within the teachers’ practices.

**Sociopolitical Consciousness**

Sociopolitical consciousness, also known as critical consciousness, proved to the most elusive tenet of CRP. The purpose of this tenet is to empower the learner to use the learned content to challenge the status quo, the existing social order, in an effort to improve it. Based on the learning tasks assigned and interview data collected from each teacher, sociopolitical consciousness was not a common practice in their classroom. All of the teachers found it difficult to implement science experiences that connected the students to their larger social context. Mrs. Boyle indicated that she shared local fun facts with the students, such as where to go to see a bald eagle (Interview, June 11, 2010), however, sharing fun facts does not address sociopolitical consciousness. Mr. Richardson discussed getting parents and grandparents involved in learning tasks (Interview, Aug. 3, 2010), but admitted that he has never implemented learning tasks that connect the students to the larger social context.

While teachers’ practices did not support their understanding of sociopolitical consciousness, all of them strongly agreed with the indicators of the tenet on the teacher profile sheet. Moreover, during the interview, the teachers seemed unsure about whether there was a connection between student success and the quality of their lives. In fact, Mr. Richardson quickly stated that his quality of life had nothing to do with student success (Interview, Aug. 3, 2010); after providing him with a specific example, however, he conceded that perhaps there is a connection.
Reform-based teaching.

Reform based teaching is the approach supported by the NSES (NRC, 1996), and science methods course often place an emphasis on this approach to science teaching. Only one teacher, Mrs. Boyle, demonstrated an understanding of the use RBT. A collective examination of the teachers’ use of RBT revealed a mean average score of 48, which is lower than the mean norm of 50 for middle school science teachers. Teachers had an opportunity to receive an overall score of 25 on each scale and subscale. None of the scales or subscales came close to that score; in fact, the procedural knowledge subscale, which measures whether students are encouraged to use various inquiry process skills\(^{13}\), had the lowest scores (\(x=4.26\)), which signify that students rarely, if ever, had opportunities to use those skills. In one classroom, students were able to make predictions and observations of specific laboratory setups, but these were not laboratory investigation designed to test hypotheses formulated by students; rather these were confirmation labs (Windschitl, 2004), in which students set up experiments that were design to support the content they had recently learned.

Lesson Design and implementation.

The lesson design and implementation portion of the RTOP focused on whether the lesson was designed to elicit students prior knowledge, to engage them as members of a learning community, to allow for exploration, to seek alternative explanations, and to allow the students to determine the focus of the lesson. For teachers to implement strategies that respect students’ prior knowledge, they must know their students. Through

\[^{13}\] These process skills include but are not limited to, making predictions, formulating hypotheses and testing the ideas (Sawada et al., 2002)
interviews, each of the teachers demonstrated knowing their students and understanding their circumstances. However, none of the teachers used that information to implement strategies and activities that respected their students’ prior knowledge. Attempts were made to engage students as members of a learning community, but these attempts typically resulted in question and answer sessions in which students competed to provide the correct response. Many of the lessons, although project based, were implemented in very tradition ways. In essence, all the projects followed formal presentation of content, was devoid of formal presentation of content, or and served as a means of assessment.

**Content (Procedural and Propositional knowledge).**

The RTOP measured procedural and propositional content knowledge. Procedural knowledge deals with what students were asked to do in the lesson, while propositional knowledge focuses on teacher content knowledge and the content inherent in the lesson. It was difficult to gauge the teachers’ understanding of the content, as they rarely had to explain or used strategies that demonstrated that they understood the content. There should have been evidence of connections of the content with other disciplines or real world phenomena, but the adherence to the curriculum without any modifications did not allow sufficient determination as to whether the teachers were able to do this. I could ascertain, however, that teachers did not know how or did not see the connections between the content and real world phenomena or they simply chose not to address it.

**Classroom Culture (Communicative and student/teacher relationships).**

The two subscales of classroom culture are communicative interactions and student-teacher relationships. Communicative interactions focused on students interacting
with one another, engaging in accountable talk (Michaels, O’Connor, & Resnick, 2008), and using their conversations as a means to make sense of the content. Overall, the practices in each classroom did not consistently support communicative interactions.

There were times when students worked in groups and discussed content, but the majority of those interactions were procedural in nature; basically, the students discussed their respective roles while engaging in their projects. On one occasion, the students in Mrs. Boyle’s classroom engaged in accountable talk as they debated the validity of another student’s response to the warm up.

As for student-teacher relationship, reform-based teachers recognize that students should do more talking and the teacher should do more listening. Across all classrooms, the teachers did most of talking and did very little listening. However, depending on the learning tasks, Mrs. Boyle spent more time than her colleagues listening to her students and serving as a resource guide, rather than the conveyor of knowledge.

**Building bridges: Bringing CRP and RBT into view**

Both CRP and RBT specify that teachers must have a solid grasp of the subject matter they teach (Ladson-Billings, 1994; Sawada et al., 2002). Throughout the observation period, it was difficult to gauge whether or not the teachers truly understood their content. Most of them assigned project-based learning tasks in which the students were in charge of developing content into a given product. Students rarely asked content-related questions of the teachers, and thus I did not have many opportunities to rate their content knowledge. Two of the teachers expressed their reservations about teaching science, as they did not believe they had sufficient content knowledge. Mr.
Richardson, during an observation requested that I assist him in explaining a life science concept to the students. His request moved me from the periphery of the classroom as an observer to that of participant-observer (Goldbart & Hustler, 2005). Later he shared with me that he was not comfortable with life science content (post observation, March 21, 2010) and that is why he asked for my assistance. In fact, as that conversation continued he also informed me that he was not comfortable teaching science as it was his secondary endorsement and the first time since he began teaching that he had to teach science. Mrs. Cole also shared, during her interview (June 7, 2010) that she was uncomfortable teaching science because, like Mr. Richardson, it was her secondary licensure area, and she preferred teaching Language Arts.

Shulman (1987) introduced the notion of pedagogical content knowledge (PCK) to the fore over 23 years ago, and it is an integral part of both CRP and RBT. Yet, today, teachers still struggle to present content in a way that makes it comprehensible to students; they lack the PCK necessary for teaching the content. Because of the assigned learning tasks taken from the curriculum, it was difficult to ascertain if the observed teachers lacked CK or the understanding of how to teach the content with PCK. An evaluation of assigned learning tasks and the content contained within might have been an indicator of teacher’s PCK, however that was not useful as the teachers utilized curricular or textbook resources without modifying them. This led me to suspect that the teachers lacked PCK, as a teacher who understands how to make content comprehensible would have modified the learning tasks to meet the needs of their students.
Discussion

As I reflected on my attempt to construct a portrait of what culturally relevant science classrooms could look like, I realized that I had an ideal view of what goes on in classrooms based on my own experience as a science teacher. All of the teachers in this study, despite their exposure to CRP, possessed a limited understanding of what CRP should look like in practice. For that reason, their classroom practices reflected a superficial application of CRP, attending only to supporting students’ academic success. Their disposition toward the use of culture was, also, completely opposite of what Ladson-Billings (1994) and Gay (2002) described; they used education to infuse culture as opposed to using culture to educate. It seemed that they wanted to show and tell their students that their lives could be better, rather than empowering their students to question the status quo within their communities.

Given my earlier assertion that CRP and RBT are aligned, it was no surprise to witness a lack of RBT in the classroom practices of the teachers. As research suggests (Windschitl, 2002, 2004), many science teacher education programs address reform based teaching but very rarely provide explicit examples of the use of inquiry. Table 5.1 compares the teachers’ rating, my ratings, and the mean norm of 50.
Figure 5.1. Comparison of RTOP ratings

CRP and preparation: Does it make a difference in teacher’s decision to use it?

The second research question asked, *Does culturally relevant pedagogy preparation make a difference in a teacher’s decision to use it?* The data corpus yielded an emphatic no. While the teachers demonstrated an agreement with CRP, they rarely used it in their practice. However, many factors contribute to teacher’s instructional decisions, and while preparation may increase the likelihood of teacher’s using a particular practice other constraints may serve as impediments.

**Traversing the terrain: Obstacles in their way.**

Throughout the observation period, there were many opportunities for the use of CRP. The teachers shared that CRP use was minimal because they were not always sure how to integrate it into the teaching of science. Mrs. Cole, who recently completed a
teacher education program that emphasized CRP, did not hold a thorough understanding of how to integrate CRP with science. She indicated, however, that using CRP in her language arts class was much easier (Interview, June 7, 2010). Perhaps all of the teachers would have demonstrated a more thorough understanding of CRP if they were teaching humanities based subject (e.g., language arts or foreign language). Mrs. Boyle admitted that she is comfortable using CRP, but not confident about integrating it with every unit (Interview, June 11, 2010). Mr. Richardson and Ms. Herman, shared that they feel comfortable and confident about integrating CRP into their teaching, yet it was not observable in either of their classroom practices.

While none of the teachers identified access to resources or functionality of their classroom for science teaching and learning, or the school climate as obstacles to using CRP and RBT, it must be noted all three of these items likely contributed to what teachers decided to do within their classrooms. The design of only one of the classrooms was specifically that of a science classroom, complete with a demonstration bench, gas valves, and sinks; none of these features functioned, however, nor were they used to aid in science instruction. Another classroom appeared to be a former home economics classroom; it, too, had non-functioning sinks and also had a washer, dryer, and stove, none of which were used to aid in science instruction. The remaining two classrooms were small and provided no evidence that they served as science classrooms except for the occasional science poster or display of student work.

Despite the classroom sizes, all of the classes were just large enough to accommodate the number of students in each class. This made mobility within the
classroom difficult, and may have contributed to each teacher’s decision not to use certain strategies that required student movement.

During data collection, the teachers did not discuss the school climate. However, because of my previous interactions with other teachers in the building and my participation in the school’s professional learning community on urban education, I was aware that many of the teachers were frustrated by the administration’s lack of attention to disruptive students. This did not seem to hinder the teachers, in this study as I did not witness extremely disruptive students in any of their classes. Further conversations with the teachers revealed that they did not have issues within their classrooms, but, in an effort at unification, joined their fellow teachers in filing a grievance against the administration and its lack of attention to school-wide discipline.

Limitations

The methodology used in this naturalistic inquiry is such that results and outcomes cannot be generalized to other contexts. However, I strongly believe that similar inquiry into other science classrooms will yield similar results. Despite this belief, I do remain optimistic that there are teachers who are consistently using both reform based and culturally relevant teaching; the challenge is finding these teachers. Finding these teachers, also, brings to the fore another limitation. At the outset of this inquiry, I intended to use a community nomination process to select participants. However, unforeseen obstacles, such as being denied entry to their classrooms for various reasons, school calendar and scheduling issues, and gaining approval to involve community members in an evaluation of teachers, prevented me from using that approach. This led me
to make an enormous assumption about the teachers’ practices, which was that their participation in an on-going professional development program regarding CRP and science teaching, provided them with the tools and skills need to be teach science in culturally relevant ways. I also assumed that each teacher would adhere to the national science reform movement of using inquiry-based teaching. Both assumptions generated enormous limitations as none of the participating teachers consistently used either practice.

This inquiry was further limited by the time spent in the field. Data collection began in February of 2010, five months after the beginning of the school calendar. Starting at the midpoint of the academic year may account for the lack of CRP and RBT seen as the school climate and other factors, beyond the classroom, may have influenced the teachers’ decision to use or not to use CRP and RBT. In addition, nine observations allowed for a small view into each classroom culture and the practices in those science classrooms. Thus, the data collected provided minimal insight into the functioning of the classrooms. An ethnographic approach would have yielded a more complete portrait of what occurred in culturally relevant science classrooms, and it would have provided more useful insight into the preparing science teachers to use both CRP and RBT.

Furthermore, interviewing students in the various classrooms could have increased the depth of the data. Students’ perspectives about the use of CRP is often overlooked, yet it could provide valuable data about the effectiveness or usefulness of CRP. Interviewing the students would have also given the students a voice in the portrait
constructed about their science classroom; after all, they, too, were key informants within the field site.

**Implications for the field**

One of the research question examined in this inquiry involved the impact of preparation to use CRP on teacher’s decision to use it; it is worth noting that most science teacher education programs do not require candidates to fully examine the cultural aspects of teaching science. I believe that it is time for change in how we prepare preservice science teachers. The days of requiring one or two courses in multicultural education (Barnes, 2006) have passed. Science methods courses must model for candidates how to integrate culture through the use of CRP or applying multicultural science education. One approach, of which I am an advocate, is to use CRP throughout science teacher education programs. The challenge is finding faculty members who understand what CRP is and how to recognize it within classrooms.

In fact, this inquiry also substantiates that finding science classrooms in which CRP is in use is also a challenge. However, as mentioned in chapter two, CRP and RBT are not two mutually exclusive pedagogical approaches; several areas, or tenets, overlap. Current science methods courses devote a great deal of time in exposing science teacher candidates to reform based teaching methods (i.e., inquiry), however this exposure does not explicitly draw parallels between CRP and RBT.

Typically science teacher education programs explicitly address the use of reform based teaching, specifically inquiry-based learning, as they are explicitly addressed in the national science education reform documents (i.e., NSES and Benchmarks for Science
Literacy). If science teacher candidates enter the field using these reform approaches, by default they will be minimally applying some aspects of culturally relevant pedagogy. However the synergy that emerges from developing science teacher education programs that explicitly address and align both RBT and CRP would better prepare candidates for the challenges associated with teaching all students.

Hence, I am suggesting several things based on this study. The first, is that culturally relevant science teaching remains elusive, and, despite preparation to use it, teachers may possess a limited understanding of how to apply it to science teaching, or school constraints may limit teachers from fully implementing CRP. Furthermore, while reform based teaching and culturally relevant teaching are aligned, teachers may not make consistent use of either in their current practices. Moreover, I am led to question the ability of science teacher education programs to prepare candidates to use both culturally relevant teaching and reform based teaching. If both approaches are absent in the classroom practices of the teacher participants, I suspect the same is true in other science classrooms. This raises the bigger question of how to prepare science teachers for culturally diverse classrooms.

Having attempted to produce a complete portrait of culturally relevant science classrooms, I still walk away optimistic about finding a classroom in which both approaches are being practices. I firmly believe that science teacher candidates need a concrete example to help them to understand what they must do in order to be culturally relevant reform based teachers of science. Thus, my quest continues!
Although the data from this inquiry did not enable the construction of a complete portrait of culturally relevant science classrooms, I have compiled a list of suggestions for creating such classrooms. These suggestions are adapted from the research of others (e.g., Ladson-Billings, 2001 and Gay, 2001) but are relevant in the context of teaching science.

1. Get to know your students; both RBT (Sawada et al., 2002) and CRP (Ladson-Billings, 1994) require that student interest or culture be used to make learning meaningful. In order to use student interest and culture, you must know who your students are. Spend time talking with them outside of class; find out what school activities are of interest to them; find out what they do beyond the school day while they are with their families. Mr. Richardson (Interview, August 3, 2010) recommended frequenting businesses within the community, as you will often find students working or patronizing those same businesses.

2. Critically review and adapt the curriculum, integrating culture throughout and not just around particular holidays. The teachers in this study did not adapt the curriculum to the interest or culture of their students, and they had to spend time motivating and encouraging students to engage in the science learning. Mrs. Boyle (Interview, June 10, 2010) indicated that she integrated culture around certain holidays, but as Banks (1988) mentioned, this is a contributions approach and it does very little to challenge students’ thinking. Cultural integration should occur frequently throughout the school year. In fact, reviewing and revising the curriculum will allow teachers to determine where
to make cultural connections. For example, Benjamin Banneker is often discussed during African American History month, however, his contribution and an examination of his studies is valuable and important to the study of astronomy.

3. Allow opportunities for students to develop their scientific inquiries that emerge from their critique of the status quo within their community. For instance, the Deer Middle School community began as an industrial area with modest housing for the industry workers. Since the establishment of the community, many of the industries have closed but they left behind toxic waste and pollution found within the community today. Students may or may not be aware of this history, but teachers can use it as an opportunity for students to learn more about their community history while engaging in efforts to change those community conditions that have been allowed to persist.

4. Genuinely support students as they strive for academic success.

The portrait of culturally relevant science classrooms describes the last of these suggestions; it is time for teachers’ voices to match their practices. If all students are capable of learning, then there should be consistency between that belief and classrooms practices. Again, I believe that for CRP to become an integral part of science teacher preparation, model of its effective in science classrooms must exist. My quest is to find, document, and share these models within the field. In doing so, I anticipate seeing a
change in science teaching and learning for all students, and subsequent improvement in science achievement among all students, as all students are people who possess culture.

**Envisioning the Possibilities: Bringing CRP and Science Teaching into View**

The data from this study illustrates that science teachers struggle to meet the needs of all students because they are not sure how to integrate CRP into science teaching. Although I set out to illustrate the integration of CRP, the data did not lend itself to drawing a complete portrait. However, the teachers in this study overlooked or did not recognize opportunities to use CRP. The following description utilizes some of the teacher’s missed opportunities, the literature descriptors of CRP, and my understanding of CRP to provide a sample portrait of what culturally relevant science classrooms could look like. Please note, however, that this sample is based on the culture of the students who participated in this study. While this is applicable to the students who participated in this study, what a teacher does depends on the students he/she teaches.

**Samples of culturally relevant science teaching**

Culturally relevant science teachers are those who understand that students who are held to high expectations are those who will succeed. They establish a classroom atmosphere that exudes mutual respect, values and uses the cultural capital that students bring to class. Culturally relevant science teachers are deliberate about learning who their students are. The talk to the students during and outside of class, they frequent local businesses knowing they will see students have opportunities to find out about their interests. They spend time within the community, taking time to learn the community’s
history. Culturally relevant science teachers are constantly looking for ways to connect local, state, and national issues to science learning.

The classroom practices of a culturally relevant science teacher requires that he/she knows the content, the learner, and how to teach the content to the learner (Ladson-Billings, 1994). For instance, a culturally relevant science teacher at DMS would know that many of their students enjoy hunting deer or know a relative who hunts deer. This teacher would then, develop a lesson in which population control, of White tail deer, is explored and students are given an opportunity to develop their own innovative ways of controlling the population. The students could then write a letter to the local city council person highlighting the method and rationale for their method of deer population control.

Another culturally relevant teacher at DMS, understands that the community has a long history of industrial pollution and while studying man-made processes that impact the Earth, the teacher allows the students to develop their own inquiry examining the man-made process, such as industrial waste, that affects their community. Student inquiries may examine local carbon emissions and associated health risks; incidences of acid rain as a result of industrial pollution over a given time period; or water quality monitoring within the local community. Results of these inquiries can be shared with other students in the school, families in the community, and local politicians.

Finally, another culturally relevant science teacher at DMS noticed that a number of homes have small garden plots in their backyard, and after having a class discussion about garden she learns that many of the students and their parents grown vegetables
during the summer. Knowing that the upcoming science unit involves learning about plant process, he elicits students’ prior knowledge and critically reviews that portion of the curriculum. Rather than assigning chapters to read and questions to answer, he challenges the students to examine the community issue of a lack of fresh produce, and supports them as they devise a plan for solving that issue while also engaging them in the learning about plant processes.

**Pulling the Portrait and the Possibilities Together**

The portrait, presented earlier in this chapter, highlighted the science teacher’s roles and interactions that promoted and sustained their commitment to ensuring students’ academic success. The portrait lacked clear examples of cultural competence and sociopolitical consciousness, but the samples described in the preceding section provide three possible approaches science teachers can take. Teaching science in culturally relevant ways requires creativity, time, cultural understanding of the students, and an awareness of the social and political structures within the local and national community. Moreover, a culturally relevant science teacher knows his/her students and the subject matter well enough to modify the curriculum so that it opens the door to the use of student culture and connections to the community are easily made. Furthermore, culturally relevant science teachers understand how social and political structures, at both the local and national level, impact science, science learning, and the lives of their students. Therefore, this teacher will provide opportunities for students to examine and critique these structures so they can make difference in their local and national community but doing so while engaging in the science content.
In conclusion, there is no one size fits all approach to any pedagogical strategies; culturally relevant pedagogy is no different. The use of CRP requires a dispositional commitment from the teacher that all students are capable of learning. Possessing this disposition requires much more than reciting it. Teachers have to practice it, and they do so by committing to themselves to learning about their students and doing what is necessary to make connections between the students, the content, and the community.
References


Irvine, J. J. (2009). Relevant beyond the basics. The Education Digest (36), 41-44.


### Appendix A: Portrait’s voices (Lawrence-Lightfoot & Hoffman, 1997)

<table>
<thead>
<tr>
<th>Voice as witness</th>
<th>Description</th>
<th>Researcher’s Use</th>
</tr>
</thead>
</table>
| Voice as witness | “The portraitist not only uses her voice to express the outsider’s stance, which looks across patterns of action and see the whole . . . [As] newcomer, she is able to perceive and speak about things that often go unnoticed by the actors in the setting because they have become so familiar, so ordinary, so habitual (p. 87-88).” | ● Functionality of the science classrooms  
● Opportunities for sociopolitical consciousness |
| Voice as interpretation | “We not only experience the stance of the observer and her place of witness, we also hear interpretations, the researcher’s attempt to make sense of the data (p. 91).” | ● Creating the portrait  
● Describing the teacher’s use and understanding of CRP  
● Describing the community/school  
● Classroom observation (e.g., Mr. Richardson speech about testing) |
| Voice as preoccupation | “Voice, here, refers to the lens through which she sees and records reality . . . It is the framework that denies – at least initially – what she sees and how she interprets it (p. 93).” | ● Researcher as Instrument  
● Portrait introduction |
| Voice as autobiography | “The research brings her own history-familial, cultural, ideological, and education – to the inquiry . . . [strikes] a balance between self-possession and selfless, disciplined reporting of other lives . . . In the field, the balance is approached through self-reflection and self-criticism as the portraits is engaged in observing, listening, and talking to people, always keeping the actors in focus and in the light, always watching for the ways her shadow might distort her clear vision of them (p. 95).” | |
### Voice as discerning others

“In the field, the researcher records all that she hears – in interviews, dialogue, or informal conversation – trying to document the words, the gestures, and the tone, witnessing the voices in context, and seeking to understand the actors’ interpretations of their talk (p. 99).”

- Classroom observations
- Teacher interviews
- Teacher conversations

### Voice in dialogue

“[T]he portraitist purposefully places herself in the middle of the action. She feels the symmetry of voice – hers and the actor’s – as they both express their views and together define meaning-making (p. 103).”

- Teacher conversations
- Teacher interviews
## Appendix B: Research (Data collection) Timeline

<table>
<thead>
<tr>
<th>Date</th>
<th>Research Activity</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/25/2010</td>
<td>Teacher Recruitment Meeting</td>
<td></td>
</tr>
<tr>
<td>02/26/2010</td>
<td>Distribution of student assent and parent permission forms to classrooms A, B, C &amp; D</td>
<td></td>
</tr>
<tr>
<td>03/05/2010</td>
<td>Classroom Observations</td>
<td>• Teacher B absent (cruise)</td>
</tr>
<tr>
<td></td>
<td>Teacher A #1</td>
<td>• Collected student assent and parent permission forms</td>
</tr>
<tr>
<td></td>
<td>Teacher B – ABSENT</td>
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</tr>
<tr>
<td></td>
<td>Teacher C # 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher D #1</td>
<td></td>
</tr>
<tr>
<td>03/12/2010</td>
<td>Classroom Observations</td>
<td>• AM School assembly</td>
</tr>
<tr>
<td></td>
<td>Teacher A #2</td>
<td>• Teacher A class shortened to 40 minutes</td>
</tr>
<tr>
<td></td>
<td>Teacher B #1</td>
<td>• Teacher B had the counselor present to the class (no science teaching)</td>
</tr>
<tr>
<td></td>
<td>Teacher C # 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher D #2</td>
<td></td>
</tr>
<tr>
<td>03/19/2010</td>
<td>Classroom Observations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher A #3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher B # 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher C # 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher D - Absent</td>
<td></td>
</tr>
<tr>
<td>03/26/2010</td>
<td>Classroom Observations</td>
<td>• PM Assembly: Teacher D class shortened to 42 minutes</td>
</tr>
<tr>
<td></td>
<td>Teacher A #4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher B #3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher C # 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher D #3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Distribution of CRP portion of the teacher profile sheet and RTOP; requested that it be completed by the next observation.</td>
<td></td>
</tr>
</tbody>
</table>

Continued
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Details</th>
</tr>
</thead>
</table>
| 03/31/2010 | Classroom Observations                                                | Teacher A #5  
Teacher B #4  
Teacher C - Absent  
Teacher D # 4 |
| 04/02-04/10| Spring Break - No School                                             |                                                                         |
| 04/10      | Transcribed field notes from 03/5 – 03/31/2010                       | Data analysis: Applied a priori coding scheme to transcribed field notes and identified emergent codes |
| 04/14/2010 | Picked up CRP survey and RTOP for Teachers A & D                    | The school schedule was modified, for the week, to practice for OAA.   |
| 04/19-04/23| OAA testing – No observations                                       |                                                                         |
| 04/28/2010 | Data analysis: Descriptive statistical analysis of CRP survey and RTOP|                                                                         |
| 04/28/2010 | Classroom Observations                                                | Teacher A # 6  
Teacher B # 5  
Teacher C # 5  
Teacher D # 5 |
|            | Requested CRP survey and RTOP from Teachers B & C; neither were done |                                                                         |
| 05/05/2010 | Classroom Observations                                                | Teacher A # 7  
Teacher B # 6  
Teacher C # 6  
Teacher D # 6 |
| 05/14/2010 | Classroom Observations                                                | Teacher A # 8  
Teacher B # 7  
Teacher C # 7  
Teacher D # 7 |
|            | Teachers B & C returned CRP survey and RTOP                          |                                                                         |
| 05/19/2010 | Classroom Observations                                                | Teacher A # 9  
Teacher B # 8  
Teacher C - Absent  
Teacher D - Absent |
<p>|            | Scheduled interviews with teachers                                    |                                                                         |
| May – June | Transcribe field notes from 04/28 – 05/19/2010                       | Data Analysis: Applied a priori coding scheme and emergent coding scheme to transcribed field notes and identified emergent codes |</p>
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>06/07/2010</td>
<td>Teacher C telephone interview</td>
</tr>
<tr>
<td></td>
<td>Transcribed teacher C interview</td>
</tr>
<tr>
<td>06/11/2010</td>
<td>Teacher A telephone interview</td>
</tr>
<tr>
<td>06/12/2010</td>
<td>Followed up with Teachers B &amp; D as they missed their interview appointment</td>
</tr>
<tr>
<td></td>
<td>Transcribed Teacher A interview</td>
</tr>
<tr>
<td></td>
<td>Interview follow up</td>
</tr>
<tr>
<td>06/13/2010</td>
<td>Unsuccessful attempt to contact Teachers B &amp; D. Left a telephone message.</td>
</tr>
<tr>
<td></td>
<td>Teachers B &amp; D returned my call to schedule interview; both were traveling but agreed to a later date for the interview</td>
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<tr>
<td>07/19/2010</td>
<td>Teacher B: Telephone interview</td>
</tr>
<tr>
<td>08/03/2010</td>
<td>Teacher D: Telephone interview</td>
</tr>
<tr>
<td>Aug. 2010 – Dec 2010</td>
<td>Data analysis: Applied a priori (and emergent) coding scheme to interview data to interview data.</td>
</tr>
<tr>
<td></td>
<td>Structured presentation of data in chapter 4 and began writing</td>
</tr>
<tr>
<td>Jan – Mar 2011</td>
<td>Writing (revising and editing)</td>
</tr>
<tr>
<td></td>
<td>Submitted initial draft of chapter four for committee member feedback (Sept. 2010)</td>
</tr>
<tr>
<td></td>
<td>Submitted revised draft of chapter four to peer writing group (Nov. 2010) for feedback</td>
</tr>
<tr>
<td></td>
<td>Submitted full draft (Jan. 2011) for feedback from committee members.</td>
</tr>
<tr>
<td></td>
<td>Submitted defendable draft to committee and graduate school March 3, 2011</td>
</tr>
</tbody>
</table>

Note: Unless otherwise noted, all class observations were 50 minutes in length.
Appendix C: Teacher Profile Sheet & CRP Survey

**Demographics:**

| Name: __________________________________________ |
| Years of Teaching: _______ | Length of teaching at this school: ________ |
| Race/Ethnicity: _________ | Gender: _________ | Age: _________ |

Do you live in or near the community in which your assigned school is located? Yes or No

**Culturally Relevant Pedagogy Survey**

Directions: Rate your degree of agreement or disagreement with the following statements, by selecting SA (strongly agree); A (agree); N/A (No opinion); D (disagree); or SD (strongly disagree).

<table>
<thead>
<tr>
<th>Statements</th>
<th>SA</th>
<th>A</th>
<th>N/A</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The teacher presumes that all students are capable of being educated.</td>
<td></td>
<td></td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>2. The teacher clearly delineates what achievement means in the context of his or her classroom.</td>
<td></td>
<td></td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>3. The teacher knows the content, the learner, and how to teach content to the learner.</td>
<td></td>
<td></td>
<td>□</td>
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<td>□</td>
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<tr>
<td>4. The teacher supports a critical consciousness toward the curriculum.</td>
<td></td>
<td></td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>
Appendix C continued

<table>
<thead>
<tr>
<th>Statements</th>
<th>SA</th>
<th>A</th>
<th>N/A</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. The teacher encourages academic achievement as a complex conception</td>
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<tr>
<td>not amenable to a single, static measurement</td>
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<tr>
<td>Cultural Competence</td>
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<tr>
<td>6. The teacher understands culture and its role in education.</td>
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<tr>
<td>7. The teacher takes responsibility for learning about students’ culture</td>
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<tr>
<td>and community.</td>
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<tr>
<td>8. The teacher uses student culture as a basis for learning.</td>
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<tr>
<td>9. The teacher promotes a flexible use of students’ local and global</td>
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<tr>
<td>culture.</td>
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<tr>
<td>Sociopolitical Consciousness</td>
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<tr>
<td>10. The teacher knows the larger sociopolitical context of the school</td>
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<tr>
<td>community, nation, and world.</td>
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<tr>
<td>11. The teacher has an investment in the public good.</td>
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<tr>
<td>12. The teacher plans and implements academic experiences that connect</td>
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<tr>
<td>students to the larger social context.</td>
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<tr>
<td>13. The teacher believes that students’ success has consequences for his</td>
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<tr>
<td>or her own quality of life.</td>
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</tr>
</tbody>
</table>
Appendix D: Reformed Teaching Observation Protocol (RTOP)

(Sawada et al., 2002)

I. Background Information

<table>
<thead>
<tr>
<th>Name of Intern</th>
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</thead>
<tbody>
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<td></td>
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</table>

<table>
<thead>
<tr>
<th>Observation Announced? (Yes, No, or Explain)</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Yes ☐ No</td>
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</table>

<table>
<thead>
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<th>District</th>
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<table>
<thead>
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<table>
<thead>
<tr>
<th>Room</th>
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<table>
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<table>
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<tr>
<th>Grade Level</th>
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<table>
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<tr>
<th>Observer</th>
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<table>
<thead>
<tr>
<th>Date of Observation</th>
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</tr>
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</table>

<table>
<thead>
<tr>
<th>Start Time</th>
</tr>
</thead>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>End Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

II. Contextual Background and Activities

In the space provided below please check all boxes that apply to give a brief description of the lesson observed, the classroom setting in which the lesson took place (space, seating arrangements, etc.), and any relevant details about the students (number, gender, ethnicity) and teacher that you think are important. Use diagrams if they seem appropriate.

<table>
<thead>
<tr>
<th>Supervising Teacher</th>
<th>☐ Mentor ☐ Substitute</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Number of students</th>
<th>Number of females</th>
<th>Number of males</th>
<th>Number of minority students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Room setting</th>
<th>☐ Groups ☐ Desks</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Rows ☐ Tables/Lab Benches</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>☐ Other</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Type of Lesson</th>
<th>☐ Introduction ☐ Computer Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Continuation of material ☐ Individual Activity/Worksheet</td>
<td></td>
</tr>
<tr>
<td>☐ Content Review ☐ Homework in class</td>
<td></td>
</tr>
<tr>
<td>☐ Homework Review ☐ Test/Quiz</td>
<td></td>
</tr>
<tr>
<td>☐ Laboratory Activity ☐ Other</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>
If you checked N/A indicate the reason, per items on the attached page.

Also, add additional comments you may wish to make about this lesson in the attached page.
Appendix E: Reliability data for the RTOP

<table>
<thead>
<tr>
<th>Name of Subscale</th>
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<tbody>
<tr>
<td>Subscale 1: Lesson Design and Implementation</td>
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<tr>
<td>Subscale 2: Content – Propositional Pedagogic Knowledge</td>
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</tr>
<tr>
<td>Subscale 3: Content – Procedural Pedagogic Knowledge</td>
<td>0.946</td>
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<tr>
<td>Subscale 4: Classroom Culture – Communicative Interactions</td>
<td>0.907</td>
</tr>
<tr>
<td>Subscale 5: Student/Teacher Relationships</td>
<td>0.872</td>
</tr>
</tbody>
</table>

(Sawada et al., 2002)
Appendix F: Interview Protocol

Date:

Teacher: A  B  C  D

Male/Female

Interview script: Thank you for agreeing to participate in this study. Please know that your participation is voluntary, and at any time, you can withdraw from the study. In addition, you do not have to answer any or part of the questions I will be asking. This interview is about your decision to use or not use culturally relevant pedagogy. **At this time, do you consent to participate in this study?**

<table>
<thead>
<tr>
<th><strong>If response to consent is yes, then say:</strong> Thank you. I would like to audio record this interview, but I will only do so with your permission. The audio tape will be destroyed as soon as the interview is transcribed. Would you allow me to audio record this interview?</th>
<th><strong>If response to audio recording is no, then say:</strong> Thank you for your time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>If response to consent is yes, then say:</strong> Thank you [Turn on the audio recorder and proceed to the first question]</td>
<td><strong>If response to audio recording is no, then say:</strong> Thank you [Put audio recorder away and proceed to the first question]</td>
</tr>
</tbody>
</table>

162
Appendix F continued

1. Before being introduced to this study, were you aware of culturally relevant pedagogy?
   a. If yes, say: When did you first become aware of CRP? Please share with me some of the details about the program that exposed you to CRP.
   b. What impact did learning about CRP have on your teaching?

2. If you had to describe CRP to a friend, how would you describe it? For those who are not aware of CRP, the question will be What do you think CRP is?

3. Do you use CRP in your classroom? Why or why not?

4. Please share with me some of the ways that you use it.

If participant is unfamiliar with CRP, say the following: Culturally relevant pedagogy, as identified by one researcher, has three components. Academic achievement, cultural competence, and sociopolitical consciousness. According to the researcher, all students should experience academic success, and teachers should maintain high expectations. Cultural competence involves the students being allowed to be themselves and the teacher recognizing that sometimes their culture and the culture of the students can be at odds, and finally sociopolitical consciousness is about the students taking what they have learned and applying it to the context of their lives. The following questions are specifically aligned to the three area of CRP.

5. How do you learn about students’ culture and community?

6. What are some ways in which you have used student culture as a basis for learning?
Appendix F continued

7. Do you think students’ success is connected to your quality of life? Please explain.

8. Do you provide students with learning opportunities that connect them to their local community and larger society? If so, please provide an example.

9. Do (would) you feel confident and comfortable using CRP in your classroom?
Appendix G: Codebook

The following are a priori codes used to analyze field notes and interview transcripts. To ensure that coding was not idiosyncratically assigned by the research, three other individuals coded excerpts of the field notes or interview transcripts using the codes below.

Theoretical Model: Culturally Relevant Pedagogy

Academic Achievement

When coding for academic achievement, does the teacher’s actions, as displayed by his or her role and interactions demonstrate that all students can learn? Do the assigned learning tasks provide students with opportunities to demonstration their academic competence? Are the learning tasks such that students are able to develop academic skills; and are the students interactions demonstrative of them choosing academic excellence?

- The teacher presumes that all students are capable of being educated (AL).
- The teacher clearly delineates what achievement means in the context of his or her classroom (DAA)
- The teacher knows the content, the learner, and how to teach content to the learner
  - **TCK**: Teacher Content Knowledge
  - **LK**: Knowledge of learner
  - **PCK**: Pedagogical content knowledge (how to teach content to the learner)
• The teacher supports a critical consciousness toward the curriculum (CCc).
• The teacher encourages academic achievement as a complex conception not amenable to a single, static measurement (EAA).

Cultural Competence

When coding for this construct, consider if aspects of student culture are evident in the classroom, and whether students are allowed to utilize their culture in the classroom. Think about whether teachers have used aspects of the students’ culture in their teaching.

• The teacher understands culture and its role in education (C&E)
• The teacher takes responsibility for learning about students’ culture and community (RL).
• The teacher uses student culture as a basis for learning (CBL).
• The teacher promotes a flexible use of students’ local and global culture (UGC) (Ladson-Billings, 2001, p.98)

Sociopolitical Consciousness

When coding for this construct, consider if the learning tasks, roles, and interactions function to provide students with the skill to critique the cultural norms, values, and institutions that produce and maintain social inequities.

• The teacher knows the larger sociopolitical context of the school community, nation, and world (SPC).
• The teacher has an investment in the public good (IPG).
• The teacher plans and implements academic experiences that connect students to the larger social context (CSC)
• The teacher believes that students’ success has consequences for his or her own quality of life (QoL)
Theoretical Model: Reform (Inquiry) Based Teaching

Lesson Design and Implementation

- The instructional strategies and activities respected students’ prior knowledge and the preconceptions inherent therein (IPK).
- The lesson was designed to engage students as members of a learning community (LC).
  In this lesson, student exploration preceded formal presentation (EP).
- This lesson encouraged students to seek and value alternative modes of investigation or of problem solving (AM).
- The focus and direction of the lesson was often determined by ideas originating with students (SFD).

Content: Propositional Knowledge

- The lesson involved fundamental concepts of the subject (CS).
- The lesson promoted strongly coherent conceptual understanding (CU).
  The teacher had a solid grasp of the subject matter content (TCK).
- Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so (AB).
- Connections with other content disciplines and/or real world phenomena were explored and valued (RWC).

Content: Procedural Knowledge

- Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc) to represent phenomena (SMR).
- Students made predictions, estimations, and/or hypotheses and devised means for testing them (ST).
- Students were actively engaged in thought-provoking activity that often involved the critical assessment of procedures (SE).
- Students were reflective about their learning (SR).
- Intellectual rigor, constructive criticism, and the challenging of ideas were valued (IR).
Classroom Culture

Communicative Interactions

• Students were involved in the communication of their ideas to others using a variety of means and media (CI&I).
• The teacher’s questions triggered divergent modes of thinking (CI&DT). There was a high proportion of student talk and a significant amount of it occurred between and among students (CI&ST).
• Student questions and comments often determined the focus and direction of classroom discourse (CI&SQ).
• There was a climate of respect for what others had to say (CI&CR).

Student/Teacher Relationships

• Active participation of students was encourage and valued (R&AP).
• Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence (R&IE).
• In general the teacher was patient with students (R&TP).
• The teacher acted as a resource person, working to support and enhance student investigations (R&TR).
• The metaphor “teacher as listener” was very characteristic of this classroom (R&TL).

Emergent Codes

The following codes emerged while analyzing the data.

• Lack of confidence in using CRP in science (LcCRP)
• Teacher reflexivity and communicative about their own culture and experiences (RCC)

Non-examples of a priori codes.

Non-examples codes emerged from the field notes, and identified teacher practices that were antithetical to the established a priori codes.
• Teacher demonstrated that he/she does not know how to teach the content to the learner (non PCK)
• Students questions and comments did not determine the focus and direction of classroom discourse (non CI & SQ)
• The classroom environment did exude a climate of respect for what others had to say (non CI & CR)
• Active participation of students was not encouraged and valued (non R & AP)
• No student talk occurred during the classroom observation (non CI&ST)
• Students were not engaged in intellectual rigor, constructive criticism, nor were the challenging of ideas valued (non IR)
• Teacher demonstrated that they do not have a solid grasp of the subject matter content (non TCK)
• Formal presentation, of the content, preceded student exploration (non EP)
• Teacher practices does not support their belief that all students are capable of learning (non AL)
## Appendix H: Boyle v. Researcher RTOP rating

<table>
<thead>
<tr>
<th>Scale/Subscale</th>
<th>Boyle</th>
<th>Researcher</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lesson Design &amp; Implementation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. The instructional strategies and activities respected students’ prior knowledge and the preconceptions inherent therein.</td>
<td>3</td>
<td>3.6</td>
</tr>
<tr>
<td>2. The lesson was designed to engage students as members of a learning community.</td>
<td>4</td>
<td>3.8</td>
</tr>
<tr>
<td>3. In this lesson, student exploration preceded formal presentation.</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>5. The focus and direction of the lesson was often determined by ideas originating with students.</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Content/Propositional Knowledge</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. The lesson involved fundamental concepts of the subject.</td>
<td>3</td>
<td>3.67</td>
</tr>
<tr>
<td>7. The lesson promoted strongly coherent conceptual understanding.</td>
<td>4</td>
<td>2.8</td>
</tr>
<tr>
<td>8. The teacher had a solid grasp of the subject matter content inherent in the lesson.</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>9. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. Connections with other content disciplines and/or real world phenomena were explored and valued.</td>
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<td>2.2</td>
</tr>
<tr>
<td><strong>Content/Procedural Knowledge</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Students used a variety of means (models, drawings, graphs, concrete materials, manipulative, etc) to represent phenomena.</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12. Students made predictions, estimations, and/or hypotheses and devised means for testing them.</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13. Students were actively engaged in through-provoking activity that often involved the critical assessment of procedures.</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>14. Students were reflective about their learning.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>15. Intellectual rigor, constructive criticism, and the challenging of ideas were valued.</td>
<td>2</td>
<td>3.67</td>
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<tr>
<td><strong>Classroom Culture/Communicative Interactions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Students were involved in the communication of their ideas to others using a variety of means and media.</td>
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<tr>
<td>17. The teacher’s questions triggered divergent modes of thinking.</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>18. There was a high proportion of student talk and a significant amount of it occurred between and among students.</td>
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<td>2.25</td>
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<td>19. Student questions and comments often determined the focus and direction of classroom discourse.</td>
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<td>3.25</td>
</tr>
<tr>
<td>20. There was a climate of respect for what others had to say.</td>
<td>3</td>
<td>3.2</td>
</tr>
<tr>
<td><strong>Classroom Culture/Student-Teacher Relationships</strong></td>
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<td></td>
</tr>
<tr>
<td>21. Active participation of students was encouraged and valued.</td>
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<td>4</td>
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<tr>
<td>22. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.</td>
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<td>2</td>
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<tr>
<td>23.</td>
<td>In general the teacher was patient with students.</td>
<td>3</td>
</tr>
<tr>
<td>24.</td>
<td>The teacher acted as resource person, working to support and enhance student investigations.</td>
<td>3</td>
</tr>
<tr>
<td>25.</td>
<td>The metaphor “teacher as listener” was very characteristics of this classroom.</td>
<td>3</td>
</tr>
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</table>

(Sawada et al., 2002)
## Appendix I: Herman v. Researcher’s RTOP rating

<table>
<thead>
<tr>
<th>Scale/Subscale</th>
<th>Ratings</th>
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<tbody>
<tr>
<td><strong>Lesson Design &amp; Implementation</strong></td>
<td></td>
</tr>
<tr>
<td>1. The instructional strategies and activities respected students’ prior knowledge and the preconceptions inherent therein.</td>
<td>4</td>
</tr>
<tr>
<td>2. The lesson was designed to engage students as members of a learning community.</td>
<td>4</td>
</tr>
<tr>
<td>3. In this lesson, student exploration preceded formal presentation.</td>
<td>4</td>
</tr>
<tr>
<td>4. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.</td>
<td>3</td>
</tr>
<tr>
<td>5. The focus and direction of the lesson was often determined by ideas originating with students.</td>
<td>3</td>
</tr>
<tr>
<td><strong>Content/Propositional Knowledge</strong></td>
<td></td>
</tr>
<tr>
<td>6. The lesson involved fundamental concepts of the subject.</td>
<td>4</td>
</tr>
<tr>
<td>7. The lesson promoted strongly coherent conceptual understanding.</td>
<td>4</td>
</tr>
<tr>
<td>8. The teacher had a solid grasp of the subject matter content inherent in the lesson.</td>
<td>4</td>
</tr>
<tr>
<td>9. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.</td>
<td>0</td>
</tr>
<tr>
<td>10. Connections with other content disciplines and/or real world phenomena were explored and valued.</td>
<td>3</td>
</tr>
<tr>
<td><strong>Content/Procedural Knowledge</strong></td>
<td></td>
</tr>
<tr>
<td>11. Students used a variety of means (models, drawings, graphs, concrete materials, manipulative, etc) to represent phenomena.</td>
<td>3</td>
</tr>
<tr>
<td>12. Students made predictions, estimations, and/or hypotheses and devised means for testing them.</td>
<td>0</td>
</tr>
<tr>
<td>13. Students were actively engaged in through-provoking activity that often involved the critical assessment of procedures.</td>
<td>3</td>
</tr>
<tr>
<td>14. Students were reflective about their learning.</td>
<td>3</td>
</tr>
<tr>
<td>15. Intellectual rigor, constructive criticism, and the challenging of ideas were valued.</td>
<td>3</td>
</tr>
<tr>
<td><strong>Classroom Culture/Communicative Interactions</strong></td>
<td></td>
</tr>
<tr>
<td>16. Students were involved in the communication of their ideas to others using a variety of means and media.</td>
<td>4</td>
</tr>
<tr>
<td>17. The teacher’s questions triggered divergent modes of thinking.</td>
<td>3</td>
</tr>
<tr>
<td>18. There was a high proportion of student talk and a significant amount of it occurred between and among students.</td>
<td>4</td>
</tr>
<tr>
<td>19. Student questions and comments often determined the focus and direction of classroom discourse.</td>
<td>4</td>
</tr>
<tr>
<td>20. There was a climate of respect for what others had to say.</td>
<td>4</td>
</tr>
<tr>
<td><strong>Classroom Culture/Student-Teacher Relationships</strong></td>
<td></td>
</tr>
<tr>
<td>21. Active participation of students was encouraged and valued.</td>
<td>4</td>
</tr>
<tr>
<td>22. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
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</tr>
<tr>
<td>23.</td>
<td>In general the teacher was patient with students.</td>
</tr>
<tr>
<td>24.</td>
<td>The teacher acted as resource person, working to support and enhance student investigations.</td>
</tr>
<tr>
<td>25.</td>
<td>The metaphor “teacher as listener” was very characteristics of this classroom.</td>
</tr>
</tbody>
</table>

(Sawada et al., 2002)
### Appendix J: Cole V. Researcher’s RTOP rating

<table>
<thead>
<tr>
<th>Scale/Subscale</th>
<th>Rating</th>
<th>Cole</th>
<th>Researcher</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lesson Design &amp; Implementation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. The instructional strategies and activities respected students’ prior knowledge and the preconceptions inherent therein.</td>
<td>3</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>2. The lesson was designed to engage students as members of a learning community.</td>
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<td>2.9</td>
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</tr>
<tr>
<td>3. In this lesson, student exploration preceded formal presentation.</td>
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<td>1.1</td>
<td></td>
</tr>
<tr>
<td>4. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5. The focus and direction of the lesson was often determined by ideas originating with students.</td>
<td>2</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td><strong>Content/Propositional Knowledge</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. The lesson involved fundamental concepts of the subject.</td>
<td>3</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>7. The lesson promoted strongly coherent conceptual understanding.</td>
<td>3</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>8. The teacher had a solid grasp of the subject matter content inherent in the lesson.</td>
<td>3</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>9. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.</td>
<td>3</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>10. Connections with other content disciplines and/or real world phenomena were explored and valued.</td>
<td>2</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td><strong>Content/Procedural Knowledge</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Students used a variety of means (models, drawings, graphs, concrete materials, manipulative, etc) to represent phenomena.</td>
<td>0</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>12. Students made predictions, estimations, and/or hypotheses and devised means for testing them.</td>
<td>3</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>13. Students were actively engaged in through-provoking activity that often involved the critical assessment of procedures.</td>
<td>1</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>14. Students were reflective about their learning.</td>
<td>3</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>15. Intellectual rigor, constructive criticism, and the challenging of ideas were valued.</td>
<td>3</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td><strong>Classroom Culture/Communicative Interactions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Students were involved in the communication of their ideas to others using a variety of means and media.</td>
<td>3</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>17. The teacher’s questions triggered divergent modes of thinking.</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>18. There was a high proportion of student talk and a significant amount of it occurred between and among students.</td>
<td>4</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>19. Student questions and comments often determined the focus and direction of classroom discourse.</td>
<td>2</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>20. There was a climate of respect for what others had to say.</td>
<td>1</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td><strong>Classroom Culture/Student-Teacher Relationships</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. Active participation of students was encouraged and valued.</td>
<td>2</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>22. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.</td>
<td>3</td>
<td>1.5</td>
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</tr>
<tr>
<td></td>
<td>Description</td>
<td>Score</td>
<td>Rating</td>
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<td>---</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------</td>
<td>--------</td>
</tr>
<tr>
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<td>In general the teacher was patient with students.</td>
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<td>2.6</td>
</tr>
<tr>
<td>24.</td>
<td>The teacher acted as resource person, working to support and enhance student investigations.</td>
<td>3</td>
<td>2.8</td>
</tr>
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<td>25.</td>
<td>The metaphor “teacher as listener” was very characteristics of this classroom.</td>
<td>3</td>
<td>2.6</td>
</tr>
</tbody>
</table>

(Sawada et al., 2002)
### Appendix K: Richardson v. Researcher’s RTOP rating

<table>
<thead>
<tr>
<th>Scale/Subscale</th>
<th>Richardson</th>
<th>Researcher</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lesson Design &amp; Implementation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. The instructional strategies and activities respected students’ prior knowledge and the preconceptions inherent therein.</td>
<td>2</td>
<td>3.3</td>
</tr>
<tr>
<td>2. The lesson was designed to engage students as members of a learning community.</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>3. In this lesson, student exploration preceded formal presentation.</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>4. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.</td>
<td>3</td>
<td>1.7</td>
</tr>
<tr>
<td>5. The focus and direction of the lesson was often determined by ideas originating with students.</td>
<td>2</td>
<td>2.6</td>
</tr>
<tr>
<td><strong>Content/Propositional Knowledge</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. The lesson involved fundamental concepts of the subject.</td>
<td>4</td>
<td>2.7</td>
</tr>
<tr>
<td>7. The lesson promoted strongly coherent conceptual understanding.</td>
<td>3</td>
<td>0.7</td>
</tr>
<tr>
<td>8. The teacher had a solid grasp of the subject matter content inherent in the lesson.</td>
<td>3</td>
<td>2.4</td>
</tr>
<tr>
<td>9. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>10. Connections with other content disciplines and/or real world phenomena were explored and valued.</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td><strong>Content/Procedural Knowledge</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Students used a variety of means (models, drawings, graphs, concrete materials, manipulative, etc) to represent phenomena.</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>12. Students made predictions, estimations, and/or hypotheses and devised means for testing them.</td>
<td>3</td>
<td>0</td>
</tr>
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<td>13. Students were actively engaged in through-provoking activity that often involved the critical assessment of procedures.</td>
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(Sawada et al., 2002)