Principal Instructional Leadership: How Does It Influence an Elementary Science Program Amidst Contradictory Messages of Reform and Change?

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PRINCIPAL INSTRUCTIONAL LEADERSHIP: HOW DOES IT INFLUENCE AN ELEMENTARY SCIENCE PROGRAM AMIDST CONTRADICTORY MESSAGES OF REFORM AND CHANGE?

By

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To the strong women in my life: I. A., C. G., and M. L.
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ABSTRACT

Reform documents clearly convey that teachers are central to national efforts to reform instructional and curricular practices in science classrooms. Although teachers are recognized as critical to reform efforts, actualizing the vision requires the combined efforts of an array of individuals. Within the school’s context, science education reform developers and researchers recognize that principals are important, and indeed influence science programs, particularly curricula and program decisions. Further, reform today calls for principals to be instructional leaders, assuming a more active role in the decisions that are made regarding the instructional program. However, research that examines the influence of the school principal within the science program is embryonic and not fully understood. Utilizing the Instructional Leadership Model and the Teacher-Centered Systemic Reform Model as guiding theoretical frameworks, this study investigated the influence of an elementary principal’s instructional leadership in a science program and the ways in which elementary teachers, charged with implementation of reform, respond to the curriculum and program decisions supported and championed by the principal.

This naturalistic investigation was conducted over a seven month period in an elementary school in a large metropolitan school district in the state of Florida. Data collection methods included interviews, document analysis, reflective journal entries, principals/teacher relational observations, classroom observations, and an open-ended questionnaire. The principal’s role, decision-making, and impact within the science program were examined. Also examined was the influence of the principal’s instructional leadership on teachers’ instructional practices. Too, the district’s influence on the principal’s instructional leadership as well as the district’s role in forwarding contradictory messages of reform (change) was explored. The findings revealed that the principal, while diligent in her efforts to develop an effective science program in which student learning was prioritized, championed and implemented first order changes (e.g.,
instituting a science laboratory, departmentalization, providing resources, instructional changes that were directed at fifth grade), and not change supported by national science education reform (second order). The district’s vision for science, which prioritized test preparations, and the principal’s lack of knowledge of national science education reform efforts, limited pedagogical knowledge in science, and the relatively small pool of ideas from which to suggest curriculum changes, greatly influenced her instructional leadership and the change efforts that were embraced. Even though the changes proposed and implemented were first order, science teachers regarded the principal as a capable and skillful instructional leader who had a history of making sound decision. As a result, many of the science teachers repressed or abandoned many of their own beliefs about how science should be taught, following the guidance and direction of their principal.

One implication of this research is the need for elementary principals to have at best, a minimal, if not robust understanding of science education reform and the goals espoused. In order for elementary schools to develop and implement science programs that parallel and reverberate the messages of reform, principals are integral. As these findings suggest, principals, perceived as effective instructional leaders, are more apt to be supported by teachers and are more apt to support the decisions made by the principal. Although the principal was not found to directly influence teacher practice, her instructional leadership defined school values and the pathway to change. Other research implications, the “fit” of this research with current research on elementary principals in science education, and recommendations for future research are included.
CHAPTER I

INTRODUCTION

Accompanying us into the 21st century was a vigorous and enduring science education reform movement that began in the 1980s and continues in many of America’s schools today. Reform recommendations embodied in the *Science for All American’s movement (AAAS, 1989, 1990, 1993; NRC, 1996, 2000)* are aggressive, pervasive, long-ranging, and offer a comprehensive and multiparty approach to scientific literacy, encompassing the way in which science is to be envisaged, taught, learned, and assessed. Scientific literacy is the knowledge and skills each member of society must have in order to make scientifically informed decisions about scientific issues (National Research Council [NRC], 1996). The goal of scientific literacy requires the use of teaching standards that articulate what teachers should know and be able to do in order to attain scientific literacy for all; the use of inquiry-based instructional practices that allow students to study the natural world, employ science processes akin to practicing scientists, carry out student-driven investigations, and propose explanation for scientific phenomena; assessment practices that provide feedback and shape future science knowledge acquisitions; and make recommendations for quality professional development experiences for teachers. Indeed, the recommendations set forth in reform documents call for dramatic and systematic changes at all levels of the system.

Fundamental to the science education reform movement embarked upon today, are collaborative and interrelated relationships amongst national, state, and local systems and the people therein. One such relationship—that between teachers and principals within schools—has been recognized as vitally important if reform efforts are to be implemented, supported, and sustained within America’s schools (Banilower, Heck, & Weiss, 2007; Fullan, 2007; NRC, 1996; Spillane, Diamond, Walker, Halverson, & Jita,
This investigation examined the relationship between teachers and principals in an elementary school as the science program underwent restructuring.

**Statement of Research Purpose**

As suggested in current science education reform documents, educators and researchers in science education and educational leadership are promoting a collaborative approach to change (Hale, 1998; NRC, 1996; Newman & Mohr, 2001; Rhoton, 2001; Rhoton, Field, & Prather, 1992), as no one group can single-handedly ensure the actualization of the vision for science education reform. Rhoton et al., (1992) and Berube, Gaston, and Stepans (2004) conceptualize the relationship between teachers and principals as “coequals” with teachers and principals working as partners to reform science education. Making this vision a reality requires the combined efforts of “teachers, administrators, science teacher educators, curriculum designers, assessment specialists, local school boards, state departments of education, and the federal government” (NRC, 1996, p. 9). This coequal relationship promoted by reformers, however, is counter to the hierarchal structure traditionally encouraged and seen in many major corporations and schools (Fullan, 2001; NRC, 1996).

The NRC recognizes that there are an array of individuals who contribute to the development, implementation, and progress towards the vision embodied in science education reform documents. But the central focus of this investigation is teachers and principals, as they are both instrumental in enacting school-based changes, developing positive attitudes toward science, enhancing the science instructional program, and improving science practices. However, it is my assertion that it has not been until recently that the science education community has begun to explore and report on the principal’s influence on the school’s science program and teachers’ instructional practices amidst science education restructuring.

The research on principals’ influence on schools’ science programs is embryonic, with studies asserting that teachers’ instructional practices are minimally affected by principals’ instructional leadership, and at best identified as a necessary, but not a sufficient component of educational change (Kelly & Staver, 2005; Supovitz & Turner, 2001; Whitaker, Whitaker, & Zoul, 2006).
2000; Vesilind & Jones, 1998); examining the relationship between principal actions and teachers’ science practices during the induction year (Saka, 2007; Saka, Southerland, & Brooks, in press; Youngs, 2007); and the impact of principal support for science in general and during times of reform (Banilower et al., 2007; Hanegan, 2001; Johnson, 2007b). By examining this relationship, it is my hope that the results of this investigation will expand our understanding of the principal’s influence within a science program, provide valuable insight into how elementary teachers and principals enact science education reform, and augment the evolving body of research in this area.

For the purposes of this study, I too view the principal as influential to the enactment of science education reform and instructional leadership as a necessary component of the process of change. What is not clearly understood in the literature, however, is the effect of principals’ instructional leadership on the attainment of the goals of science education reform. Thus, I argue that understanding the instructional leadership role of the school principal within the school’s science program is significant. Goldsmith and Pasquale (2002) assert that “[a]dmnistrators who are knowledgeable about the issues and challenges involved in developing scientifically literate students will be in a stronger position to promote and facilitate improvements in the science curriculum itself and in its implementation” (p. 25). I assert that in order to inform our understanding of the principal’s influence, science educators must begin to understand 1) what principals do in terms of science the science program, 2) how principals’ actions influence teachers’ science instruction, and 3) how the instructional leadership employed affects school-wide emphasis on science (e.g., available resources, budgetary considerations, professional development, science-related activities, etc.).

The authors of Project 2061 offer a compelling statement that puts into perspective why school principals, like teachers, are critical to science education improvement:

Although teachers are central to reform, they cannot be held solely responsible for achieving it. They need allies. Teachers alone cannot change the textbooks, install more sensible testing policies than are now in place, create administrative support systems, get the public to understand where reform is headed and why it
takes time to get there, and raise the funds needed to pay for reform. Thus, school administrators…need to support teachers (AAAS, 1990, p. 213).

It seems relevant that if current science education reform initiatives are to be successful in elementary schools, researchers must focus on the principal’s office, as both the science education community and the educational leadership community have acknowledged that the principal is important in sustained reform. In fact, where science education is concerned, some science education advocates have concluded that the school principal has the greatest influence within the school’s context (Ediger, 1999; Greenleaf, 1982; Mechling & Oliver, 1982, 1983; Vasquez, 2008). As articulated by Mechling and Oliver (1983), “[p]rincipals are bona fide school leaders, and few would deny their potential for making things happen…Principals have the power to promote or prevent innovation not because they have a monopoly on imagination or creativity, but because they have the authority to make a decision” (p. 14), decisions that with the current structure of schooling, teachers alone cannot make. Therefore, if “[s]cience is, in fact, the most neglected academic subject in the United States schools” (Shaw, Doan, & Hale, 1994, p. 2), especially at the elementary level (Ediger, 1999; Greenleaf, 1982; Spillane et al., 2001), then science educators need more research into this area to better understand how principals influence the enactment of science education reform.

**Significance of Study: Science…it’s just not so “Elementary”**

There is a need for science education reform at all levels of the education continuum—from grade school through college (Davis, 2003; Gess-Newsome, Southerland, Johnston, & Woodbury, 2003; Radford, 1998; Rhoton, 2001; Strahan, 2003), but the need is even greater at the elementary level, as evidenced by a wealth of research. According to Ediger (1999), Greenleaf (1982), Mechling and Oliver (1982, 1983), and Vasquez (2008), science is one of the most disregarded disciplines at the elementary level with it being “largely a fringe subject, taken up when time allows, but mostly forgotten or treated intermittently and unsystematically” (Spillane et al., 2001, p. 919). Haphazardly incorporating science into a school’s academic program undoubtedly is counterproductive in achieving the national goal of scientific literacy for all citizens.
The results of the National Survey of Science and Mathematics Education support this contention. Conducted in 2000 by Sherri Fulp and the Horizon Research Institute (2002) with almost 6,000 teachers in over 1,200 schools, this study reports that elementary teachers spend less time engaging students in science instruction per week than reading/language arts and mathematics. Table 1 summarizes these findings.

**Table 1 Instructional Time Across Subject Areas**

<table>
<thead>
<tr>
<th></th>
<th>Science</th>
<th>Reading/Language Arts</th>
<th>Mathematics</th>
<th>Social Studies</th>
</tr>
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<tbody>
<tr>
<td>K – 3rd</td>
<td>23 minutes</td>
<td>115 minutes</td>
<td>52 minutes</td>
<td>21 minutes</td>
</tr>
<tr>
<td>4th – 6th</td>
<td>31 minutes</td>
<td>96 minutes</td>
<td>60 minutes</td>
<td>33 minutes</td>
</tr>
</tbody>
</table>

In addition to science being disregarded in terms of the amount of time that is devoted to it, elementary teachers also feel less qualified to teach science when compared with other subjects. These data are represented in Table 2 (Fulp, 2002).

**Table 2 Percent of Elementary Teachers Considering Themselves “Very Well Qualified” to Teach the Subject**

<table>
<thead>
<tr>
<th>Physical Science</th>
<th>Earth Science</th>
<th>Life Science</th>
<th>Social Studies</th>
<th>Mathematics</th>
<th>Reading/Language Arts</th>
</tr>
</thead>
<tbody>
<tr>
<td>18%</td>
<td>25%</td>
<td>29%</td>
<td>52%</td>
<td>60%</td>
<td>76%</td>
</tr>
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</table>

These results indicate that although elementary teachers on average spend the same amount of time teaching science as they do social studies, they feel much more qualified to teach social studies when compared to science. Further, teachers spend much more instructional time teaching reading/language arts. Considering the political and educational climate, I would assert that the paucity of time devoted to science instruction
may be the result of the national emphasis placed on reading and literacy by policy makers and lobbyists. However, since science is now included in the No Child Left Behind (NCLB) measures, as studies are conducted, it will be interesting to see how the time elementary teachers spend teaching science in affected.

Lacking foundational skills and abilities renders future adults virtually incapable of “mak[ing] sense of how the world works; think[ing] critically and independently; and…lead[ing] interesting, responsible, and productive lives in a culture increasingly shaped by science and technology” (AAAS, 1993, p. xi). The long-term effects of elementary students not being provided opportunities to develop as scientific thinkers can negatively impact society and the national science education reform initiative, which is “to guide our nation toward a scientifically literate society in the 21st century” (NRC, 1996, p. 11). If science principles explored and learned in elementary school are essential to the building capacity of scientific understandings throughout a student’s life (Cain, 2002; Howe, 2002), how can we begin to ensure cogent and auspicious elementary science experiences?

Although there is a plethora of research that supports the contention that elementary teachers believe that teaching science is important (Shaw et al., 1994; Vasquez, 2005), as the findings in Tables 1 and 2 indicate, this belief has not translated into practice. The political climate has created a national emphasis on reading/language arts (literacy) and mathematics (Johnson, 2007a; Perlstein, 2004; Settlage & Southerland, 2007). By the mere fact that many elementary teachers feel inadequately prepared to teach science, thereby teaching it less, students are often not provided the opportunity to develop the skills necessary to be informed decision-makers about science and technology.

Although national, state, and local policies specify science goals and objectives for student achievement and in some cases provide a roadmap to successful attainment, within the school’s context, teachers and principals are responsible for developing science programs that translate the vision into reality. Teachers are central to reform efforts because they are directly responsible for implementing the curriculum and helping students to integrate a complex collection of ideas, understandings, reasoning, and applications to expand the acquisition of scientific knowledge. But with science
education reform calling for principals to assume a more active role in the instructional program—how science is taught, what science is taught, how science is assessed, when science is taught (Fouts, Stuen, Anderson, & Parnell, 2000; NRC, 1996; Rhoton, 2001; Vasquez, 2008), principals undoubtedly influence an array of things from the amount of classroom time devoted to science (scheduling), the quality of curriculum materials that are ordered and used for instruction, the inclusion of special programs dedicated to sparking in some and nurturing in others an interest in science, teachers instructional practices, and building positive attitudes toward science just to name a few (Habegger, 2008; Nelson & Sassi, 2005).

It is imperative that as science education advocates and researchers we make every attempt to understand the many factors that contribute to or impede the nurturing and development of students’ ideas about scientific concepts, logical and critical thinking, science process skills, natural curiosity, problem solving capabilities, and natural inquiry abilities. The importance can not be overemphasized for elementary students. According to Nelson & Landel (2007), “Students who start middle and high school with severe deficits in science and mathematics…rarely catch up through traditional remediation, and they have small hope of succeeding in advanced courses for which they are underprepared” (p. 72). This investigation is therefore important because it examines through the use of rigorous qualitative methodology, the dynamic relationship between teachers and principals—key figures in the development and implementation of effective science programs, in a school district that had embraced the ideals and principles embodied in the science education reform movement (or so it seemed).

A “Plan” of Action: A School District that “Seemed” to Embrace Science Education Reform

This investigation was conducted in the Snella County School District (all names in this document are pseudonyms as to maintain anonymity), one that embraced the ideals of the Science for All Americans movement, establishing the Science Plan: School-to-Careers initiative in the early years of this decade. One of the largest school districts in Florida, the comprehensive science plan (also referred to as the “public” science plan)
developed by the school district pointedly expressed the importance of preparing students to be scientifically literate consumers, and principals’ and teachers’ role in the process of change (Snella County School District). (Note: The reference information for the Snella County School District is withheld due to the nature of the findings of this investigation.)

Funded by two national organizations, the Snella County School District developed and implemented the School-to-Careers reform initiative recognizing that there was dissension between the curriculum, corresponding educational experiences, and the needs of an unrelenting global economy (Snella County School District). The district’s comprehensive plan sought to change the entire K–12 system, or as described by the district, the entire superstructure of the School-to-Careers initiative. Utilizing an architectural design metaphor, Snella County School-to-Careers initiative included the blueprint – the curriculum. The elementary program was conceived of as the foundation on which pillars – the middle school program and the pristine edifice – senior high school program were erected. And to be assured that the structure was secure and powerful, it had a substructure – teacher professional development.

Although the elementary, middle, and high school science programs were the focus of the reform initiatives, much of the district’s resources and professional development activities were directed toward the superstructure’s foundation, the elementary school program (Snella County School District). The developers of the School-to-Careers initiative recognized that preparing the community to be scientifically literate consumers was of grave importance, and this must begin in elementary classrooms.

**School-to-Careers – Efforts Toward Scientific Literacy**

Central to the efforts of Snella County’s School-to-Careers initiative was the preparation of a skilled and knowledgeable labor force for the Snella County community. According to the initiative, graduates will complete Biology, Chemistry or Physical Science, and Earth/Space Science and be able to apply the concepts learned to real-world situations. With the primary goal of scientific literacy as the result of engagement in inquiry-based science experiences, students would graduate equipped to make informed
decisions about science topics, compete in the job market, and flourish in post-secondary settings.

In order to reach the goal of science literacy for all of its students and enact science education reform across the entire school district, developers recognized that teachers’ instructional practices must change. Professional development that built leadership capacity, enhanced the professional competencies of teachers, and improved individual and organizational functioning was seen as key to this success (Snella County Public School District). Shifting from a professional development model that relied on outside experts to increase the content knowledge of teachers, the model the district employed during this investigation recognized that change must focus on the entire school community. These efforts included both teachers and principals, with professional development as the intermediary that assisted these education professionals in the successful implementation of reform.

Reform in science education has chiefly reported on issues related to the teaching and learning of science, as the teacher is recognized as central to change efforts (AAAS, 1990). Indeed targeting teachers is essential considering teachers and their beliefs are at the epicenter of improved teaching and learning. Although professional development opportunities aimed at improving the teaching and learning of science were stipulated in the science plan, the Snella County School District also recognized that principals too are essential to sustaining reform in science education. As a result, the school district embraced the Revitalization Model for professional development. The model specified that all elementary principals and assistant principals would engage in professional development to support science instructional decision-making and restructuring. These professional development opportunities were to assist elementary administrators in the development of quality science programs that encouraged and promoted science careers and scientific literacy.

As the administrative team (principal and assistant principals) was an integral part of the district’s vision for science improvement, elementary principals were to actively participate in, contribute to, and improve the quality of science teaching and learning at their school. When examined from the perspective of educational leadership reform, elementary principals are being asked to act as instructional leaders for science teaching
and learning, intimately involved in bringing to fruition the goals of science education reform (Blasé & Blasé, 1998; Gupton, 2003; Mechling & Oliver, 1982, 1988; Rossow & Warner, 2000; Wanzare & Da Costa, 2001). It is important to recognize that this approach to science education reform, which is inclusive of principals, is promoted and encouraged in national science reform documents (AAAS, 1990; NRC, 1996). Unfortunately, as will be discussed in subsequent chapters, the School-to-Careers science initiative, which supported reform as defined by national movements, failed to promote this vision in their leadership practices.

Science in the Snella County School District and NCLB

Although science is viewed as a core subject within elementary schools’ instructional programs (Perie, Baker, and Bobbitt, 1997), it is not assessed to the degree that reading and mathematics are assessed. According to the Council for Science Supervisors (n.d.), reading and mathematics are assessed in all states, whereas science state-wide assessments prior to this report were administered in roughly 30 states across the country. However, after several years of assessments in reading and mathematic as per NCLB legislation, the 2006 – 2007 school year marked the beginning of required accountability assessments in science.

Florida’s science assessment that addresses the federal requirements for Annual Yearly Progress (AYP) is the Florida Comprehensive Achievement Test (FCAT). The FCAT science assessment is administered in grades five, eight, and eleven and covers an array of concepts. The concepts addressed on the fifth grade FCAT include: physical and chemical sciences; earth and space sciences; life and environmental sciences; and scientific thinking. Students in Florida are ranked according to achievement levels (1-5) on a scale score of 100 to 500, with Level 3 (323-376) representing the minimal passing level. “Achievement levels describe the success a student has achieved on the Florida Sunshine State Standards tested on the FCAT Reading, Mathematics, Science, and Writing+ assessments” (Florida Department of Education [FLDOE], 2008, ¶ 2). Tables 3 and 4 provide a description of FCAT science achievement levels with the corresponding scale scores as defined by the FLDOE.
Table 3 Florida Achievement Levels for Assessed Grades

<table>
<thead>
<tr>
<th>Grade</th>
<th>Achievement Level 1 (lowest)</th>
<th>Achievement Level 2</th>
<th>Achievement Level 3</th>
<th>Achievement Level 4</th>
<th>Achievement Level 5 (highest)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>100 - 272</td>
<td>273 - 322</td>
<td>323 - 376</td>
<td>377 - 416</td>
<td>417 - 500</td>
</tr>
<tr>
<td>8</td>
<td>100 - 269</td>
<td>270 - 324</td>
<td>325 - 386</td>
<td>387 - 431</td>
<td>432 - 500</td>
</tr>
<tr>
<td>11</td>
<td>100 - 278</td>
<td>279 - 323</td>
<td>324 - 379</td>
<td>380 - 424</td>
<td>425 - 500</td>
</tr>
</tbody>
</table>

* Adapted from the Florida Department of Education FCAT Achievement Levels website http://fcat.fldoe.org/pdf/fcAchievementLevels.pdf

Table 4 Florida Achievement Levels Definitions

<table>
<thead>
<tr>
<th>Level</th>
<th>Achievement Level Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 (highest)</td>
<td>This student has success with the most challenging content of the Sunshine State Standards. A student scoring in Level 5 answers most of the test questions correctly, including the most challenging questions.</td>
</tr>
<tr>
<td>4</td>
<td>This student has success with the challenging content of the Sunshine State Standards. A student scoring in Level 4 answers most of the test questions correctly, but may have only some success with questions that reflect the most challenging content.</td>
</tr>
<tr>
<td>3</td>
<td>This student has partial success with the challenging content of the Sunshine State Standards, but performance is inconsistent. A student scoring in Level 3 answers many of the test questions correctly but is generally less successful with questions that are the most challenging.</td>
</tr>
<tr>
<td>2</td>
<td>This student has limited success with the challenging content of the Sunshine State Standards.</td>
</tr>
<tr>
<td>1 (lowest)</td>
<td>This student has little success with the challenging content of the Sunshine State Standards.</td>
</tr>
</tbody>
</table>

* Adapted from the Florida Department of Education FCAT Achievement Levels website http://fcat.fldoe.org/pdf/fcAchievementLevels.pdf

To meet the demands of federal accountability, the Snella County School District had an explicit science plan that provided a roadmap to scientific literacy for all graduates of the district who enter the workforce or pursue post-secondary education. Although the science plan provided the vision for change, according to the participants of this investigation, the district had focused very little attention on science since the plan’s
inception. However, with science accountability measures approaching, the district spearheaded what participants in this investigation term an “aggressive” and deliberate effort to make up for several years of science neglect. In so doing, the district made many of the major decision regarding science (e.g., science textbooks, the administration of quarterly formative assessments, infusion of science technology, etc.) and made “suggestions” that school administrators were strongly encouraged to incorporate. Important however, is the fact that the reform-minded science plan, with scientific literacy at its core, was not the major focus of the district’s efforts. Rather, the emphasis was on preparing students for the impending science assessment by making structural changes (e.g., departmentalization, FCAT preparation exercises, science laboratory, etc.). Although the principal did have some autonomy to make less significant decisions in the science program (e.g., inclusion of a science club, what science-related technologies to purchase, science tutoring, etc.), district leaders seemed to monopolize control, making decisions that they saw as instrumental to success according to federal and state accountability standards.

Theoretical Underpinnings

There has been an abundance of research conducted to help scholars, practitioners, politicians, and all other stakeholders understand why, even with current science reform initiatives, the status quo in schools is never significantly altered (Appleton, 2003; Davis, 2003; Gee & Gabel, 1996; Hammrich, 1999; Lee, Hart, Cuevas, & Enders, 2004; Lee & Houseal, 2003; van Driel, Beijaard, & Verloop, 2000), but rather is “adapted to fit what exist[s] or sloughed off” (Woodbury & Gess-Newsome, 2002, p. 764). Following an extensive examination of the literature, I became interested in understanding why reform efforts rarely have a widespread impact on instructional practices, particularly in science, considering the current science education reform movement. The Teacher-Centered Systemic Reform (TCSR) Model of Educational Reform (see Figure 1) developed by Woodbury and Gess-Newsome (2002) provided a theoretical lens to help me understand why science reform initiatives often do not generate long-term changes in the teaching and learning of science.
Teacher-Centered Systemic Reform Model

In the article, *Overcoming the Paradox of Change Without Difference: A Model of Change in the Arena of Fundamental School Reform*, Woodbury and Gess-Newsome (2002) propose a model that delineates why fundamental changes are often not achieved during times of reform, by its description of the many intersecting factors that facilitate or inhibit the reform process. Woodbury and Gess-Newsome (2002) contend that “school change is ultimately about teacher change” (p. 774). But focusing solely on teachers “captures only but a partial picture of the variables that affect reform…The TCSR model of educational reform recognizes the interplay between teachers’ thinking, their backgrounds and classroom practices, and the context of their work as the critical influences on reform” (p. 772). Of the contextual factors (both cultural and structural) identified—national, state & district context; school context; department & subject area context; and classroom context (see Figure 1), the school context, more pointedly, the principal within the school context recurrently interacts with and influences what teachers think and do as they attempt to change classroom practices in light of reform.

A common theme within current reform documents is the notion that although teachers are at the center of reform (AAAS, 1990; NRC, 1996; Woodbury, & Gess-Newsome, 2002), as the African proverb tells us, *it takes the efforts of the entire village* to change the current state of science education in our country. Large-scale changes such as those proposed by science educators must include persons within the school community who have a direct influence on the enactment of science education reform, and those outside the school community whose influence is indirect. Although reform recognizes that everyone’s role is critical in the restructuring process, current science education reform initiatives are prompting a reconceptualization of the traditional roles of teachers and principals (NRC, 1996). Understanding how and what those individuals within one school community—particularly teachers and the school principal—are doing to reform or restructure the school science program seems to be particularly salient.
Figure 1 Teacher-Centered Systemic Reform Model of Educational Reform
As one examines the TCSR model, within the school’s context, Woodbury and Gess-Newsome (2002) point out that the school principal (in addition to other contextual factors) influences teachers as they enact science education reform. Through inservice, district-wide reform initiatives, or summer institutes, many teachers participate in science professional development expanding their teaching repertoire, returning to their classrooms excited about improving their science instruction. However, in many cases, reformed practices are attempted but not sustained (Lee et al., 2004; Marx & Harris, 2006), as the preoccupation with preparing students for high-stakes tests (George, 2001; Wideen, O’Shea, Pye, & Ivany, 1997) causes some elementary principals to take drastic steps to ensure their school receives a passing grade (i.e., increasing the amount of time spent on reading/language arts and mathematics instruction in lieu of science) (George, 2001).

For example, I will draw from my own teaching experience to demonstrate how some principals compromise science instructional time in an effort to increase the amount of time devoted to reading/language arts and mathematics. I have had the opportunity to teach the elementary science methods course at the institution in which I am pursuing my doctoral degree. As part of the requirements for this course, the students had pre-internships in elementary classrooms across the district. Many of these students explained that their cooperating teachers did not teach science or did not teach much science in the months prior to the FCAT, and if they did it was textbook-based and/or integrated with reading. Unfortunately, over the two semesters that I taught this course, these were not the sentiments of one student, but many, and from placements in several elementary schools across the district. Through our discussions and further inquiry, many of these students indicated that additional reading and/or mathematics was taught in lieu of science at the direct request of the principal. This demonstrates that, although teachers are directly responsible for providing science instruction, the elementary principal, although external, influences the teaching and learning of science or the lack thereof (Dickinson, Burns, Hagen, & Locker, 1997; Hanegan, 2001).

Within the science education literature, researchers recognize that principals are important and influence classroom teachers during science education reform. But the nature of the principal’s role in terms of the science program is not fully understood.
This investigation sought to understand the interplay between the teachers and principals, as this understanding is critical if science education reform is to truly have the broad impact that is intended. To help focus on this interplay, I needed a lens that would help me examine and understand behaviors and leadership practices engaged in by school principals. Therefore, the *Instructional Leadership Model* served as a framework to understand the leadership actions/behaviors of the principal.

**Instructional Leadership Model**

As attempts to reform education have almost become endemic in the United States, the role of the school principal has evolved, with the educational leadership community and science education reformers recognizing that the principal must take a more active role in the school’s instructional program if reform is to be successful (Blasé & Blasé, 1998, 1999a, 1999b, 2004; Blasé & Kirby, 2000; Fulmer, 2006; Gupton, 2003; Hallinger, 2005; Halverson, Grigg, Prichett, & Thomas, 2007; Krug, 1992; Lashway, 2002; Rossov, 1990; Spillane et al., 2001; Vesilind & Jones, 1998; Wanzare & Da Costa, 2001; Whitaker, 1997). As such, educational leadership researchers purport that principals must be instructional leaders who are directly involved in the teaching and learning process (Blasé & Blasé, 1999a, 1999b; Blasé & Kirby, 2000; King, 2002; Krug, 1992; Lashway, 2002; Lemahieu, Roy, & Foss, 1997).

Definitions of instructional leadership are bountiful, wide-ranging, and vary greatly vis-à-vis what instructional leadership *is* and what instructional leaders *do* within the context of the schools. Because schools are so diverse, defining instructional leadership has been rather difficult; the complexity is discussed at length in the following chapter. Taking into consideration the many perspectives of instructional leadership (see review of the literature on instructional leadership in Chapter II), for the purpose of this investigation, instructional leadership is defined as the actions/behaviors employed by the school principal in the development of a science program that incorporates reform-minded instructional practices as defined by science education reform documents that promote student learning.

Researchers in the educational leadership community contend that in order to aid teachers in the successful reformation of their practice, principals should engage in an
array of actions/behaviors from articulating a school vision to observing teachers’ instructional performance (as a development tool) (Blasé & Blasé, 2000; Fullan 2001; Quinn, 2002; Wanzare & Da Costa, 2001; Whitaker et al., 2006). When these actions/behaviors are executed and displayed consistently by principals, researchers assert that teachers feel supported and are more apt to try innovative teaching approaches. Because many of the actions/behaviors of principals presented in the literature have common characteristics and are analogous in the intent, I have grouped them into six broad themes. Principals who are instructional leaders: (1) engage in and promote professional growth and development (2) monitor student progress (3) make available the necessary resources for instruction (4) prepare the culture for change (5) develop teacher leadership, and (6) use leadership skills to promote (science) education (Blasé & Blasé, 1999a, 1999b, 2001a; Gupton, 2003; King, 2002). Research supports the contention that when principals are leaders of instruction, they establish flourishing and innovative instructional programs in which teachers are challenged and encouraged to be innovators and where classrooms are breeding grounds for success (students and teachers) (Blasé & Blasé, 2001a; Crum & Sherman, 2008; Fullan, 2002; Rourke, & Boone, 2008).

The instructional leadership model delineates the actions/behaviors employed by principals who wish to be hands-on leaders and effectuate change in the schools’ instructional program. Therefore, this framework helped me to identify those actions/behaviors used by the principal and understand their influence on science teachers’ practice, teacher’s efforts toward science education restructuring, and the science program as a whole.

**Research Questions**

With science education reform calling for principals to function as instructional leaders and to take on a more active role in the instructional program, science education researchers must begin to understand this instructional leadership and the influence it has on the teaching and learning of science. As an instructional leader and advocate for reformed science practices, Vasquez (2005) discusses the importance of the elementary principal.
To effectively improve elementary science, it has to be taught at the elementary level. Schools and administrators need to value the science education they offer, and they must provide quality professional development, mentoring, and resources to our elementary teachers. This will be vital if as a nation we want to truly see students achieve in science. (¶4)

Therefore, science educators need to understand how principals as instructional leaders interact with and influence teachers as science education reform is embarked upon. It is my hope that this qualitative investigation, which utilized naturalistic inquiry to better understand how an elementary school principal enacts instructional leadership in the school’s science program and how teachers’ interpret and respond to this instructional leadership, would help me to understand this interplay. The following research questions guided this investigation:

1. How does a principal’s instructional leadership influence the enactment of science education reform in an elementary school?
   a) What is the portrait of science and science instruction being supported by the principal’s instructional leadership?
   b) What are the most important influences on this portrait of science and science instruction?
   c) How does this portrait align with that set forth in the national standards for science teaching and learning?

2. How do teachers interpret and respond to the principal’s instructional leadership in science?

Summary

The significance of this study cannot be overemphasized, as science (like all academics subjects) can contribute to students being informed decision-makers of the future. Elementary school science programs are integral to this process of development as reformed-minded science instruction and quality science experiences are thought to provide the prerequisite skills for advanced scientific acquisitions (Committee on Science Learning, Kindergarten Through Eighth Grade, 2007; Victor & Kellough, 2000). Because both teachers and principals are key players in the development of quality
science programs, we need to begin to understand the interplay between the school principal and teachers as science education reform is enacted so that as researchers, we can help practitioners prepare students to be scientifically literate consumers and voters.

In the next chapter, I examine the literature on this phenomenon, particularly science education reform, the need for science instruction in elementary schools, the historical evolution of education reform that has directly impacted science, and the principal’s role as instructional leader within the context of science.
CHAPTER II

LITERATURE REVIEW

Taking a Closer Look at Science Education Reform

Over the years, Americans—from policy makers to taxpaying citizens—have expressed concern about the quality of education students are receiving and the ability of these students to protect the country’s national interest and meet the educational demands of today’s job market (Bayer Group, 2003; Rhoton, 2001; Smith, 2008). According to Carter and Klotz (1990), “Low student achievement, poor attendance, high dropout rates, low scores on college entrance examinations, and indications that American students lag behind foreign students in reading, writing, computing, and mathematics have prompted demands for school reform” (p. 36). Smith (2008) goes on, reporting that there have also been concerns because “teachers were being drawn disproportionately from the lowest quartile of graduating high school and college students and that in certain shortage subjects, such as mathematics, science, and English, teachers were simply not qualified to teach” (p. 611).

The National Center for Educational Statistics (NCES) (1999), in an overview of the Trends in International Mathematics and Science Study (TIMSS), indicate that the dismal state is not only the case in reading, writing, computing, and mathematics, but science as well. Although American students scored above the international average in science, “No measurable changes were detected in the average mathematics and science scores of U.S. fourth-graders between 1995 and 2003. Moreover, the available data suggest that the performance of U.S. fourth-graders in both mathematics and science was lower in 2003 than in 1995 relative to the 14 other countries that participated in the studies” (NCES, n.d.a, ¶ 2).

It has also been argued, at least in the United States, that recent reforms in
education had their greatest impact in the earlier grades, and that a second TIMSS assessment could show better results for eighth grade in 1999 than in 1995. Of the three countries with a relative decline from fourth to eighth grade in 1995, only the United States showed the same relative decline from fourth grade in 1995 to eighth grade in 1999. (NCES, n.d.b, p. 35)

These results and other factors continue to support the need for systematic changes in how science is taught and learned (Charles & Cummings, 2001; Kahle, 2007; van Driel et al., 2001) not only in the United States, but other countries across the globe. Changes in the teaching and learning of science however can be traced back to the 1920s with the **Progressive Movement**. This period, along with the **Curriculum Reform Movement** of the 1960s, provide a historical context to understand how the science education community has arrived at the vision for science education reform today—*Science for All Americans*.

**1920s: The Progressive Movement**

One of the most celebrated educational reform efforts to date is the **Progressive Movement**. This effort was not solely focused on science teaching and learning, but instead was to be an overhaul of the fundamental notions of schooling and “a many-sided protest against pedagogical narrowness and inequality” (Cremin, 1959, p. 160). Although progressive educators focused their energies in different areas, they were bounded by a shared conviction in that

…democracy means active participation by all citizens in social, political and economic decisions that will affect their lives. The education of engaged citizens, according to this perspective, involves two essential elements: (1) **Respect for diversity**, meaning that each individual should be recognized for his or her own abilities, interests, ideas, needs, and cultural identity, and (2) the development of **critical, socially engaged intelligence**, which enables individuals to understand and participate effectively in the affairs of their community in a collaborative effort to achieve a common good. These elements of progressive education have been termed "child-centered" and "social reconstructionist" approaches. (John Dewey Project on Progressive Education, n.d., ¶ 1)
Social consciousness was becoming ever so important as progressive ethos emphasized “economic and political individualism” (Bower, 1967, p. 453) and the liberation of individual thought. Liberal thinking and social awareness ushered in progressive education that stressed individualism, nurturing through instruction, intellectual growth that utilized prior conception, and lived experiences as the vehicle for advanced understandings (Cremin, 1959; Sullivan, 1996).

Curriculum reformers lobbied for radical changes in teaching and learning and curricula content. The “main aim was to loosen the shackles of traditional education which was characterised by rote and decontextualised learning in an unstimulating and strictly controlled classroom often led by an untrained and unskilled teacher” (Sullivan, 1996, p. 350-351).

Science education reform was slow to embrace the individualistic notion purported in progressivism as the discourse of science was often used to polarize society, providing the scientifically astute or educated person with leverage and an “attitude of mind” (Cotkin, 1984, p. 201) that was used to preserve existing power dynamics and dominance over the working class. But as the ideals at the core of the progressive movement took shape, there was an attempt to reformulate the goals of science education—science learning for citizenship, health, and practical uses in everyday life. Later referred to as life adjustment learning, the practical emphasis involved in the reforms reduced the importance of developing an elite and scientifically astute group of thinkers, and shifted to producing citizens that had a working understanding of science (Atkins & Black, 2003; U. S. Depart of Education, n.d.), could apply science principles in practical situations (DeBoer, 1991), and problem solve (Ruby, 2001). Further, teachers were no longer viewed as “knowledge controllers” (Sullivan, 1996, p. 351), directly responsible for knowledge acquisition, but facilitators in the learning process.

As with any movement that threatens to revolutionize the core values that bind a society together, there was a definite reluctance to change. But the progressive movement with science education at its core incited change. The educated were now questioning the “moral absolutes of the past” (Bower, 1967, p. 455) and the rudimentary notions of being. Educators were reevaluating the fundamental philosophy of public education, as progressivism attempted to eradicate the gross inequalities in education and
protest pedagogical narrowness. Central to these efforts was individualism, the notion that students should learn from their own experiences, diversity of instruction, and that “subject matter should always be taught in connection with its social and cultural meanings” (DeBoer, 1997, ¶ 4). Although unprecedented in the 1920s, science education reform today recognizes these elements as salient to science teaching and learning.

The demise of progressivism came in 1946. Because ideals inherent to the progressive movement—empowerment and uplift of the individual—had not yet become central to American culture, the onset of the Cold War united Americans and incited patriotism, cultural homogeny, cultural conservatism, and national solidarity.

1960s: Curriculum Reform Movement

The Curriculum Reform Movement of the 1960s was a large-scale initiative that came as a direct result of societal pressures. Following the launch of the Sputnik satellite in October of 1957 by the Russians, there was widespread concern aimed at the American educational system. It was argued that school science programs needed an intellectual boost if America was to remain an international presence (Bybee, n.d.; DeBoer, 2006; Dow, 1997; Sarason, 1995; U. S. Department of Education, 2002). This was imperative because as Sarason (1995) describes…

We [America] had become Avis to the Soviet Union’s Hertz. As was (and still is) the case when national pride has received a narcissistic wound, blame had to be assigned and our schools were sitting ducks. The scientific leadership of our country seemed imperiled, the number of young people interested in or knowledgeable about science seemed alarmingly low, and the future supply of scientists was drying up. (p. 65)

Consequently, federal regulations regarding science curriculum standards displayed, both verbally and financially, a vested interest in curriculum development in science, mathematics, and technology. “Curriculum reformers of the 1960s were responding to a barrage of conservative criticism of progressive, child-centered education. What was needed was rigor and discipline, the critics said. To them, student interest had little relevance when national security was an issue” (DeBoer, 1997, ¶ 3). With science, mathematics, and technology as a national priority, the aim for science during this reform
movement was on the development of new curricula that: “(1) upgrade[d] teachers’ and students’ knowledge of what was known in the world at the time, and (2) instill in students a keen interest in science. The principal goal [however]…was to produce a new generation of scientists” (Duschl, 1990, p. 30).

Although teachers were to implement the new curricula, they had little to no input in its design or content. “The role of teachers and administrators was primarily to provide feedback to the scientist-writers” (Duschl, 1990, p. 22) once the curricula had been implemented. “More often than not, however, teachers’ feedback had very little effect on subsequent versions of the curriculum” (p. 22) as scientists were leery of the suggestions made by “school-teachers” (p. 22).

However, by 1964 it had become clear that the Curriculum Reform Movement had not been as successful as anticipated, doing very little to improve the teaching and learning of science. According to Duschl (1990), this is because the movement was less about preparing teachers to successfully implement the curriculum aimed at reformed science practices, but rather the curriculum implementation itself. As a result, “Before the mid-seventies the Education Directorate of the National Science Foundation had shrunk to less than 10% of the agency’s budget, and following the election of President Reagan in 1980, the Directorate closed altogether” (Dow, 1997, ¶ 7). Dow goes on to say that “If the movement had lasted longer, it may have solved more of its implementation problems and had a wider impact on the schools” (¶ 7). Despite the problems with the Curriculum Reform Movement, more changes were on the horizon and the goals and objectives would be quite different.

1990s: Science for All Movement

Reform efforts of the 1960s and 1970s, prompted by reports such as A Nation at Risk: The Imperative for Educational Reform (National Commission on Excellence in Education, 1983) and Educating Americans for the 21st Century (National Science Board Commission on Precollege Education in Mathematic, Science and Technology, 1983), were dominated by America’s preoccupation with “catching up” with the Russians following the launching of Sputnik. However, reform efforts of the 1990s were unlike those in previous years; the American public was the focus. The common theme was the
This reform, like the Curriculum Reform Movement of the 1960s, was spawned as a result of concerns about the quality of science instruction students were receiving in America’s schools (Duschl, 2008). During a two-day gathering at the National Academy of Science and Engineering, educators, scientists, politicians, researchers, and business leaders gathered to discuss the “state of affairs” (Duschl, 1990, p. 15) of science and mathematics education. The outcome of this meeting was the shared argument that reform was once again needed in science and mathematics. The need for reform was true for science, as more and more it was becoming a permanent part of our daily existence. Therefore, scientific literacy had become a necessity for everyone.

It was argued that everyone needs to use scientific information to make choices that arise every day. Everyone also needs to be able to engage intelligently in public discourse and debate about important issues that involve science, mathematics, and technology. Important, too, is that everyone deserves to share in the excitement and personal fulfillment that can come from understanding and learning about the natural world. Scientific literacy also is of increasing importance in the workplace. More and more jobs demand advanced skills, requiring that people be able to learn, reason, analyze, think creatively, make decisions, and solve problems (Hurd, 1998; National Center on Education and the Economy, 2007; Ryder, 2001). An understanding of science and the processes of science contribute in an essential way to the development of these skills. It is argued that other countries are investing heavily to create scientifically and technically literate workforces. So, to keep pace in global markets, the United States needs to have an equally capable citizenry (NRC, 1996). Three major documents—*Science for All Americans, Benchmarks for Science Literacy, National Science Education Standards* (AAAS, 1990, 1993; NRC, 1996) would become pivotal in setting the stage for long-term changes in science education.

**Science Education Reform Documents.** In 1989, “150 teachers and administrators in six school districts accepted a daunting challenge…to help shape the future of education in America…in which all students would become literate in science, mathematics, and technology by graduation from high school” (AAAS, 1993, p. vii).
Working collaboratively, Project 2061 innovators developed *Science for All Americans* and later *Benchmarks for Science Literacy*, offering these documents to school districts as tools to use in developing their own curricula. The authors’ intent for the *Benchmarks* was to provide a document that translates the literacy goals outlined in *Science for All Americans* (AAAS, 1989, 1990) published years earlier, into learning benchmarks, recommending what students should know and be able to do after 13 – years of matriculation. As reported, “Many of today’s state and national standards documents have drawn their content from the *Benchmarks*” (AAAS, n.d.a, ¶ 2) (and this is the case in Florida).

Likewise, the NRC (1996) presents a similar vision for science education reform. Expressed in a single phrase, the intent is “Science standards for all students” (p. 2), regardless of age, cultural background, gender or ethnicity. Further, just as with *Project 2061*, the *Standards* rest on the premise that students will be actively involved in the learning process, engaging in quality experiences, taught by quality professionals, in quality schools.

Translating science reform documents into new ways of thinking about, teaching, learning, and assessing science has been slow yet unyielding in the effort toward change. Although national science education reform initiatives attempt to sway federal and state policy and legislation regarding science education, political rhetoric and competing agendas hamper a unified effort (Atkin & Black, 2003; Hurd, 2000; Southerland, Smith, Sowell, & Kittleson, 2007). In somewhat of a linear fashion, reforms goals are disseminated through school districts and private foundations (e.g., Urban Systemic Initiative via the National Science Foundation) to school personnel by way of workshops, inservice trainings, and professional development institutes (Knapp, 1997; Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2003). Although a combined effort toward improvements would be ideal, science education reforms articulated in the *Science for All* movement and legislation aimed at improving student achievement in science are quite often at odds.
2000s: Legislative Mandates and Science Education

The authors of reform documents in science education seek to engender educational changes by providing a framework for what science concepts should be taught, how they should be taught, and how they should be assessed, as their aim is to improve instructional practices and increase student learning. However, science education reform initiatives are not the only documents that impact school science programs; national legislation does as well, particularly—No Child Left Behind (NCLB). With this legislation, changes are driven by high-stakes and results-based accountability where clear expectations for student learning are not explicated. Instead, student learning is measured by performance on standards-based science assessments—an assessment that was “kept on the back burner…in the first few years of this mandate” (Johnson, 2007a, p. 134) and excluded from AYP calculations (unlike like reading and mathematics).

No Child Left Behind is a federal reform initiative that seeks to “strengthen K – 12 math and science education” (U. S. Department of Education, n.d., ¶ 17) through strong accountability and academic proficiency. According to NCLB, if student achievement is to improve, three goals must be reached: 1) schools must develop challenging and rigorous curricula 2) students must take advanced level mathematics and science courses, and 3) the number of out-of-field teachers must decrease. To lessen or eliminate these barriers to student achievement and to improve the teaching and learning of science, NCLB made available federal funds to encourage collaborative partnerships between schools and scientists, institutions of higher learning, mathematicians, and engineers (U. S. Department of Education, 2002).

In accessing these funds—$4,874,682 under Title II, Part B—the FLDOE offered competitive two-year grants available for the 2003-04 and 2004-05 school years “to partnerships of an engineering, mathematics, and/or science department of an institution of higher education and a high need local educational agency” (FLDOE, 2003, ¶ 1). Increasing annually, the total grant amount available December 2007 was $8,191,146 and would extend for a three year period (pending additional funds) (FLDOE, 2007). The grants provided a financial incentive for collaborative partnerships aimed at achieving the goals of improved student achievement in mathematics and science. Eligible applicants must have developed a plausible action plan that aimed to provide content-specific
professional development within Institutions of Higher Learning, particularly the Colleges of Arts and Sciences. Other groups were also eligible for funding such as businesses, informal education centers, and teacher education departments. However, will partnerships be sufficient as national reports “continue to demonstrate that students in the United States are poorly prepared in science and mathematics” (Rice, n.d., ¶ 1)?

This question becomes an important one, as science education reform developers and science education researchers encourage and support collaboration, but developers and researchers advise that collaboration alone is not sufficient to generate the depth and breadth of change proposed by science educators (Kelly & Staver, 2005; NRC, 1996; Spillane et al., 2001). The emphasis of NCLB is to increase student achievement as evidenced by standardized measures (Azin & Resendez, 2008; Marx & Harris, 2006). Science for All, on the other hand, seeks to improve student learning by establishing goals for science teaching and learning; provide a framework for what students learn, how teachers should teach, how students should learn, and how students are assessed; press for reform that challenges and changes core beliefs structures about how science should be taught and learned; and promote collaboration among stakeholders. This vision reflects the “efforts of scientists and educators on behalf of all children” (AAAS, 1990, back cover).

A goal of both NCLB and science education reform is to improve the science achievement of students by increasing instructional quality. However, the method by which to achieve said goal is different. No Child Left Behind is attempting to accomplish this task through accountability and high stakes testing, making what is currently happening more efficient. Science education reform in contrast seeks more substantive changes—transformation of individual and collective beliefs and the practices influenced by those beliefs. However, science education researchers (Brickhouse, 2006; George, 2001; Griffith & Scharmann, 2008; Jones, Jones, & Hardin, 1999; Wideen et al., 1997) assert that the emphasis on student outcomes as described in NCLB undermines the true intent of science assessment. As described in the National Science Education Standards (NSES),

assessment is a primary feedback mechanism in the science education system. For example, assessment data provide students with feedback on how well they are
meeting the expectations of their teachers and parents, teachers with feedback on how well their students are learning, districts with feedback on the effectiveness of their teachers and programs, and policy makers with feedback on how well policies are working. Feedback leads to changes in the science education system by stimulating changes in policy, guiding teacher professional development, and encouraging students to improve their understanding of science… (NRC, 1996, p. 76)

In science education, assessment is to be used as a means (formative) to an end (increased students achievement), but under current NCLB statutes, assessments are more often only viewed as the end product of instruction. And because of the ramifications for poor student performance, such assessments often determine schools’ approach to instruction, that is, what teachers teach, how it is taught, and when it is taught (Azin & Resendez, 2008; Darling-Hammond, 2004; George, 2001; Linn, 2000).

In a review of assessments and accountability in this country over the past 50 years, the concerns Linn (2000) discusses are similar to those expressed by science educators (Griffith & Scharmann, 2008; Marx & Harris, 2006; Johnson, 2007a). Although there are benefits to the current standards-based accountability system, Linn (2000) concludes, “assessment systems that are useful monitors lose much of their dependability and credibility for that purpose when high-stakes are attached to them. The unintended negative effects of the high-stakes accountability uses often outweigh the intended positive effects” (p. 14). Linn also maintains that high-stakes accountability systems have had “undesirable effects on teaching and learning because they led to a narrowing of the curriculum and an over-emphasis on basic skills” (p. 8). Although Linn suggests that on the surface, it is easy to accept the positions discussed above, he is unsure whether “there is a know-how or will…to develop assessments that are sufficiently “immune to this type of corruption” (p. 12). Meyers (1996) further contends that “in a high-stakes accountability system, teachers and administrators are likely to exploit all avenues to improve measured performance” (p. 140).

The effects of what some would classify as a “misdirected use” of a high-stakes assessment system can be felt here in Florida with Governor Bush’s (Now Governor Crist’s A+ Plan) (George, 2001; Goldhaber & Hannaway, 2004). In a study conducted in
50 schools across the state with principals and central office personnel, George (2001) finds that there is a deliberate attempt by school leaders to identify strategies that will improve student achievement on standardized assessments. Principals are sharply divided on whether assessment and accountability measures have had positive effects on teaching and learning. Some believe that they have had positive effects “because of the emphasis on higher-level thinking and consequent changes in content and instruction” (p. 32). Other principals are bitterly negative about such assessments “mostly because they believe that the processes for testing and awarding school grades, bonuses, and punishment are harshly punitive and unfair” (p. 32). Irrespective of which side of the debate educators may be on, instruction in low achieving as well as high achieving schools has narrowed, with teachers spending more instructional time preparing students for FCAT (Goldhaber & Hannaway, 2004).

Science educators and advocates would agree with the latter view, suggesting that under such pressure, principals have “pass state assessment” as their primary goal, and therefore developing students’ scientific understandings and habits of mind essential for well-informed decision-making are seldom the focal point of instruction (Atkins & Black, 2003; George, 2001; Johnson, 2007a; Settlage & Meadows, 2002). These science educators and advocates suggest that when policy-makers, school board and district personnel, principals, and teachers recognize that “good science teaching” (such as that described in national reforms) can improve student achievement, then and only then will the students in our classrooms move closer to the vision of scientific literacy. “Unfortunately, school conditions often force many teachers to learn to survive and to keep students busy at the expense of teaching science effectively” (Johnson, 2007a, p. 133).

Although NCLB supports the idea that science education can be improved through collaborative partnerships, improving teachers’ content knowledge such that they increase their students’ performance on state assessments appear to be the objective. Conversely, science education reform seeks systematic changes at all level of the system (Kahle, 2007; NRC, 1996). Therefore, science education reform seeks to re-member a system that is fragmented and disjointed and resume with a new vision for a new day. But because the future of science is nestled in the impressionable minds of children,
reform must begin in our elementary classrooms where the foundation for future learning in science is laid and curiosities are peaked. The following section examines reform in elementary science education.

**Elementary Science Education: Is it that Elementary?**

**Early Vision for Elementary Science Education**

Elementary science teaching as we know it today can be traced back to the 19th century. One of the most noteworthy contributions of early scientists to elementary science education was the recognition of science as a distinct discipline within the academic program. The recognition of science as a distinct program was a major shift from the academic program’s past focus on mathematics and literary studies—reading, spelling, writing, and literature (Victor & Kellough, 2000). Changes in early education (as is most often the case), came as a direct result of changes in economic and political events in society that warranted changes in schools. In this case, the elementary science program was greatly “influenced by the rise of industrialism in the United States” (Bybee & DeBoer, 1994, p. 365), as the primary goal of education became the cultivation of a knowledgeable society who knew “about raw materials, processes, and products of the new industrial economy” (p. 365).

Towards the end of the 19th century, the *nature-study curriculum*, which promoted social/personal development, was introduced. The educational purpose of the nature-study curriculum “was to help children develop a more balanced life by getting to know the natural environment through firsthand observations, classification, and measurement of objects and organisms…in natural habitats” (Victor & Kellough, 2000, p. 5). Many supported the nature-study movement because, if successful, it would help children develop an interest in farming and agriculture, curtailing their migration to New York City, which at the time was becoming rapidly overpopulated. Interest in the nature-study curriculum waned as experiential knowledge with nature was replaced by reading about nature in textbooks. Also, the nature-study faced unremitting criticism for its lack of structure, and its neglect in explicating clear learning goals. “In the early twentieth century, the nature-study movement lost prominence and the goal of science teaching at
the elementary level continued its long hold on organized knowledge” (Bybee & DeBoer, 1994, p. 364).

Although knowledge was the primary goal of elementary science in the 19th century, into the 20th century, scholars weighed in on the debate shifting the focus between the learning of scientific knowledge/facts, the utilization of scientific process for knowledge acquisition, the application of the scientific method to raw data, and science learning for personal/social development (Bybee & DeBoer, 1994). Contemporary reform recognizes the importance of scientific literacy for personal/social development, but the debate will continue as long as society continues to evolve. What is important to take from this historical analysis is that scholars all agree that there is indeed a need for elementary science education (DeBoer, 2006).

**Why Do We Need Elementary Science Education?**

The elementary school years are considered to be critical for the development of positive attitudes towards science (Mechling, 1983; Nelson & Landel, 2007; NRC, 1996; Shapiro, 1994; Victor & Kellough, 2000). These years lay the foundation for more sophisticated understandings in science, nurturing the natural curiosity inherent in young children as they ask questions, touch, make connections, observe, and reason to make sense of their world (Harlen, 2000; McElroy, 2008; Mulholland & Wallace, 2005; Victor & Kellough, 2000). “Curiosity, while important for all learning, is particularly so for learning science since it leads children forward into new experiences and so is essential for learning from exploration of things around” (Harlen, 2000, p. 46). Harlen goes on to say that although the curiosity children display is often immature and varies greatly, it must be nurtured and legitimated as to develop into mature curiosity—that is, learning for understanding.

The nurturing of a child’s natural curiosity has been recognized as one of the primary reasons for engaging children in science. However, researchers have identified other reasons why science should be taught in elementary classrooms:

- It helps to develop important communication skills (Harlen, 2000).
- It provides the opportunity to apply mathematics principles (Mechling & Oliver, 1982).
• It allows children to learn and refine their ability to use science processes and learn scientific concepts (Gallenstein, 2005).
• It can help children meet their personal needs of health and wellness (Mechling & Oliver, 1982).
• It provides the experiential, conceptual, and attitudinal foundation for future learning in science through inquiry (Plevyak, 2007).
• It develops skills necessary for survival in the real world (Victor & Kellough, 2000).
• It allows students to develop skills for effective and productive group collaboration (Baines, Blatchford, & Chowne, 2007).
• It informs children of the many career choices in science that are available to them (Victor & Kellough, 2000).

These are just a few of the reasons why engaging elementary students in science is considered to be so important. The argument is that scientific literacy in our youth cannot be accomplished if we wait to teach science when students are in middle and high school (Nelson & Landel, 2007). Elementary science builds “a foundation of small ideas that help children to understand things in their immediate environment… [and] make links between different experiences and ideas to build bigger ideas” (Harlen, 2000, p.12). Further, “the attitudes and values established toward science in the early years will shape a person's development of scientific literacy as an adult” (NRC, 1996, p. 122). Given its importance, it becomes important to ask, “What is the current state of elementary science in today’s schools?”

**Current State of Elementary Science Education**

It is well documented that very little science is being taught in elementary classrooms (Fulp, 2002; Perlstein, 2004; Raizen & Michelsohn, 1994). When it is taught, it is often teacher-centered, textbook-driven, short in duration, and varies depending on the comfort level and interest of the teacher (Dickinson et al., 1997; Fulp, 2002; Mulholland & Wallace, 2005; Sandall, 2003). What is even more dispiriting about these findings is that not much has changed in elementary science since the 19th century (Bybee & DeBoer, 1994; U. S. Department of Education, 2002), with many of these same issues.
affecting what science is taught, how much is taught, and how it is conveyed to students. Although elementary science programs have seen an increase in informal science experiences for elementary students (Cox-Petersen, Marsh, Kisiel, & Melber, 2003; Mortenson & Smart, 2007) and a concerted effort in many school districts and schools to engage elementary teachers in sustained professional development programs (Banilower et al., 2005; Posnanski, 2002; Shymansky, Yore & Anderson, 2004), science instruction in elementary classrooms is frequently traditional, static, and under the strict control of an often uncomfortable teacher. Some may argue that reform over time has been successful, considering the 2003 results of the Trends in International Mathematics and Science Study (TIMSS), which indicates that 4th grade students in the United States, with a means score of 536, averaged 47 points higher than the international average of 489 in science (Biological Sciences Curriculum Study, 2005). As we await the 2007 TIMSS results, how can we understand these gains when research shows that teachers are not devoting a great deal of academic time to science?

Recent studies in education in general and elementary classrooms in particular indicate that school accountability has created a culture of “teach the test”—a culture that may help to increase science test scores, but does so through test strategizing and the memorization of facts. Clearly, this approach is counter to the ideals set forth in current reform initiatives (Charles, 2002; King, Shumow, & Lietz, 2001; Lee & Housal, 2003; Sivertsen, 1993; Trepanier-Street, McNair, & Donegan, 2001; NRC, 1996; Wideen et al., 1997). So what then is the current state of elementary science education? Does national survey data and research in elementary classrooms tell a different story?

As one would imagine, scores on science assessments vary a great deal nationally. According to Kids Count, a database that provides state-level data for America’s schools, when assessed in 2005, 55% of the fourth graders in Mississippi scored below basic science level (most nationally) and 17% of the 4th graders in New Hampshire scored below basic science level (least nationally) (Kids Count, 2006). In Florida, 32% of 4th grade students scored below basic proficiency in science. Although scores were not available for eight states because science assessment data was not available, the results show that there are a significant number of elementary students nationally who are not
performing at the basic level in science, with a national average of 34%, up 4% from 2000.

In Florida, where this study was conducted, the state average science score for 5th grade students was 310, up from the 2005 – 2006 score of 306 (FLDOE, n.d.b). The state science FCAT average in elementary school for students scoring at Level 3 and above was 43%, up one percent from last year. In the county where this investigation was conducted, the average mean scale score for students was below the state average.

In addition to assessment data, the level of teaching self-efficacy may provide further insight into the current state of elementary science. As previously discussed, teachers are spending far less time engaging students in meaningful science experiences when compared to the time spent teaching reading and other disciplines. This may be directly related to self-efficacy “beliefs in one’s capabilities to organize and execute the courses of action required to produce given attainments” (Bandura, 1997, p. 3). Low science teaching efficacy is characterized by teacher-directed, authoritative instruction that is often textbook-driven (Lee & Housal, 2003). In contrast, teachers who have a high science teaching efficacy are more resourceful, use inquiry more often, consider the prior knowledge of students, engage students in argumentation through “science talk,” are less dependent upon seatwork as a classroom management deterrent, attend to equity issues, and are comfortable with cooperative learning groups (Haney, Lumpe, Czerniak, & Egan, 2002; Lee & Housal, 2003; Mulholland & Wallace, 2005; Varelas, Pappas, Kane, Arsenault, Hankes, & Cowan, 2008).

Engaging in long-term professional development can enhance teacher science efficacy, as was the case with Dickinson and her colleagues (1997). These researchers and teachers formed a support group as they worked to match their personal goals for science reform with those of reform documents. Meeting two hours a week for two years, they increased their self-efficacy in science, building content knowledge, experimented with diverse implementation strategies, and reflected collectively and individually. Long-term professional development has a positive impact on elementary teachers when the emphasis of the program is the transformation of teacher conceptions about scientific inquiry, the nature of science, and their use of inquiry as an instructional tool. Long-term professional development helps to build confidence and provides
opportunities for teachers to dialogue, process, and internalize new ideas and ways of thinking; participate fully in the learning experiences; function as “members of the science education community” (Akerson & Hanuscin, 2007, p. 658); participate confidently in national conferences; and share their knowledge and conception with colleagues.

Efforts to teach for scientific literacy must begin in elementary classrooms through quality instruction. Many teachers express the importance of the elementary science experience for all students and recognize the benefit of engaging students in inquiry-based, open-ended science experiences (Dickinson et al., 1997; Lee et al., 2004; Spillane et al., 2001). Teachers also recognize that early science experiences help children develop problem-solving skills and motivate them toward a lifelong interest in issues of scientific importance. Despite these admissions, researchers have identified contextual barriers that negatively influence the work that elementary teachers do.

**Barriers to Teaching Elementary Science**

**Inadequate Science Resources.** Science reform stresses the importance of teaching science inductively—experiences that engage students in deep learning through critical thinking, problem solving, questioning, and exploration (AAAS, 1989; NRC, 1996). In such a learning environment, resources, both physical and teaching activities, are critical to lesson execution and student learning. The lack of resources, teachers argue, influences what science they teach, how it is taught, and the depth in which students learn it (Loucks-Horsley et al., 2003; Yore, Henriques, Crawford, Smith, Gomez-Zwiep, & Tillotson, 2008). In a study of beginning elementary science teachers, Appleton and Kindt (2002) indicate that when science resources are inadequate or unavailable, it affects the perception that elementary teachers have of themselves as science teachers and their perception of the value afforded to science by the school district, school administrators, and other teachers. More importantly, teachers acknowledge that the availability (or lack of availability) of resources limit the topics they teach, the “selection of teaching strategies and activities and by default encourages them to work within a personally comfortable teaching zone” (Appleton & Kindt, 2002, p. 53).

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**Insufficient Planning Time.** Science, like all other academic subjects, requires a great deal of time to prepare quality lessons. From gauging students’ prior knowledge on the topic to gathering and organizing materials to structuring the lesson, sufficient time is needed to plan effectively (Dickinson et al., 1997; Yore et al., 2008)). On average, elementary teachers have between one and three hours for planning each week (8.3 minutes for every hour in the classroom) (Darling-Hammond, 1999). In addition, teachers spend between 10 to 15 hours per week planning and preparing lessons outside of school, “as opposed to the in-school time of teachers in other countries that is spent primarily in collaborative planning and learning” (p. 34).

When teachers feel as if they have not had time to plan quality lessons, they often resort to worksheets, teacher-centered lessons from textbooks, and “cookbook” investigations. As a result, students are not provided the opportunity to engage in science investigations that develop higher-order thinking processes and scientific habits of mind. Teachers need sufficient time to plan individually and collaboratively, reflect on lessons in supportive environments, and “bounce ideas” off of others (Appleton & Kindt, 2002). What science educators do know is that when sufficient time is invested into planning science lessons, the return is the increased effectiveness of science teachers and quality lessons that encourage hands-on and minds on learning (Dickinson et al., 1997; Radford, 1998).

**Teacher Attitude.** As previously mentioned, many elementary teachers recognize the importance of engaging students in science. Yet there are others who do not enjoy teaching science, therefore lack the commitment needed to teach in reform-minded ways (Briscoe & Peters, 1997). “For a number of teachers, science [is seen as] a second order curriculum priority, with subjects like language and mathematics assuming highest priority” (Appleton & Kindt, 2000, p. 51). According to Bencze and Hodson (1999) and Munck (2007), the attitudes and beliefs that elementary science teachers have about the teaching and learning of science are often manifested in their actions. They often mask their unfavorable disposition by teaching as little science as possible, teaching within their comfort zone, and over-utilizing expository teaching methods. Bencze and Hodson (1999) further elucidates that “Little imagination is needed to appreciate how
these strategies [those mentioned above] will impact negatively on children’s science education experiences” (p. 524), a fate that science educators are attempting to avoid.

In order to change the unfavorable attitudes that elementary teachers have about science, they must engage in long-term professional development in which beliefs are challenged and new instructional approaches are learned (Jarvis & Pell, 2004; Jones & Carter, 2007). McGinnis, Parker, and Graeber (2004) report that change may be easier and more attainable at the elementary level as both elementary and middle school teachers report that the elementary culture is more nurturing and supportive in the midst of reform.

**Teacher Preparation.** There are countless studies and research documents that indicate that the lack of content knowledge and pedagogical content knowledge influence a teacher’s ability to design and implement effective science lessons. Not only does the lack of content knowledge and pedagogical content knowledge inhibit conceptual change, create an over-reliance on didactic and rote learning, and restrict curriculum choices, they also cause teachers to lack confidence in their ability (Appleton & Kindt, 2002; Briscoe & Peters, 1997; Dickinson et al., 1997; Haney et al., 2002; Kelly & Staver, 2004; Lee et al., 2004; Mechling & Oliver, 1982; Radford 1998). Because most elementary teachers already feel unqualified to teach science (Fulp, 2002), they often go through each year teaching less science and engaging in even fewer professional development activities to improve their ability. When teachers feel unprepared, they often rely on textbook publishers to determine the curriculum, very rarely deviating beyond their personal comfort zone. Further, when teachers feel unprepared, even when resources are available to teach science, they often do not know how to incorporate them effectively into science lessons (Bencze & Hodson, 1999; Gess-Newsome, Southerland, Johnston, & Woodbury, 2003).

**High-Stakes Testing and Accountability.** Many elementary teachers would agree that preparing students to reach levels of proficiency on standardized assessments is a primary concern expressed by many school leaders today. They would also agree that the aggressive effort waged by school leaders, particularly in the areas of reading and mathematics, leaves very little time to engage students in science instruction, let alone reform-minded science instruction. Consequently, “science instruction tends to be of low
quality” (Banilower et al., 2007, p. 390) and in many cases the sole purpose for this instruction is posting a grade for the week. Even more daunting is the fact that some school leaders promote such an intentional disregard where science is concerned. While reporting on Montgomery County’s fervent effort to raise the test scores of struggling students, the superintendent, John Weast reveals, “Once they [students] learn the fundamentals of reading, writing, and math, they can pick up science…on the double-quick…You’re not going to be a scientist if you can’t read” (Perlstein, 2004, ¶ 10). And although elementary school curricula may be diluted, streamlined, and irrefutably stifled because of leadership decision based on inaccurate perceptions such as those held by Weast, the fingers of politicians, parents, and laypersons are often pointed at classroom teachers when students fail to make adequate progress (Sarason, 1995).

Although teachers inherently recognize that learning science will contribute to the development of the whole child, the potential backlash when students do not make AYP has left schools frantic and one-dimensional in their plight to meet the demands of accountability (Marx & Harris, 2006; Pringle & Martin, 2005). The pressure (often punitive) to raise assessment scores of low performers, forces teachers, either by imposition from the principal, district leaders, or simply because of their own fear of disciplinary action, to teach and reteach those concepts that will be assessed and expose students to common test-taking strategies. Because failing schools and low student performance is deemed to be the result of incompetent and ineffective teaching, teachers, disempowered and disheartened, conform or go to extremes to protect their livelihood. Unfortunately, tests do not fully represent students’ capabilities, particularly struggling students, a reality that demoralizes teachers amidst a barrage of often harsh criticism (Settlage & Meadows, 2002).

**Lack of Principal Leadership.** In elementary schools, a principal’s leadership through the process of reform is recognized as very important. Spillane and his colleagues (2001) find this to be the case. In their study of an urban school mobilizing resources to improve the teaching and learning of science, the principal’s leadership through the process of change is found to be the key to its success. Not only did the principal provide monetary support for resources and professional growth activities, she supports instructional innovation and took on “the role of instructional leader. [She also]
emphasized the articulation, development, and implementation of curricula and became a catalyst for the staff to develop curricula that supported the school’s goals and philosophy” (p. 928). Three other studies find that principals influence teachers as they seek to reform their practice. Kelly and Staver (2005) find that as a school district adopts and implements a new science program, principals’ support and leadership for the new program is positive, but is “not sufficient to facilitate full implementation…” (p. 44). Similarly, Supovitz and Turner (2000), examining the effects of professional development on the extent to which teachers’ utilize inquiry-based science practices, discovers that teachers with principal support report a greater use of reform-minded practices than did those teachers who did not feel supported by their principal. In another study aimed at systemic science reform, teachers perceive a principal’s lack of involvement and lack of knowledge of the science program being implemented to be a constraining force (Harwell, 2000). The author goes on to say that it is only when those elements perceived as “constraining forces are alleviated and a more supportive environment grows…” (p. 18) will successful implementation of reform take place.

Teachers need the support and leadership of their principal as they attempt to change their practice (Banilower et al., 2007; Johnson, 2007b; Sloan, 1993). In a study of the potential effect of professional development on the alignment of instructional practices with the vision espoused in reform documents, Banilower and his colleagues (2007) indicate that “teachers more frequently use the designated instructional materials when they feel supported by their principal to implement science education reform” (p. 386). Similarly, in her dissertation research on elementary principals’ perspectives on their support for elementary science, Hanegan (2001) argues that principal support is a necessary element in a teacher’s willingness to employ reform-minded and innovative instructional practices. Although the level of support varied depending on the principals’ leadership style, school context, and science background, the principals in Hanegan’s study perceive their support to be integral to the success of the science program. Recognizing the importance of her support, one principal reveals that if she did not show that science was indeed a priority, teachers would also place less emphasis on its implementation. Encouragement and assistance from other teachers is necessary and encouraged, but by the mere nature of the position, principals can make structural
changes (such as release time for professional development activities, change schedules, find funds for resources, etc.), things that others on staff often times cannot do (AAAS, 1990; Dickinson et al., 1997; Fullan, 2002; Hanegan, 2001; Hoy, 2003; Sheppard, 2003; Spillane et al., 2001; Vesilind & Jones, 1998).

Teachers perceive many elements (such as materials, planning time, teacher preparation, high-stakes testing, administrative support, etc.) as barriers to the teaching of science as described in reforms. Because of teachers’ quick recognition of these barriers, their students are deprived of the joy, experiences with science, and conceptual development that is possible when students experience science in ways described in reform documents. How then can reform be enacted in elementary science classrooms such that teachers develop positive attitudes and greater confidence in their ability to effectively teach science?

Much of educational research currently views the teacher as the most essential feature in school change (NRC, 1996; Glickman, 2002; Levitt, 2001; Mechling & Oliver, 1982; Woodbury & Gess-Newsome, 2002). But, Woodbury and Gess-Newsome (2002) caution “that past failures of many attempted reforms can often be explained by reformers’ lack of attention to the support systems that surround a desired change” (p. 774). How then can teachers be supported through the process of change and begin to teach science in reform-minded ways?

**Change: The External and Internal Challenges**

**Reforming Science Education: The Contradictions of Change**

Many argue that changes in science education have been minor and, despite repeated attempts at reform, changes in educational practices have not been sustained. According to Woodbury and Gess-Newsome (2000), “Being “in school” today is fundamentally the same as it was 100 years ago” (p. 765). As one tries to understand how, despite large and small-scale efforts to reform science education, reform attempts have resulted in very little noticeable difference over the past 40 years, understanding this paradox of “change without difference” (Goodman, 1995, p. 1; Woodbury & Gess-Newsome, 2002, p.765) is essential.
In the article, *Change without Difference: School Restructuring in Historical Perspective*, Goodman (1995) discusses how, amidst the “third wave” school reform movement, change has not necessarily translated into improvement. He theorizes that reform initiatives have not had a profound affect on how schools operate and the instructional practices that are employed, because the communal discourse 1) “actually reinforces the basic values upon which conventional education is based” (p. 2). Five years later, Woodbury and Gess-Newsome in *Overcoming the Paradox of Change Without Difference: A Model of Change in the Arena of Fundamental School Reform*, identifies four additional explanations for what many researchers in science education would characterize as much of the same: 2) a disregard for the functioning system 3) change that focuses primarily on school structures 4) the type and enormity of change that is attempted, and 5) teachers’ beliefs as it relates to the internalization and implementation of change being proposed.

**(1) Conventional Views Personified in Contemporary Schools.** The taken-for-granted notion embedded in the word “change” is that substantive improvements will naturally occur once a decision has been made to change the way schools currently operate. However, researchers caution that a decision to change does not necessarily imply things will improve or progress will be made (Cuban, 1990; Goodman, 1995; Sarason, 1996; Tyack & Cuban, 1995). Toward these efforts to “change” traditional notions and practices in science, to date, education in America has undergone three “waves” of reform. Despite the existence of three distinctive movements aimed at improving American education, the underlying notions on which schools and schooling was premised in Wave I—The Progressive Movement—can clearly be identified in schools today.

According to Goodman (1995), education in Wave I was concerned with social functionalism—meeting the immediate needs and commercial interest of society; efficiency and productivity—raising the productive capacity of schools, hence increasing subject matter quantity; individualism—schooling for self-interest as opposed to the common good of society, and expertism—the notion that schools are to develop specialist or field experts. Goodman (1995) contends, “The problem with schools is that they are designed for the industrial age that emerged in the early years of this [20th] century, and
no longer adequately serve the current or future educational needs of the nation” (p. 4). Therefore, he asserts that schools today must have ideological commitments that are holistic and go beyond the surface, hence initiating reform that truly changes how schools function.

(2) Looking in the “System” Amidst Change. Although there are many social systems that are throttled by the comfort that lies in tradition, schools are perhaps the largest and most ubiquitous. Many researchers would argue that this is because change by its mere nature is a difficult feat (Briscoe & Peters, 1997; Davis, 2003; Fullan, 2000; Hohn, n.d.; Yerrick, Parke, & Nugent, 1997). I would not disagree with this contention. I would however venture to say that in addition, considering the barrage of programs and innovations that are introduced and discontinued daily, quarterly, and yearly in schools, “tradition” in terms of how teachers teach (e.g., didactic, lecture-based, individual learning, etc) and how schools operate systematically is one of the few constants today, traversing time and space (Brooks, 2006).

But if schools are to prepare students for the complexities of an evolving society, earnest efforts must be made to change how schools function. However, schools are “highly complicated and highly organized social systems” (Sarason, 1995, p. 78) that do not simply consist of administrators, teachers, students, counselors, support personnel, and parents. They too consist of structural and cultural arrangements and systems within larger social systems. Further, schools function within policy and legislative regulations that are instituted outside of the system, but directly influence what happens on the inside of the system. Looking at the system holistically, one may begin to understand that change in one part of the system necessitates changes in its many interconnected parts (Gee & Gabel, 1996).

Sarason posits, “Innovations or changes [in schools] practically never reflect the initiatives of teachers but rather come from the highest level of administration” (1995, p. 82). Thus, teachers, those who are responsible for implementing change, merely act as passive implementers. However, those who are responsible for directly implementing change cannot be the “convenient objects of criticism (from within as well as without the system) in regard to policies and programs which are not of their making” (Sarason, 1995, p. 82). Schools are very dynamic systems consisting of formal and informal
networks that interact with and are influenced by, politicians, independent agencies, and interest groups that often have self-serving and/or political agendas. As such, change often trickles (or floods) down from hierarchal structures and/or persons outside of the school, as an antidote for societal and economic ills (Cuban, 2003; Tyack & Cuban, 1995), with little regard for those charged with implementing change and the existing school culture. The school culture consists of theories, ideas, principles, standards, guidelines, rituals, inertias, habits and practices—ways of doing and thinking, mentalities and behavior, settled over time into the shape of traditions, customs and ground rules, unquestioned and shared by the actors within the body of the education institutions. These traditions, customs and ground rules are passed on from generation to generation and provide strategies for integration into said institutions, to interact and carry out, especially in classrooms, the daily tasks expected of everyone, as well as to face the demands and limitations that these tasks imply or entail (Viñaño, 2001, p. 32).

These are cherished institutional norms that cannot be easily forsaken for what many teachers consider to be the newest “fly-by-night” innovation.

Reformers must recognize that educational change is not a linear process wherein schools will automatically implement the proposed initiatives. This is a naïve standpoint. “In practice, schools and school systems are authoritarian social systems in which their “proletariat” (teachers) [often] overtly conform to what is expected of them but covertly resent their lack of power” (Sarason, 1995, p. 82). If school change is to be effective, one must begin to understand the complex nature of changing a system that has so many interconnected parts; a school culture that influences teachers’ thinking and classroom practices; and individual as well as shared beliefs structures that make all schools similar, albeit unique. Mandating changes from the top down fails to recognize that in an interconnected system, changes in other parts of the system are needed as well.

However, as researchers have noted (Cuban, 2003; Rativch, 2000; Sarason, 1995; Sarason, 1996; Tyack & Cuban, 1995), when the success or failure of school change is holistically ascribed to what schools are not doing or are not doing right, ignoring the difficulty embedded in the change process and the reshaping of school culture, school reform will continue to make “superficial scratch[es]” (Viñaño, 2001, p. 33).
Science education has embarked upon a large-scale reform that seeks to change how science is taught by teachers, learned by students, and experienced by both (AAAS, 1990; Bybee & DeBoer, 1994; Lawton, Berns, & Sandler, 2009; NRC, 1996). Such reform efforts necessitate that those structural and cultural contexts in which teachers work must be altered to meet the goals of reform. With both contexts combining to shape and influence the behaviors of teachers who work in them; consequently, both must change.

Within the paradox of change without difference, Woodbury and Gess-Newsome (2002) define structures and cultures of schools.

Structures of school settings are factors such as physical layout of building and space, students and staff demographics, core curricula, mandated assessments and evaluations, textbooks and teaching materials, technology availability and use, and budget. Structures of school settings also include grade level(s), departments or other teaching teams, the type of school (e.g. elementary, secondary, magnet, or high school), and governance systems at the local, district, and/or state level…Culture of teaching are teachers’ and administrators’ taken-as-shared sentiments, habits of mind, and patterns of interaction and behavior. (p.765, 766)

Examining the process of reform a bit closer, Elmore (1995) explains that reformers most often channel their energies into changing structures, for example the school’s schedule, but have no clear vision of what this means for teaching. “To them, it is obvious that changing the schedule would lead to a different kind of teaching, but it…[isn’t] necessarily obvious what kind of teaching that might be…It is not obvious in other words, that changes in teaching practice follow from changes in structures” (p. 23, 24). One commentary offered by a classroom teacher on such a change in structure was, “Oh good, now I can show the whole movie” (p. 23-24), a sentiment that clearly shows that teachers may not know how to use the additional instructional time to teach something more in depth, to teach something differently, or for students to engage differently. What Elmore concludes is that reformers target structures because considering some of the alternatives (i.e. replace the entire staff, close schools rezoning students, etc.), changing structures is easy.
Reform undoubtedly requires that a number of interconnected structural and cultural systems must change in order for the efforts of reform to be sustained long-term. And even when structural and cultural conditions are mediated, attempts at reform can be derailed by other intersecting factors. Gess-Newsome and her colleagues (2003) find this to be the case in their study of university science professors. Funded by the National Science Foundation (NSF), the researchers observed three professors as they planned and taught a course using what can be termed reformed-based teaching practices. The findings indicate that the NSF grant eliminated “many of the structures that typically bar fundamental reform in science classrooms…[But] a grant-supported mitigation of structural barriers is a necessary but insufficient precursor to change” (p. 731, 757). Individual teachers’ personal practical theories (i.e., teacher thinking, teacher beliefs, and instructional goals) are found to “both shape and constrain teachers’ interaction with reform” (p. 758).

Clearly, reform efforts cannot continue to be one-sided and only attend to the structural barriers of reform. A more concentrated and balanced effort must be made to support teachers as cultural elements of the contexts’ in which teachers work change as well. In doing so, the context would be one in which teachers will have the time and support needed to reevaluate the personal and practical theories at the core of their teaching; a process that challenges entrenched belief constructs. One of the implications identified by Elmore (1995) hinges on the notion that reform might focus first on changing norms, knowledge, and skills at the individual and organizational level before they focus on changing structures. That is, teachers might actually learn to teach differently and develop shared expectations and beliefs about what good teaching is, and then invent the organizational structures that go with those shared skills, expectations, and beliefs. (p. 26)

For example, this may be accomplished through weekly or biweekly whole school or grade level professional development meetings where teachers work collaborative to improve science knowledge and pedagogical practices, implementing and debriefing about the triumphs and challenges on an ongoing basis (Antosz, Boyd, & Clauset, 2005; Lick, 2000). Elmore suggests a more balanced approach (focusing equally on changing
structures as well as individual and organizational norms), a position that may be a feasible proposition to alter the paradox of change without difference.

(4) The Intent of Change Efforts. As history has told us, there have been many attempts made to change how schools function. It has also told us that despite the many attempts made, fundamental changes have not been sustained. As Sarason (1995, 1996) and Woodbury and Gess-Newsome (2002) note, the foundation of schools lies in the cultural norms and tacit understandings that create a shared vision, patterns of engagement, and professional relationships. Such an ensconced sense of connectedness, if ignored, makes instituting change difficult and sustaining it virtually impossible. However, school cultures and the institutional norms that make them unique may not be the aim of reform efforts. This is because school reform can seek either first order or second order changes (Southerland et al., 2007). In this section, Florida’s education plan and the Curriculum Reform Movement in science are used to differentiate between the two.

An attempt to change how schools operate in Florida was legislated in the A+ Plan for Education that was instituted in 1999 by Governor Jeb Bush and carried on by current governor Charlie Crist.

The A+ plan for education has three major parts - one addressing accountability and improving student learning, one to raise standards and improve training for educators, and one to improve school safety and reduce truancy…The legislation includes real changes that have one thing in common; they are all designed to improve student learning. Improving student learning will become the test by which we should measure education policy. (FLDOE, n.d.a, ¶ 2)

The primary mode of carrying out this vision is by amending policies and government regulation (George, 2001; Goldhaber & Hannaway, 2004; Smith, 2008). These regulations make available K-12 funds; introduce higher standards and more rigorous student outcome measures; grades schools based on student achievement data; and provide monetary bonuses for high achieving schools.

This approach to school change does not look to change how schools function, but rather assumes that the existing “structures of schooling are adequate and desirable” (Woodbury & Gess-Newsome, 2002, p. 769). This effort presupposes that what is
needed are “tweaks” or minor adjustments to the existing goals and structures that are currently in place in order to increase student achievement. Examining Florida’s attempt to improve the academic achievement of students through the lens of reform, researchers would term the goals of this effort as first order or ameliorative change (Goodman, 1995; Southerland et al., 2007; Woodbury & Gess-Newsome, 2002).

First-order changes try to make what already exists more efficient and more effective, without disrupting the basic organizational features, without substantially altering the ways in which adults and children perform their roles…(Cuban cited in Goodman, 1995, p. 3). Basic values and power relationships within the institution are not examined as part of the change effort.

(Goodman, 1995, p. 2)

Such reforms include single-grade classrooms, updating textbooks, self-contained classrooms, utilization of worksheets, standardized testing, and the infusion of innovative programs. Conceptualized as a quality control issue (Woodbury & Gess-Newsome, 2002), the impetus for first order changes are that policies, practices, and overall operations are seen as deficient and in need of improvement, while the system as a whole is seen as functioning as intended.

In contrast, second order or radical reform efforts “confront the cultural and pedagogical traditions and beliefs that underlie current practices and organizational arrangements” (Goodman, 1995, p. 2). Change of this magnitude is conceived of as being transformative, “alter[ing] the fundamental ways in which organizations are put together…[and introducing] new goals, structures and roles that transform familiar ways of doing things into new ways of solving persistent problems” (Cuban 1990, p. 73). Changes that call for solutions to design problems such as, a reconceptualized vision of the instructional programs, cultural and structural changes within schools, and shifts in power relations, are much more difficult to carry out, because they call for changes at all levels of the system (Gee & Gabel, 1996). A most notable second order change effort in science education discussed earlier is the Curriculum Reform Movement. Although unsuccessful by all accounts, the goals of the Curriculum reform Movement were fundamentally different from the goals of the previous era and required large conceptual shifts at all level of the system.
Although current reforms in science education envisions second order changes (Woodbury & Gess-Newsome, 2002), efforts have rarely resulted in anything beyond first or ameliorative changes. However, with the development and implementation of Project 2061 and NSES, science education reformers seek to radically change how science is done, thought about, structured, and organized through second order change efforts. However, the second order changes that the science education community is pushing, exists within a context of exhaustive and ambitious first order changes of NCLB. Therefore, if change is to be sustained, reform efforts must move beyond making existing practices more efficient and effective and begin to “confront the cultural and pedagogical traditions and beliefs that underlie current practices and organizational arrangements” (Goodman, 1995, p. 2).

Making the distinction between first and second order changes provided a means of classifying the types of changes that were being implemented by the school and as suggested by the district. Consequently, I was able to examine the subsequent affect of the changes put into practice in the science program through first and second order lens.

(5) Teachers’ Belief: Internalizing and Implementing Change. Classroom teachers are recognized as central to the successful implementation of science education reform (NSES, 1996; Mechling & Oliver, 1982). This is not because other persons such as school administrators, parents, politicians, and scholars or other factors such as the curricula, textbooks, and policies do not aid in the enactment of reform; they most certainly do. The success of science education reform is dependent upon the ability of teachers to develop an understanding of the reform initiatives being promoted; internalize and fuse this understanding into their existing professional schemas; and implement it in a manner that is consistent with the intent of reform (Charles & Cummings, 2001; Dass, 1997; Keys, 2007; van Driel et al., 2001). As stated by Levitt (2001), “The success of current programs of science education reform depends on teachers’ ability to integrate the philosophy and practices of current programs of science education reform with their existing philosophy, extant practices, and established district models, without compromising the intent of the new science program” (p. 1).

Teachers’ implementation of reform is quite often unpredictable, “fickle,” and without a pattern. Researchers have concluded that this uncertainty and seemingly
capriciousness is because the messages of reform are not simply conveyed to teachers and then mindlessly translated into images that are consistent with reform intent (Czerniak & Lumpe, 1995; Haney et al., 2002; Keys, 2007; Kang, 2008; King et al., 2001; Levitt, 2001; Lumpe, Haney, & Czerniak, 2000; Roehrig, Kruse, & Kern, 2007; van Driel et al., 2001; Yerrick et al., 1997). Instead, reform initiatives are filtered by teachers through intricate and often convoluted mental constructs that constitute teachers’ beliefs about science, how children learn, and how science should be taught and learned (Davis, 2003; Keys, 2007; Pajares, 1992; Yerrick et al., 1997).

There is a considerable body of literature that looks at teacher beliefs and the influence they have on the way teachers plan to teach science, what they choose to teach (or not to teach), and decisions that they make while teaching (e.g., Bryan, 1998; Czerniak & Lumpe, 1995; Jones & Carter, 2007; Keys, 2007; Lumpe et al., 2000; Pajares, 1992; Yerrick et al., 1997; Wee, Shepardson, Fast, & Harbor, 2007). Snider and Roehl (2007) also point out in their review of the literature that, teacher belief constructs are so multifaceted that instructional commitments vary between grade levels (e.g., elementary and high school teachers) and across academic disciplines (e.g., English and Science). The intent at this juncture is not to thoroughly examine the varied streams of research that exist in this area. Rather, my focus here is to briefly examine teachers’ beliefs as it relates to their ability to impede or assist in efforts to reform science education, considering “beliefs are the best indicators of decisions individuals make through their lives” (Pajares, 1992, p. 307).

As Pajares (1992) avows, understanding teacher beliefs is a “messy” (p. 329) undertaking. Empirically, researchers have had little success determining where “knowledge ends and belief began” (p. 309). Not only have researchers experienced difficulty in defining the construct of beliefs, two distinct groups have emerged: 1) those who have etched a lucid boundary that divorces beliefs from knowledge, and 2) those who see the line between beliefs and knowledge as blurred, making a dissociation impossible (Southerland, Sinatra, & Matthews, 2001). This debate continues to fester in philosophical and educational circles around the globe, with consensus far from being reached. However, teacher education researchers have found that teachers think and speak about their practice subjectively from personal convictions (considered beliefs), as
well as empirically based on their experience (considered knowledge). But “teacher thinking researchers in science education tend to use the term beliefs to refer to both constructs [knowledge and beliefs]” (Southerland et al., 2001, p. 347).

Researchers agree that beliefs influence what teachers’ think, say, do, and intend to do in their classrooms, as well as influence how they translate the curriculum into practice (Davis, 2003; Elmore, 1995; Pajares, 1992; van Driel et al., 2001). These beliefs are solidified through teachers’ K–12 experience and teacher education programs, as teachers craft what they (and others they have observed) consider to be effective teaching practices, behaviors, and dispositions (Tobin, Tippin, & Gallard, 1994). Therefore, if current science education reform initiatives are to have long-term effects, efforts should focus in part on building upon what teachers believe about the nature of teaching and learning.

Historically attempts at science education reform have expended very little energy identifying, understanding, and altering teachers’ beliefs during reform. Most of the effort has gone into instituting new policies/procedures, reconceptualizing the vision, developing new curricula, redesigning or developing assessment instruments that reflect the new vision, crafting “innovative” instructional materials, and increasing accountability measures (Fullan, 2000; Goldhaber & Hannaway, 2004; Johnson, 2007a; Sarason, 1996). Fullan (2000) laments that large-scale reform often generates surface level changes (first order changes), particular instructional artifacts, with no “change in practice or beliefs” (p. 23). But reform efforts must begin to challenge those ingrained beliefs that guide practice. How then can this be accomplished?

“Change is hard” (Davis, 2003, p. 5) and it is for this reason that in order for change to be sustained, teachers’ beliefs must be at the core of reform initiatives, challenging their beliefs incessantly. This challenge can happen in a variety of contexts (i.e., classrooms, professional development inservices/workshops, teacher preparations programs, college courses, community learning groups, etc.). But of particular importance in any of these situations is that teachers are immersed in long-term professional development, as to provide a forum for teachers “to make beliefs explicit... provid[ing] them with a context to examine, critique, and weave new ideas into their existing constructs” (Dickinson et al., 1997, p. 6). In cases were sustained
professional development is not provided or inadequate, teachers revert back to more conventional and teacher-centered modes of science instruction (Johnson, 2007b; Posnanski, 2002).

The notion of reform of teachers’ beliefs at first may appear to be a simplistic undertaking. But Fullan (2000) warns us that it is not as easy as it appears. Beliefs are reinforced through experiences and filtered through an internal system of checks and balances, making them “highly resistant to change” (Pajares, 1992, p. 317). It is for this very reason that “teachers’ beliefs about teaching must not continue to be ignored if…[reform] recommendations will result in enduring change in the classroom” (Lumpe et al., 2000, p. 276).

In the past, the aforementioned paradoxes have lead to reform efforts that have had marginal effects at best and considered by others as unsuccessful. How then do we reconcile the fractured view of a system of education that seeks change, but is often disheartened by the predictability of the outcome? How has the science education community attempted to reform science such that efforts have lasting effects on classroom practices?

**Did We Learn from Past Science Education Reform?**

Does reform in science education today differ considerably from reform efforts attempted in the past? Depending on whom you ask, the answer to this question can vary, depending on individual or group perspective. Consequently, as indicated in the previous section, many of these efforts have not produced the desired results; hence Woodbury and Gess Newsome’s (2002) “paradox of change without difference.” Despite the lackluster efforts of the past, science education reform today seems to have learned from the mishaps of past reform movements, potentially surmounting the paradoxes that have lead to nominal change. The following sections examine how this is being done.

**Paradox I: Conventional Views Personified in Contemporary Schools**

Goodman (1995) proclaims that although American schools have undergone three distinct school restructuring movements, he maintains that the ideals promoted in Wave I—*social functionalism, efficiency and productivity, individualism,* and *expertism*—are still evident today. However, the authors of the *Science for All* movement (AAAS, 1989)
have learned from the mishaps of past reforms attempts, transcending main of the core values that Goodman contends are preventing substantive change from taking place. Table 5 provides a comparative analysis of both movements.

Goodman argues that four core values undergird third wave school restructuring, providing a great contrast between how schools function now—third wave reform—and how they functioned during first wave reform efforts. But as shown in Table 5, science education reform efforts today are looking to make significant changes, reframing how principals, teachers, students, and those intimately involved in the education process do, think about, and work towards scientific literacy.

Table 5 Comparing the Progressive and Science for All Movements

<table>
<thead>
<tr>
<th>Ideologies of the Progressive Movement (Wave I)</th>
<th>Ideologies of the Science for All Movement (Wave III)</th>
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<tbody>
<tr>
<td><strong>Social Functionalism:</strong> Meet the functional needs of a migrant society; prepare the community to be “good workers.”</td>
<td>Scientific literacy for all; preparing all students to understand and helping all students to appreciate scientific discoveries of today to make scientific and informed decisions for tomorrow.</td>
</tr>
<tr>
<td><strong>Efficiency/Productivity:</strong> Produce more goods in less time; create a greater return on the investment of human capital.</td>
<td>Science reformers today are less concerned with production and efficiency subscribing to the fundamental principle that less is more.</td>
</tr>
<tr>
<td><strong>Individualism:</strong> Self-interest is the essential principle upon which society should be based.</td>
<td>Although the portrait of science that we see in many schools today is very individualistic, science education reformers now realize that collaboration is an important element; both in terms of the manpower that is needed to implement change of this magnitude and student collaborative projects.</td>
</tr>
<tr>
<td><strong>Expertism:</strong> Schools seek to develop experts in a particular field.</td>
<td>Science education reform documents acknowledge that science courses are separated into distinct disciplines. This has an advantage: provides a conceptual structure for organizing research and research findings, and a disadvantage: the divisions do not reflect the intersects that exist in the natural world, making communication difficult (AAAS, 1990).</td>
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Paradox II: Looking in the “System” Amidst Change Efforts

Science education reformers today recognize the interplay between the many interacting systems and subsystems that work with and within other larger social systems thereby influencing public education. As depicted in Figure 2, reformers recognize that overlapping systems do not work in isolation, as this representation is a reminder that “actions taken in one system have implications not only for science education but for other systems as well” (NRC, 1996, p. 228).

Figure 2 Overlap of Systems that Influence Science Education

By preparing an elite population of students, Curriculum Reform Movement developers thought that well-crafted curricula would facilitate the United States gaining political freedom, assuring national security, and reclaiming their title as the leader of scientific innovations. In schools informed by the Curriculum Reform Movement, students would advance their knowledge of scientific principles. However, there was still a need for a unified vision and changes in the many interconnected systems that influence the system of education.

Today, science education reformers acknowledge that a “[c]oordination of action among the systems can serve as a powerful source of change” (NRC, 1996, p. 228). This union must reach from the most external systems (college/universities, the judiciary,
professional associations, teacher unions, etc.) to the internal systems within individual schools that consist of knowledgeable communities of learners. This is particularly important for those teachers and principals working in schools—a population that has been overlooked and undervalued in previous reform efforts. As such, effective leadership structures in the many interconnected systems that influence public education must develop an “understanding of the professional, social, and cultural norms of a school” (NRC, 1996, p. 223) that are delicate and must be altered as systems undergo change. Through analyzing past efforts of reform, we now recognize that the distinctiveness and uniqueness of individual schools must be honored during the reform process, because ultimately, schools are responsible for implementing change.

**Paradox III: Educational Change: The Emphasis on Structure**

Reducing the structural constraints that adversely influence teachers has been the aim of many reforms efforts (Elmore, 1995), and the failure of the Curriculum Reform Movement to address structural constraints is thought to be a major cause of its demise. In contrast, science education reform today recognizes the importance of supporting teachers during reform as cultural norms, values, practices, beliefs and interactions are transformed. Indeed, reform documents place great emphasis on supporting teachers through professional development. “The current reform effort requires a substantive change in how science is taught; an equally substantive change is needed in professional development practices” (NRC, 1996, p. 56). To assist in these efforts, internal as well as external support is promoted. For example, internally, schools are encouraged to promote professional growth through collaboration within and between grade levels (Dickinson, et al., 1997); engage in context-specific professional development sessions (Davis, 2003); offer inservices that meet the needs of individual organizations (Dass, n.d.); organize whole-faculty study groups (Antosz, Boyd, & Clauset, 2005; Jolly, 2001); participate in long-term professional development opportunities (Johnson, 2007b); and involve teachers in shared leadership and decision-making (Rinehart, Short, Short, & Eckley, 1998). Externally, professional/networking organizations are in place to support educators during time of reformation (Kelly & Staver, 2005); national centers for science improvement (e.g., The National Center for Improving Science Education) are available.
to provide staff development and curriculum frameworks for school science programs (Bybee & DeBoer, 1994); a national resource database and curriculum materials has been developed for educators to use during curriculum planning (AAAS, 1993); and collaborative ventures with businesses, scientists, educators, politicians, and institutions of high learning are promoted (Dixon & Wilke, 2007; Lynch, 1997; NRC, 1996). Current reform also recognizes the importance of preparing and supporting preservice teachers as they learn to engage students in reform-minded practices (Edgecomb, Britner, McConnaughay, Wolfe, 2008; Scharmann, 2007; Settlage, 2000).

To these ends, reformers have and are continuing to work toward the vision of reform by not only mitigating structural constraints that hamper change efforts, but cultural constraints as well. Changing things such as, textbooks, mandated assessment/evaluation instruments, and school structures is less laborious than changing what teachers believe, practices they employ, and rituals that make individual schools unique. Changing these cultural elements require a long-term investment in the people and the settings in which they work.

**Paradox IV: The Type and Intent of Change**

“Reform goals or intentions play a powerful role in the reform’s ultimate effect” (Woodbury & Gess-Newsome, 2002, p. 768). Generally in education, reform attempts have been first order, seeking only to change components of a system that are viewed as functioning as intended. But previous attempts at science reform were generally first order and science reformers were disenchanted with the outcome and the lack of observable changes in classroom practices. Understanding that another major criticism of the Curriculum Reform Movement was the lack of teacher involvement, reformers set out to articulate a reformulated approach, one that acknowledges the importance and centrality of classroom teachers to reform.

Therefore, reform today recognizes that teachers are pivotal to reform efforts (AAAS, 1990; Davis, 2003; Yerrick et al., 1997) and what they do in their classrooms and their expertise about science teaching and learning is regarded as critical to improving science education. According to AAAS (1990), “Although creative ideas for reforming education come from many sources, only teachers can provide the insight that
emerge from intensive, direct experiences in the classroom itself” (p. 212). This awareness is monumental considering the discount of teacher professional knowledge was a major flaw in previous reform. Therefore, reform not only describes a vision of teaching and learning science in which scientific literacy is available to all students, it also describes a vision for teachers’ growth through life-long engagement in professional development activities; support networks/tools for teachers as familiar habits of mind are transformed; and teacher leadership that effectuates change. The intent of reform today is clear; second order changes that adopt “new ways of thinking, acting, and organizing rather than an assimilation of new ideas into existing patterns” (Woodbury & Gess-Newsome, 2002, p. 770).

**Paradox V: Teachers’ Belief: Internalizing and Implementing Change**

What teachers think is often actualized in what they do in their classrooms. But the Curriculum Reform Movement informed current reform in that the most well-developed curricula did not change deep-rooted beliefs teachers held about teaching and learning (Atkins & Black, 2003; DeBoer, 1991; Dow, 1997; NRC, 1996). In contrast, current reform documents recognize that changing teacher beliefs and thinking about their practice is critical if reform is to be sustained. As such, through the Standards for professional development, reformers seek to

- create opportunities for teachers to confront new and different ways of thinking;
- to participate in demonstrations of new and different ways of acting; to discuss, examine, critique, explore, argue, and struggle with new ideas; to try out new approaches in different situations and get feedback on the use of new ideas, skills, tools, and behaviors; to reflect on the experiments and experiences of teaching science, and then to revise and try again (NRC, 1996, p. 67-68).

The intent of current science education reform is not simply to change teacher practices, but rather to challenge what they think about their practice, in a supportive and nurturing environment. So as teachers think about change, the rationale for why and how best to change their practices takes on intrinsic value.

As a community, science educators, researchers and advocates are responsive and are aggressively working towards the goals espoused in reform documents. Recognizing
that the task will be demanding and challenging for stakeholders, we must keep in the forefront of our minds the ultimate intent of our efforts: scientific literacy for all Americans. While obstacles, resistance, and opposing agendas are assured, compromising the core values inherent in this science education reform movement is non-negotiable.

Is the Science for All Movement Really for All? Concerned Skeptics

The vision inherent in the Science for All reform movement is but a regulatory ideal that is not supported by all in the science education community (Lee, 1999; Noddings, 1997; Pushin, 2002; Rodriguez, 1997; Shiland, 1997). In fact some opponents argue that current reform, particularly the NSES, “are indeed a double-edged sword, a proverbial blessing and curse. Blessed by breadth, yet cursed by lacking specificity and depth…” (Pushkin, 2002, p. 161). Shiland (1997) illuminates this point prudently arguing that the NSES is “atheoretical” because it shows a lack of reference to specific theories in science and “ahistorical because it lacks specific theories that have specific points in time” (p. 616). Rodriguez (1997), examining from a different perspective, criticizes the standards for being “a political document” (p. 34) and for its uses of a “discourse of invisibility… not directly addressing the ethnic, socioeconomic, gender, and theoretical issues which afflict science education today” (p. 19). By not making specific reference to a single ethnic group throughout the document or avoiding to address why, empirically or otherwise, equity is such a priority, the goals of equity and excellence are subverted. Lee (1999) further asserts that reform documents, particularly NSES and Project 2061, face strong opposition from scholars who have critiqued weakness of their equity considerations. Reform documents “define the nature of science in the tradition of Western science…[implicitly promoting] the assimilation perspective [which suggests that] individuals from diverse backgrounds adopt the mainstream culture while ignoring or rejecting their cultural backgrounds” (p. 90, 92). According to Noddings (1997), the preoccupation with creating national standards divert attention away from social issues that breed inequalities, prohibiting equity for all, instilling an erroneous belief that all students have an equal chance at success.
As with most things, there are those who support and others who oppose this reform movement to varying degrees. Despite these and other objections, reformers have examined reform efforts of the past—identifying what has worked and what has failed—leading a movement that they hope will have lasting effects, hopefully entombing the paradox of change without difference forever.

**Looking Ahead: An Expanded Research Agenda in Science Education**

Science education scholars and researchers are looking to fundamentally alter how education traditionalists conceptualize science teaching and learning in and effort to beget reform-minded science practices; however, the many efforts collectively have minimally contributed to changes in classroom practices. Despite mutual causality, Paradox V—the psychological perspective which includes teacher thinking, teacher knowledge, and teacher beliefs—is quite often the focus of most research in education (Anderson & Helm, 2000). According to Anderson and Helms (2000),

> [p]sychological perspectives have dominated educational research through most of its history…Persons approaching their research from this perspective have chosen to focus on the mental processes of the people in the educational setting…The research assumes that mental processes are of major importance and that much will be learned about the total situation by understanding more about this aspect. (p. 4)

Further, researchers partial to this perspective believe that these internal constructs are powerful indicators of actions within a given context (Pajares, 1992).

In science education, studies conducted in the area of teacher thinking have yielded similar conclusions, as most of the research on teacher thinking is based on two important assumptions, one that relates directly to why scores of science education researchers have made this strand their primary research focus: “[W]hat teachers believe … affects their behavior in the classroom” (Anderson & Helms, 2000, p. 7). As a result, the science education community expends a great deal of time, energy, and resources to change how teachers think. This is not solely because teacher thinking is central to school reform, but because teachers’ thoughts are believed to be deep-rooted, ensconced,
and “shaped by the thousands of hours spent in college classrooms internalizing objective models of science” (Tobin et al., 1994, p. 62), therefore difficult to change.

The science education reform documents, although they make explicit that teacher beliefs are integral to the enactment of reform, also acknowledge that there are other players that influence teacher thinking, hence classroom practices. The reform documents go on to acknowledge that, “[a]ll of these individuals have unique and complementary roles to play in improving the education that we provide to our children” (NRC, 1996, p. 9). This acknowledgement does not however come with a blueprint to understand each individual or groups’ influence on teacher thinking. Research in science education is calling for studies that examine these dynamic influences. Anderson and Helms (2000) contend “[t]he desired research needs to be broad and comprehensive in the sense of being approached from a multiplicity of perspectives (e.g., psychological—both cognitive and affective—sociological, cultural, organizational, economic, philosophical, and subject matter” (p. 11). Further, Adams and Krockover (1998) suggest that researchers explore political aspects of science education reform. Anderson and Helms (2000) and Adams and Krockover (1998) propose a research agenda that helps stakeholders to understand how other people, factors, and forces impact the intended outcome of science reform.

To this end, a broadened research agenda is desired; one that examines the many influential factors on science education reform. A noteworthy figure that has been found to impact teacher thinking, hence the outcome of reform, is the school principal (Banilower et al., 2007; Blasé and Blasé, 1998; 2004; Woodbury & Gess-Newsome, 2002). As science education and educational leadership reform documents support the contention that principals must assume a more active role in instructional improvements, a multidisciplinary research agenda in this area is needed if we are to understand and support, from a holistic perspective, progress towards the goals of science education reform.

Reform in educational leadership promotes a portrait of today’s principal as an instructional leader. The following section provides an extensive review of the literature on the principal as instructional leader. Presented as a historical chronology, the intent is to show how the principal’s role has evolved over time. This section concludes with an
examination of a model and instructional leadership frameworks that collectively reflect the expectations for today’s principal.

**The Principal as Instructional Leader**

*Early 1900s: Principal as Leader of Instruction*

The role of the principal as instructional leader predates much of the current research. In fact, the word principal was used in the early 1900s to identify whom among the teachers in the school was “in charge” (Rossow & Warner, 2000, p. xiii) or the “head teacher” (Hall, Mackay & Morgan, 1986, p. 11). The term *principal teacher* was used to acknowledge the person in the school who was viewed as the superior teacher. This person was respected for his/her expertise and knowledge of teaching and learning and sought out by other members of the staff for guidance and direction with instructional matters. But as times changed, so did the principalship.

The principals’ responsibility for developing and maintaining a successful instructional program was emphasized at differing levels since the early 1900s. However, it was not until the 1980s that the literature suggested that effective schools were run by leaders who were change agents directly involved in the teaching and learning process. Although the principals’ role was still regarded as that of ultimate authority and decision-maker, these roles were expanded to include matters of instructional improvement.

*The 1980s: Rebirth of the Principal as Instructional Leadership*

As an instructional leader, effective principals were expected to understand how students and adults learn, be a visionary, manage the instructional program, be a resource provider, get involved in classroom operations, be a reformist, and most importantly make student achievement of primary concern either directly or indirectly (Pitner, 1988). Although the instructional leadership used by principals was context-dependent ranging from assertive and demanding to humanistic and collegial (Beck & Murphy, 1993), principals were expected to make instructional decisions such that teachers had the necessary resources, direction, and professional training to provide students with the best education possible (Keefe & Jenkins, 1984). As such, instructional leaders of the 1980s...
were principals who were charged with improving instructional quality (Rossow & Warner, 2000), a reconceptualization that was seen as critical to the success of the school’s instructional program. Improving instructional quality through effective instructional leadership remains a goal of educational leadership advocates today, although the leadership looks quite different.

Despite the reconceptualization, “there remains much muddled thinking, about what constitutes instructional leadership, how it is distinguished from leadership in general, and what behaviors are those most closely tied to improving teaching and learning” (Gupton, 2003, p. 32). In the following section, the complexity in explicating what instructional leadership means is explored, as researchers attempt to define this elusive and often obscure construct.

**Defining Instructional Leadership: An Evolving Construct**

Instructional leadership falls under the broad umbrella of principal leadership. According to Elmore, (2000) leadership as it relates to the principal is a concept borne out of the effective school’s movement. Based on the research on school effectiveness, there emerge two different school climates that distinguish “effective schools” from “ineffective schools.”

One kind of normative climate, characterized by an emphasis on collaboration and continuous improvement, develops in schools where teacher effort, through a variety of principal actions, is focused on skill acquisition to achieve specific goals. In such schools, experimentation and occasional failure are expected and acceptable in the process of teacher learning. Further, seeking or giving collegial advice is not a gauge of relative competence, but rather a professional action viewed as desirable, necessary, and legitimate in the acquisition of new skills. In schools characterized by norms of autonomy, on the other hand, there are ambiguous goals and no attempt to develop a shared teaching technology. There is no agreement among teachers and principals about the outcomes they seek and the means for reaching them. In such settings, therefore, definitions of teaching success and the manner in which it is attained are highly individualistic (p. 15).
The effective schools movement was instrumental in defining what constitutes the ideal school environment. Today, as schools continue to strive for this normative school climate, “leadership holds exciting possibilities to foster change in people’s views of themselves, their work, and the continuously improving results of their collective efforts” (Drake & Roe, 2003, p. 140).

Researchers define leadership in different ways. According to Elmore (2000), leadership is conceptualized as the act of guiding and facilitating instructional improvement. Spillane (2005) articulates a more pointed definition, “Leadership refers to activities tied to the core work of the organization that are designated by organizational members or that are understood by organizational members as intended to influence their motivation, knowledge, affect, and practices” (p. 384). Drake and Roe (2003) present the most comprehensive definition, recognizing that schools are interactive and dynamic environments. The authors conceptualize leadership as a “deliberate process” that produces the following for all participants:

1. [Collaborating towards] an ever-expanding vision of excellence in the achievement of organizational and personal/professional goals and objectives.
2. Creating a threat-free environment for growth so that the creative talents and skills of each person are maximized.
3. Encouraging and building working relationships that are individually and organizationally satisfying, unifying, and strengthening, in the realization of mutually determined goals and objectives. Such relationships result in effective group problem solving.
4. Optimizing available human and material resources (p. 140-141).

Drake and Roe’s conceptualization of leadership can be considered an “organizational quality” (Spillane et al., 2001, p. 920) that is a socially fluid and manifold endeavor that can be executed from any concerned stakeholder. Drake and Roe (2003) add that the principal’s leadership task is to “nurture, develop, and reinforce leadership whenever it is found to further the shared purposes of the school” (p. 141).

Taken together, the definitions embody principal leadership as it relates to this investigation. My contention however is that, although leadership can be and is executed by formal (principal) and informal (teachers) leaders, students, and others who are
concerned with educational improvement, schools are still hierarchal systems. Despite shifts toward a more democratic form of leadership (Marlow, 2003) that neutralizes the authority/subordinate relationship, the reality is that the principal is the appointed leader who is ultimately responsible for decisions made by the collective, must support endeavors initiated by others, and create a culture wherein informal leadership is encouraged and welcomed. Although authority and power does not make a person a leader, it complicates the true nature of leadership. Therefore, leadership as it relates to this investigation starts with the principal and is defined as her ability to induce and nurture a school culture where others are motivated, without coercion, to work collaboratively to improve teaching and learning; the ability to positively influence the feelings, thoughts, behaviors, and practices of others such that they strive for instructional and professional excellence; and the ability to build leadership capacity in others.

How then does one define instructional leadership? Researchers have had difficulty agreeing on a definition that is universally accepted and facilitates an understanding of what instructional leadership is and what instructional leaders do. Although there appears to be an intentional avoidance of a uniformed, nicely packaged definition within the literature (because school contexts and cultures are so dynamic and diverse that the needs of one school may differ from another), several researchers have attempted to formulate an adequate definition. These definitions range in focus from specific tasks that principals must perform to his or her influence on school culture.

For example, one of the earliest definitions describe instructional leadership as the direction, resources, and support that a principal provides to teachers and students for the improvement of teaching and learning in the school (Keefe & Jenkins, 1984). Compared to more recent definitions, this can be seen as evasive, lacking specificity in what is meant by direction, resources, and support. King’s (2002) definition is not only more specific, but also prioritizes those actions that lead to student learning. According to King (2002), “instructional leadership might simply be described as anything that leaders do to improve teaching and learning in their schools and district” (p. 62).

Another definition speaks to the complex nature of instructional leadership for today’s principal, with the authors finding it necessary to combine the notions of several researchers. For Wanzare and Da Costa (2001), instructional leadership: 1) relates to the
processes of instruction in which teachers, learners, and curriculum interact 2) includes those activities taken on by the principal to produce satisfying working environments and conditions for both teachers and students 3) consists of the actions that a principal takes and tasks that he or she delegates to promote student learning 4) includes the involvement of teachers in the decision-making process, and 5) incorporates the principals’ concern with “the factors and conditions within a school that affect student learning, such as class size, quantity and quality of curricular materials, and sociological characteristics of the students” (¶ 5). A more recent definition proposes three instructional leadership dimensions: defining a school mission; managing the school’s instructional program; and promoting a positive school climate where learning is optimized (Hallinger, 2005).

Two books on the issue provide strikingly similar interpretations. Blasé and Blasé (2001b) consider a framework for instructional leadership that stresses, among other things, participative decision-making and “the development of a culture of learning, analysis and critique” (p. 157). Along the same line, Gupton (2003) defines instructional leadership as the act of providing a sense of vision, empowering stakeholders, supporting and monitoring instruction, and mobilizing resources in the education of young people.

**Instructional Leadership Model and Character/Behavior Frameworks**

Holistically speaking, the notion of instructional leadership has evolved since the 1980s, with the instructional leadership role becoming an essential part of the principal’s professional responsibility. However in recent years, differing perspectives and the complex nature of the construct of instructional leadership has lead researchers to use models and character/behavioral frameworks to depict the intricacy of this phenomenon. The following analyzes an *instructional leadership model* that has been developed to conceptualize instructional leadership and then moves to the *character/behavioral frameworks*.

**1) Instructional Leadership Model: Promoting Teacher Professional Growth.** School reform, increased accountability, and the state of education as a whole, has undoubtedly contributed to the changing role of today’s principal. Blasé and Blasé (1999a, 1999b, 2001a), two authors who write a great deal on the subject of instructional leadership discuss how the principalship is becoming more intricate and variegated. In an
effort to guide principals in their efforts to be effective instructional leaders, the authors conducted a study with classroom teachers to identify positive and negative characteristics displayed by the principal that influence classroom teaching. An open-ended questionnaire, the Inventory of Strategies Used by Principals to Influence Classroom Teaching (ISUPICT), was administered to 809 full-time public school teachers taking courses at three major universities. The purpose was to ascertain the impact of principals’ instructional leadership behaviors on teachers’ practice. From the data, Blasé and Blasé developed the Reflective-Growth (RG) model of instructional leadership (1999b) that consists of two major themes: (1) *talking with teachers to promote reflection* and (2) *promoting professional growth* (Blasé & Blasé, 1999a, 2001a). Each theme is summarized in Table 6.

This investigation is one of the few to demonstrate that principals have a direct impact on teachers as individuals (professionally and the affective dimensions) and their instructional practice (Blasé & Blasé, 1999a, 1999b), both of which interact to promote student achievement (Pitner, 1988; Hallinger & Heck, 1996). This study may therefore contribute to our understanding of instructional leadership from the perspective of classroom teachers. Further, the authors contend that if principals engage in the behaviors cited, they can enhance a teacher’s sense of self-efficacy and well-being, cognitively, emotionally, and behaviorally (Blasé & Blasé, 2001a).
Table 6 Reflective Growth Model of Instructional Leadership

<table>
<thead>
<tr>
<th>Theme I: Talking With Teachers To Promote Reflection</th>
<th>Description: Teachers indicate…</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Character/Behavior</strong></td>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>Makes Suggestions</td>
<td>Principals often make suggestions after observations and informally on a regular basis.</td>
</tr>
<tr>
<td>Gives Feedback.</td>
<td>Principals engage in thoughtful and critical discourse with teachers about their practice.</td>
</tr>
<tr>
<td>Modeling</td>
<td>Principals demonstrate teaching techniques, are role models for the students, and demonstrate teaching techniques during visits to the classroom.</td>
</tr>
<tr>
<td>Uses Inquiry/Solicits Advice and Opinions</td>
<td>Principals use appropriate questioning strategies to identify why teachers engage in certain classroom practices as opposed to dictating what should be done; this leads to teacher reflection.</td>
</tr>
<tr>
<td>Gives Praise</td>
<td>Principals always praise teachers for the things that they do in their classrooms; principals who give praise that focuses on teaching behaviors “significantly affected [teachers] motivation, self-esteem, and efficacy…reflective behavior…risk taking, and innovation/creativity” (Blasé &amp; Blasé, 1999a, p. 134).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Theme II: Promoting Professional Growth</th>
<th>Description: Teachers indicate …</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Character/Behavior</strong></td>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>Promote the Study of Teaching/Learning</td>
<td>Principals provide opportunities for staff development that focuses on the needs of teachers and learners in individual classrooms.</td>
</tr>
<tr>
<td>Support Collaboration Among Educators</td>
<td>Principals provide the opportunities for peer observations and sharing, and encourage networking outside of the school.</td>
</tr>
<tr>
<td>Develop Coaching Relationships.</td>
<td>Principals encourage teachers to become peer coaches, opening up their classrooms for observations from other teachers.</td>
</tr>
<tr>
<td>Encourage/Support the Redesign of Programs</td>
<td>Principals encourage and provide the necessary resources for teachers to redesign the instructional program to meet the needs of learners.</td>
</tr>
<tr>
<td>Apply Principles of Adult Learning in Staff Development</td>
<td>Principals create school cultures where adult learners can flourish, establishing collaborative cultures where inquiry, learning, experimentation, and reflection can happen.</td>
</tr>
<tr>
<td>Implement Action Research to Inform Instructional Decision Making.</td>
<td>Principals use action research as a means of evaluating the academic programs, to assess the effectiveness of new instructional approaches, to make decisions about areas of instructional improvement, and to determine if staff development is needed. Principals also encourage teachers to work collectively on a particular area to improve student performance or individually to improve their own practice.</td>
</tr>
</tbody>
</table>
An Integrated Framework of Instructional Leadership. In the age of school reform, and with mounting concerns about student achievement, the principals’ responsibility now “includes a larger focus on teaching and learning, professional development, data-driven decision-making and accountability” (King, 2002, p. 62). As a result, King (2002) asserts that instructional leaders must be flexible enough to accommodate different learning communities. She writes in a school or district with a significant number of students performing at levels below identified standards, leadership might focus on examining student achievement data to identify areas of weakness and use those data to improve classroom instruction. Conversely, in a school community with a perceived tradition of success, leadership may need to challenge the status quo, promoting such ideas as peer observation to ensure that teaching practices enable all students to learn at high levels. An unsafe school environment that hinders teaching and learning may require that instructional leadership focus first on advocating for improvements in the physical plant (p. 62).

These are just a few of the challenges that modern day principals face. Because of these challenges, King has observed ways in which today’s principals operate “differently” than their predecessors. After several years working with school districts to design and implement programs to support the professional development of principals and school district leaders, Deborah King, the Principal Associate in the Leadership Initiative at the Annenburg Institute for School Reform at Brown University, developed a theoretical framework to conceptualize the role of principals as instructional leaders in today’s schools. She proposes that instructional leaders must: 1) lead learning 2) focus on teaching and learning 3) develop leadership capacity 4) create conditions for professional learning 5) use data to inform decisions, and 6) use resources creatively. Table 7 summarizes the model.
Table 7 Integrated Framework of Instructional Leadership

<table>
<thead>
<tr>
<th>Character/Behavior</th>
<th>Description: King indicates …</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Lead Learning</em></td>
<td>Principals must engage with teachers in professional development activities centered around improving teaching and learning.</td>
</tr>
<tr>
<td><em>Focus on Teaching and Learning</em></td>
<td>Principals must work with teachers to help them improve their instructional practice.</td>
</tr>
<tr>
<td></td>
<td>Principals must make sure that students are receiving the most valuable educational experiences.</td>
</tr>
<tr>
<td><em>Develop Leadership Capacity</em></td>
<td>Principals eagerly develop instructional leadership capacities in others.</td>
</tr>
<tr>
<td></td>
<td>Principals do more than simply delegate responsibilities or tasks to others, but rather provide opportunities for others to become leaders and influential figures in the school and community.</td>
</tr>
<tr>
<td><em>Create Conditions for Professional Learning</em></td>
<td>Principals allocate time throughout the school day for teachers to peer coach, participate in small group discussions offering reaction and feedback about performance, or to engage in conversation about instructional strategies.</td>
</tr>
<tr>
<td><em>Use Data to Inform Decisions</em></td>
<td>Principals must be able to use assessment data to identify what students are learning, areas where improvement is needed, and work with others to develop a plan to address areas of concern.</td>
</tr>
<tr>
<td><em>Uses Resources Creatively</em></td>
<td>Principals make use of all resources—money, people, supplies, and time—as they seek to improve teaching and learning.</td>
</tr>
</tbody>
</table>

Although educational leadership reform is shifting to models of leadership wherein principals are more involved in the instructional program, there is no list of actions/behaviors that principals as instructional leaders must perform in a calculated manner in situations that are encountered; the diverse nature of schooling does not allow for such inflexibility. Hence, as King (2002) explains, “there is no litmus test for the presence of instructional leadership, nor is there a definitive list of its characteristics or behaviors. In places where instructional leadership truly exists, it becomes an integral, almost invisible, part of how a school community works…” (King, 2002, p. 63). But if one were to look for instructional leadership, King contends that this framework provides an evidential lens to examine its existence.

(3) **“Toolbox” for the Instructional Leader.** As other researchers have articulated, student learning is the most important dimension of school leadership.
However, contrary to what the term principal often symbolizes, “where the buck stops” (Gupton, 2003, p. vii), leadership today is proactive, inclusive, and facilitative (Gupton, 2003; Quinn, 2002). With 20 years of experience as a teacher, principal, director of instruction, and superintendent, as well as observing the dynamic changes in the ethnic makeup of America and school populations, Gupton (2003) posits that “principals as true instructional leaders are exemplars in their relentless quest for information that can be used to improve teaching and learning and to personalize the educational experience for each boy and girl” (p. 122). Table 8 provides a summary of Gupton’s instructional leadership model.

Table 8 “Toolbox” for the Instructional Leader

<table>
<thead>
<tr>
<th>Character/Behavior</th>
<th>Description: Gupton indicates…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus on Learners and Learning</td>
<td>Principals must be proactive, developing an understanding and getting to know students as real people. Principals must interact often and freely with students during the school day, taking a personal interest in their development, and appreciating the uniqueness of each student as an individual with one-of-a-kind talents, strengths, and weaknesses.</td>
</tr>
<tr>
<td>Create a Climate for Learning</td>
<td>Principals must exert every effort to assure that the physical plant and grounds are clean, safe, and well-maintained, and that students and teachers are nurtured as they work towards excellence.</td>
</tr>
<tr>
<td>Communicates High Expectations</td>
<td>Principals must communicate the expectations for achievement to all stakeholders.</td>
</tr>
<tr>
<td>Looks for Indicators of Effective Teaching and Learning</td>
<td>Principals (working collaboratively with teachers) must make sure that: the most appropriate and up-to-date instructional strategies are being utilized; a plethora of instructional strategies are being used to meet the diverse needs of the student population; and the environment is conducive for learning.</td>
</tr>
</tbody>
</table>

Gupton (2003) maintains that improving teaching and learning should be the primary focus of all systems of education and the work of a principal in the capacity of instructional leader facilitates such efforts. Utilizing the metaphor toolbox, Gupton conceptualizes her framework of instructional leadership as a “tool having particular potential for helping school principals improve their leadership skill and thus the school’s capacity to help children” (p. viii). Instructional leaders therefore: 1) focus on learners
and learning 2) create a climate for learning 3) communicate high expectations, and (4) look for indicators of effective teaching and learning.

The preceding instructional leadership definitions, model, and action/behavior frameworks in no way reflect all that has been developed to explain what instructional leadership is and what instructional leaders do; indeed, the research is sizable. But even though comprehensive and wide-ranging, high-stakes testing and accountability have been the impetus behind yet another major reconceptualization of the principals’ role: that of data-drive instructional leader.

**Data Data Data: Instructional Leaders for Data-Driven Systems**

Although research on instructional leadership over the past five years suggests that “effective” instructional leaders should use data to make school-wide decisions, the “new instructional leader” (Halverson et al., 2007) understands that the task of “translat[ing] organizational outputs into useful information to guide subsequent input behaviors” (p. 163) is inescapable and intricately linked to their effectiveness as leaders. In essence, as data-literate practitioners, principals (along with teachers) are expected to use the array of data available (state assessment data, district test data, and school-based diagnostic data) as feedback for programmatic restructuring, to improve student achievement, address issues of literacy, and to enhance instructional practices (Lachat, Williams, & Smith, 2006; Zavadsky & Dolejs, 2006). According to Halverson et al., (2007),

[the research on data driven decision making suggests that schools link several key organizational functions together into a cycle for collecting, reflecting on, and acting on feedback data…First, schools and districts must establish practices to collect, store, and communicate relevant data. These data should include not only student achievement data but also behavioral data; parent, staff, and community surveys; financial information; and student services records. Second, schools need to establish social processes to reflect on these data and establish statewide goals. Third, schools need to develop interventions designed to achieve their goals. And finally, schools must develop practices to learn from their
interventions and to integrate what is learned into subsequent cycle iterations. (p. 163)

While the usefulness of assessment data is multipurposed, the pressures of accountability have constricted what constitutes as instructional leadership “[j]ust as accountability systems narrow expectations for what counts as student learning in schools” (p. 161). Although the recent surge in available data (high stakes assessment data particularly) is propagated by a mindset that “what gets measured, gets done” (Ramirez, 2007, ¶ 1), as stated by former U. S. Secretary of Education Margaret Spelling in a U.S. News & World Report, the benefit of making school-wide decisions with the most accurate and precise information available is most advantageous. The challenge for school principals is putting the scores of data into a useable and functional format such that it is easily disaggregated, user-friendly and informative, providing answers to questions that will improve student learning, and subsequently achievement on standardized assessments. On their website, Technology Alliance (n.d.) provides a comparison of the decision-making outcomes when made through random, traditional mean to those that are data-driven.

Undoubtedly, most principals want to make the most efficient use of the schools’ time and efforts by effectively using the available data to make the most appropriate decisions possible. And now that schools have become data-rich environments, principals are expected to develop and implement programs that are informed by these data. Data can inform something as broad as addressing school-wide literacy to something as specific as fifth grade students’ understandings of Newton’s first law of physics. Moreover, utilizing data “supports a culture of inquiry, continuous improvement, accountability, and purposeful data-driven decision-making—cornerstones of efforts to ensure the success of all students” (Lachat et al., 2006, p. 21). “The principal’s job is to lead [these] discussion[s] and help the faculty develop an action plan that responds to information gleaned from data” (Mills, 2006, p. 48). Therefore, using school data is no longer an option, but rather essential in today’s performance and accountability-driven era.
Table 9 Paradigm Shift to Data-Driven Decision-Making

<table>
<thead>
<tr>
<th>Decision-Making Based on Intuition, Tradition, or Convenience</th>
<th>Data Driven Decision-Making</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scattered staff development programs</td>
<td>Focused staff development programs as an improvement strategy to address problems/needs identified by data</td>
</tr>
<tr>
<td>Budgetary decisions based on prior practice or priority programs</td>
<td>Budget allocations to programs based on data-informed needs</td>
</tr>
<tr>
<td>Staff assignments based on interest and availability</td>
<td>Staff assignments based on skills needed as indicated by the data</td>
</tr>
<tr>
<td>Reports to the community about school events</td>
<td>Organized factual reports to the community about the learning progress of students</td>
</tr>
<tr>
<td>Goal-setting by board members, administrators, or teachers based on votes, favorite initiatives, or fads</td>
<td>Goal-setting based on data about problems and possible explanations</td>
</tr>
<tr>
<td>Staff meetings that focus on operations and the dissemination of information</td>
<td>Staff meetings that focus on strategies and issues raised by the local school data</td>
</tr>
<tr>
<td>Parent communication via twice-a-year conferences, open-houses, and newsletters</td>
<td>Regular parent communication regarding the progress of their children with specific data</td>
</tr>
<tr>
<td>Grading systems based on each teacher’s criteria of completed work and participation</td>
<td>Grading systems based on common criteria for student performance that reports progress on the standards as well as work skills</td>
</tr>
<tr>
<td>Periodic administrative team meetings focused solely on operations</td>
<td>Administrative team meetings that focus on measured progress toward data-based improvement goals</td>
</tr>
</tbody>
</table>

Adapted from http://www.technology-alliance.com/pubs/pols/dddm/paradigmshift.html

Holistically speaking however, the direction the field has followed and is currently following over the past 20 years in terms of research on the principal as an instructional leader can be summarized by these definitions, the model, the action/behavior frameworks, and the increased emphasis on data-driven decision-making. Indeed, instructional leadership is a multifarious and often perplexing undertaking that fundamentally challenges traditional beliefs of leadership. But if student learning is the goal of education, principals can no longer tell the village how to raise the child, but join in these efforts.
**Principal Instructional Leadership in Other Areas**

When principals are instructional leaders, the primary goal is to enhance the instructional program such that it improves student learning (Hallinger, Bickman, & Davis, 1996; Halverson et al., 2007; Quinn, 2002; Wanzare & Da Costa, 2001). Central to the notion of instructional leadership is a principal’s ability to develop the collective capacity of those within the organization who are critical to student success. Even with the restructuring of the principalship to encompass instructional leadership, very few studies that I have found examine the phenomenon within the context of the science program. But when the principal is an instructional leader, does it truly make a difference to instructional effectiveness? To answer this question, I examined principal instructional leaders in other academic disciplines or other areas of the curriculum.

Research has established that principals indeed make a difference in the effectiveness of schools (Weast, 2000). However, a long standing debate concerning the effect of principals’ instructional leadership on student achievement has been the object of concern. Do principals directly affect student achievement? “Most scholars now believe that principals’ influence student learning through their interactions with teachers and by shaping features of the school organization” (Hallinger et al., 1996, p. 529). This mediated or indirect relationship between student achievement and a principal’s instructional leadership is clearly linked to the principal’s interactions with others within the school context (Wahlstrom & Louis, 2008). Exercising said instructional leadership is described as “critical to the development and maintenance of an effective school” (Quinn, 2002, p. 447).

Hallinger and his colleagues (1996), over a four-year period studied the effect of elementary school principals’ instructional leadership on reading achievement in a sample of 87 schools across Tennessee. Their findings indicate that there was no significant direct effect of principal instructional leadership on reading achievement of elementary students. There was however, a statistically significant effect of principal instructional leadership on the mediating school climate variable (clear school mission). “A clear mission, in turn, influenced student opportunity to learn and teachers’ expectations for student achievement” (p. 543).
In another study, Pollard-Durodola (2003), studied the success of at-risk, African American students in an urban elementary school in Houston, Texas, in which the instructional leadership of the principal is described as instrumental to the school’s academic success. Pollard-Durodola (2003) reports that the principal, Dr. Thaddeus Lott, is an instructional leader that all teachers agree “mobilized faculty, students, and parents toward a common goal through his words, actions, and commitment to student academic success” (p. 100). The commitment led to increased student performance in reading and mathematics after one year. Students, who were reading below grade level just one year prior, were reading on grade level. Before Dr. Lott implemented his educational plan, “only 18% of the third graders scored at or above grade level in Reading Comprehension on the Iowa Test of Basic Skills. However, by 1980, 85% scored at or above level…[and by] 1990, first graders were reading at nearly a 3rd-grade level, and 5th-graders at the school were doing 8th-grade math…” (p. 110). Although the author cited nine factors that contributed to Wesley’s academic successes, “it was the presence of a strong instructional leader that, at the end, made the difference” (p. 114).

Cobb (2005) and Ediger (2001) espouse how critical principals are to the success of a reading program. In an effort to improve the reading performance of students, Cobb (2005) advocates for literacy teams, which includes the principal, reading specialist/coaches, and classroom teachers working collaboratively in the process of change. Although success is dependent upon the team’s cohesiveness and ability to work as a unit, she expresses that the principal is vital to the success of the leadership team because they coordinate and facilitate a shared approach to leadership. Ediger (2001), who advocates for principals’ leadership in reading, emphasizes that “[t]he principal is the closest in relationship of any school administrator with classroom teachers and thus is assumed to exert a leading influence on learner progress” (p. 1). This means that they must be knowledgeable about how reading should be taught and learned in order for students to be successful.

Principal instructional leadership is also found to be important in a school district’s initiative to improve the mathematics curriculum. The Montgomery County School District in Rockville, Maryland, developed a plan of action to target student underachievement in mathematics (Weast, 2000). Following the examination of
empirical data from three studies focusing on organizational staff and structures, five areas are recognized as critical to systematic changes in the mathematics curriculum. One of the five areas is principal instructional leadership. The emphasis on principals’ ability to be leaders of instruction was prompted and informed by a wealth of research that clearly articulates that successful schools are lead by principals that are instructional leaders. Because school officials now recognize that the principal is said to “make a big difference…[the] principal selection process has been revised and the principals training program has become more rigorous, shifting the emphasis on the principal as an instructional leader” (p. 8-9).

Researchers also find principal instructional leadership to be important to student success in other areas of the curriculum. After examining the literature on the under-representation of African American students in gifted programs, Grantham and Ford (1998) identify four key elements of instructional leadership—teacher supervision and evaluation, staff development, and quality control—that can increase representation. The authors indicate that the “[s]ubstantive change to reverse this under-representation cannot occur without principal commitment to providing instructional leadership” (p. 9). In another article, Stone and Clark (2001) outline the evolving collaborative leadership role of the school principal and the school counselor toward academic achievement. Although this collaborative model described has not currently been adopted in many schools, “collaboration between principals and counselors is increasingly necessary to the operation of an effective instructional program” (p. 49). The authors assert that when principals/counselors enter into this type of partnership students are more likely to be armed with information, resources, and experiences necessary to be productive members of society.

One may ask, “Why is it necessary to examine a principal’s instructional leadership in other academic disciplines or areas of the curriculum independently?” This is because the context (Snider & Roehl, 2007) and subject matters (Spillane, 2005). Although there are similarities in how instructional leadership is executed, differences do exist. For example, in elementary schools, principals’ instructional leadership is routinely directed toward reading and literacy, with instructional leadership in other subject areas, particularly science, resting in the hands of classroom teachers, if present at
all (Spillane, 2005; Spillane et al., 2001). According to school leaders in eight schools across the Chicago area, because science is not regarded as part of the core curriculum, the principal’s instructional routines differed or were non-existent (Spillane, 2005).

The contention set forth by Spillane (2005) that *subject* matters cannot be ignored. As researchers, we must begin to conduct research that examines and explicates the execution of principal instructional leadership in subject areas distinct and separate from others as leadership may look different depending on the subject or context. The literature in other disciplines or areas of the curriculum supports the notion that when principals are instructional leaders, students reap the benefits academically. Therefore, understanding this leadership in the area of science is essential to transforming elementary science programs and revolutionizing the science experiences of all students.

**Theoretical Framework**

Examining principal instructional leadership in a science program amidst national science education reform requires distinctive yet complementary lenses to explore the tenets of this phenomenon. The TCSR Model of Educational Reform developed by Woodbury and Gess-Newsome (2002), captures the multi-dimensional and multi-layered process of education reform on teacher classroom practice. Developed following an extensive review of the literature, the *Instructional Leadership Model* was used to help me identify and recognize instructional leadership behaviors employed by the principal in science. The following section examines both models.

**TCSR Model of Educational Reform**

Despite on-going reform efforts in school districts across the country, many well-intentioned programs have not produced desired results and changes in classroom practices have been elusive. Although the model recognizes that teacher thinking is one variable that influences change, focusing on a single element is “not sufficient to produce major reforms” (Anderson & Helms, 2000, p. 4) and presents at best a one-sided, biased picture of the complex nature of reform. It is therefore necessary to examine reform “from a variety of perspectives…as the person wishing to bring about significant educational reform—such as putting into practice the major elements of the *National Science Education Standards*—must come to grips with the totality of this complex
situation in a manner that few policy makers, administrators, practitioners, or researchers ever seem to do” (p. 4).

Each of the individual perspectives identified by Woodbury and Gess-Newsome (2002) represent an overly simplistic image of the complex nature of educational reform, but are required of a new perspective on fundamental education reform. “This new perspective, while combining many different sets of factors that influence fundamental change into one comprehensive view, will simultaneously have to equal more that the sum of its parts to account for the effects of these perspectives on each other” (Woodbury & Gess-Newsome, 2002, p. 772). Table 10 summarizes each perspective described by Woodbury & Gess-Newsome (2002).

Table 10 Limitations of the Individual Perspectives on Educational Reform

<table>
<thead>
<tr>
<th>Perspective I: Interconnectedness of Systems</th>
<th>Perspective II: Intent of Reform Efforts</th>
<th>Perspective III: Teacher Thinking</th>
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<tbody>
<tr>
<td>Fails to recognize and address the influence of other systems (e.g., sociopolitical, cultural, structural, legislation, inter- and intra-related) on schools operations.</td>
<td>The intent of reform—first order or second order—establishes the parameters for change. The intent and expected outcome must align, but are often at odds.</td>
<td>Fails to examine the factors (e.g., knowledge, beliefs, experience) that impede alignment of teacher thinking with reform expectations.</td>
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*Modified from Woodbury & Gess-Newsome, 2002, p. 771-772*

Within the TCSR model, Woodbury and Gess-Newsome (2002) suggest that three overarching frameworks—the general context of reform, the teachers’ personal contextual factors, and the contextual factors of structure and culture “recursively interact with and affect teachers’ thinking” (p. 775). In so doing, the images that are revealed in their classroom practice are but a synthesis of the many intersecting factors that have been sieved through the teachers’ belief construct prior to execution. It is therefore imperative that research, particularly qualitative research that is interpretive in nature, is conducted to help us understand these subtle yet intricately enmeshed relationships and the effects they have on the intended outcomes of reform.

The TCSR model (see Figure 1) examines the general context of reform, through the personal contextual factors of the teacher (e.g., gender, teacher preparation, years of experience, extent of professional development, etc.) the contextual factors of structure...
and culture (e.g., standards and curriculum, local policies, size of school, principal influence, subject area, department demographics, class size, etc.), and through teacher thinking (e.g., knowledge and beliefs about change, content, students and learning, schools, and teaching). All of these contexts are understood to interact with each other, influencing the enactment of reform.

Since the inception of the Science for All movement, there has been studies conducted that examine how the different contexts—personal, structural and cultural, and teacher thinking—interact and influence each other.

**The Personal Context.** When studying science education in urban schools, King and his colleagues (2001) describe that four teachers (two black and two white) lack the necessary skills to engage their students in inquiry-based science. The researchers suggest current policy-level problems exist with teacher preparation programs, which are not adequately fostering the development of teachers who teach science in urban settings. As a result, “ill-prepared students graduate and struggle for success as teachers in settings that would challenge the most rigorously prepared individuals” (King et al., 2001, p. 104). Lack of preparation adversely influences teacher efficacy and the belief that they can enact inquiry-based science instruction in their classrooms.

Another study examines the effectiveness of a county-wide professional development model at year two of a five-year project. The findings suggest that participation in an intense and sustained professional development project improves teacher preparedness, suggesting that change occurs in teachers’ knowledge of science content, instructional practices, and beliefs (Khourey-Bowers, Dinko, & Hart, 2005). According to the TCSR model, “teachers’ continued learning efforts” (Woodbury & Gess-Newsome, 2002, p. 773) influence teacher practice. As such, poor teacher preparation as described in the previous study or increased knowledge of content and pedagogy as indicated in the latter study directly impacts a teacher’s personal context, influencing what their science instruction will look like.

**The Structural and Cultural Contexts.** Other studies illustrate how the structural and cultural contexts influence teacher practice as well. In a study conducted by Bencze and Hodson (1999) in the Ontario School District, two seventh grade teachers collaborate with a university researcher to change the naïve views that teachers hold
about scientific inquiry. The results indicate that teachers’ classroom practice reflect a more authentic and philosophically appropriate perception of the nature of science, one that aligns with science reform envisaged in *The core curriculum*. Despite instructional improvements, “Public opinion and its impact on the culture of the school was a constant constraint on the work of the group” (p. 532). As teachers make the philosophical shifts in their beliefs and practice, the challenge is in helping parents to understand that new approaches to science are not always going to be available or presented to them in a printed document. “[C]onvincing a parent who demands to see the curriculum and expects to be handed a document of specific directions for teachers [and] that it makes better educational sense to regard curriculum as a resource to help teachers critique and reconstruct their professional practice…is no easy matter” (p. 533). Hence, community expectations presented a constant struggle for these teachers engaged in the process of change.

In another study, Dass (1999) discusses how *structural and cultural contexts*, particularly support that is provided by the district, peers, and school principal (Banilower et al., 2007), is viewed as instrumental in leading to implementation of reformed science practices. The support systems foster a spirit of commitment and collaboration wherein schools are able to make modifications to assessment practices, grade-level dynamics, and curriculum structures that “ultimately lead to better and fuller implementation of the desired instructional approaches” (Dass, 1999, p. 19).

**Teacher Thinking.** Just as the *personal* and *structural and cultural contexts* of reform directly influence teacher thinking and their subsequent practice, what teachers think too influences the outcome of reform. Goodnough (2008), Hammrich (1999), and Yerrick and his colleagues (1997) find this to be the case as professional development aimed at reforming practice is hampered by the beliefs teachers hold when they enter a professional development activity. Despite intense engagement in the activity, “participants professed that they had not seen that much of a change in their thinking…[as they] had interpreted most of the message of the institute through the firm beliefs that they brought into the institute” (Yerrick et. al., 1997, p. 152). In both cases, teacher beliefs about teaching and learning are assimilated through an intricate filtering system
that ultimately affects their receptiveness to new approaches embarked upon by the district, individual school, department, or grade level.

These studies are but a few that have been instrumental in helping science educators understand that teacher practice is affected by an array of factors, both internal and external. The important point to be made here is that the personal context and the structural and cultural contexts all interact with teacher beliefs producing the enacted curriculum. As science educators, we must develop a better understanding of the different contexts as well as the systems, subsystems, and people within the contexts to better understand how they influence the enactment of science education reform.

**Instructional Leadership Model: The Role of the Principal Reformed**

**The Principal’s Role in Instructional Development.** The literature is replete with empirical studies and position papers that articulate that the school principal is essential to the development and maintenance of an effective school (Andrews & Soder, 1987; Galvan, 1999; Rodriguez, 2007; Sloan, 1993; McEwan, 2003; Wahlstrom & Louis, 2008). But what is not as clear is what principals actually do within the confines of a school that is thought to promote success. That is, what is it about the quality of leadership at these schools that appears to determine why some schools are not as successful as others?

Following an extensive literature search, it becomes clear that effective schools have effective principals who are involved in the instructional programs at their schools (Andrews & Soder, 1987; Fouts, Stuen, Anderson, & Parnell, 2000; Fulmer, 2006; Spillane et al., 2001). Although a theme that emerged in the 1980s identifying the ultimate power within the school (Beck & Murphy, 1993), instructional leadership of the 1990s and 2000s has the principal sharing the task of school improvement and student achievement with the larger school community through data-driven decision making.

Principals are “expected to coach, teach, and develop the teachers in their schools and be the instructional leader. Overall, this change in the role of the principal might best be described as a movement from management to leadership, with management still necessary for the efficient operation of the school” (Berube et al., 2004, p. 2). Principals, therefore, are said to set the tone within the school, with their influence having a direct
and indirect effect on the teachers’ susceptibility to new ideas and innovations (Banilower et al., 2007; Hallinger & Heck, 1996; Sloan, 1993), the teaching methods and strategies that are or are not used (Blasé & Blasé, 2001a), the (data-driven) instructional decisions that are made (Halverson et al., 2007; Lachat et al., 2006); the success or failure of curricula (Carter & Klotz, 1990); and the overall school culture (Pajak & McAfee, 1992; Rodriguez, 2007), just to name a few.

Vasquez (2008) asserts that “[t]he key to having effective teachers teaching science is a well-informed and educated administration. Most elementary administrators and district-level administrators are not well versed in science education” (p. 96). This has to change if science education reform has any chance of long-term sustainability.

**Pulling it all Together: Holistic View of Instructional Leadership**

The instructional leadership discussion postulates that researchers have different views about what should constitute instructional leadership. This can be seen by examining the *Instructional Leadership Action/Behavior Model* (Table 11), which includes actions or behaviors researchers indicate principals should be performing as instructional leaders (Blasé & Blasé, 1999a; Gupton, 2003; Halverson et al., 2007; King 2002; Wanzare & Da Costa, 2001). However, upon closer examination it becomes clear that many of the ideals and principles presented in the literature overlap, with researchers using different terms to refer to like concepts/behaviors. Moreover, because many are similar, I have grouped them into six broad themes: 1) engage in and promote professional growth/development, 2) monitor student progress, 3) make available the necessary resources for instruction (4) prepare the culture for change 5) develop teacher leadership, and 6) use leadership skills to promote (science) education. These themes parallel those that emerged in Hanegan’s (2001) research investigation, in which principals identify these themes as important components of their *support* of elementary science teaching and learning. These themes, along with the actions or behaviors encompassed in each, served as a framework to examine the instructional leader of today’s principal.
Table 11 Instructional Leadership Action/Behavior Model

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<tr>
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<tbody>
<tr>
<td><strong>THEME: Engage in and Promote Professional Growth/Development</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Praise Teacher for Jobs Well Done</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Provide a Supportive Environment</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>3. Foster Collaborative Relationships (Mentor/Coaching)</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>4. Promote Teacher Professional Development</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>5. Supervise Teachers’ Performance/Give Feedback</td>
<td>*</td>
<td></td>
<td></td>
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<tr>
<td>6. Promote Teacher Reflection</td>
<td>*</td>
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</tbody>
</table>
| 7. Lead Learning | | | *
| 8. Look for Effective Teaching | | | *
| 9. Model Instructional Practices | | | *
| **THEME: Monitor Student Progress** | | | |
| 10. Monitor Student Progress | * | | |
| 11. Organize Classrooms For Instruction | * | | |
| 12. Promote Orderly Learning Environment | | * | * |
| 13. Consider Students in Learning Process | | | *
| 14. Set High Standards | | | *
| 15. Promote Student Learning | | | *
| 16. Data-driven Decision-Making | | | *
| **THEME: Make Available the Necessary Resources for Instruction** | | | |
| 17. Allocate Resources for Instruction | | * | |
| **THEME: Prepare the Culture for Change** | | | |
| 18. Articulate a School Vision | | * | *
| 19. Define School Values | * | * | *
| **THEME: Develop Teacher Leadership** | | | |
| 20. Develop Leadership Capacity in Teachers | | | *
| 21. Teachers as Decision-Makers | | | |
| **THEME: Use Leadership Skills to Promote (Science) Education** | | | *
| 22. Positive/Informal Leadership | * | * | *
| 23. Human Relations Skills/Expertise | * | * | *
| 24. Participation in the Decision-Making | * | * | *
| 25. Solicit Parental Support | | | *

* - Reflected in the proposed model or action/behavior frameworks
Italicized – Action or behavior is taken from definitions
Bold – New Instructional Leadership (Halverson et al., 2007)
Educational leadership reform places a premium on instructional leadership as it provides the preconditions for enhanced student learning. But as researchers indicate, when elementary principals function as instructional leaders, it is more often in reading and mathematics, because they feel more confident in their ability in these areas and it is often assessed through standardized means (Fulp, 2002; Templeton, 1999). However, a principal’s instructional leadership must facilitate and support teaching and learning in all academic areas, including science; teachers cannot do it alone.

**Summary**

Principals have been recognized as very influential at the elementary level, being seen as major contributors to the successful implementation of school reform. While the goal of scientific literacy for all continues to be a work-in-progress, reformers recognize the importance of collaboration between principals and teachers if changes are to be long-term and transforming. Although principals and teachers are encouraged to collaborate to bring about changes in science instruction, the literature that examines this phenomenon is scarce, albeit emerging. As science educators anxious to support the reform of science teaching, we must begin to understand the relationship between a principal’s instructional leadership and how it shapes what teacher do in their classrooms. With the goal being “lasting reform of education [rather than] immediate improvement” (AAAS, 1990, p. 209), we are in the infantile stages of a movement that began in the 1980s and is expected to see maximum results by 2061, coincidentally, roughly the period of time of the human lifespan (Rutherford, 2001).

The following chapter examines the methodology, data collection methods, and data analysis procedures used in this investigation. Included also is a description of the setting and the participants.
CHAPTER III

METODOLOGY

The researcher who has not yet penetrated the world of the individuals being studied is in no firm position to begin developing predictions, explanations, and theories about that world.

Norman K. Denzin

Research Design

Philosophical Foundation

I am but a compilation of my many experiences, interactions, and encounters in that they shape who I am and how I view the world. And although a goal of qualitative researchers “is to objectively study the subjective states of their subjects” (Bogden & Biklen, 1998, p. 33), I can never be nor do I wish to be a clean slate unaffected by my surroundings. The postpositivist posture adopted for this investigation recognizes that the researcher brings beliefs, assumptions, and lived experiences into a research investigation, shaping the development of relationships and interpretation.

Postpositivism provides an alternative to the traditional positivists thought, arguing that methods chosen, the process of interpretation as one seeks to ascertain meaning, and researcher bias has the potential to distort reality. For these reasons, postpositivists “accept fallibilism as an unavoidable fact of life [as]…conjectures are supported by the strongest (if possibly imperfect) warrants we can muster at the time and always subject to reconsideration” (Phillips & Burbules, 2000, p. 29-30). However, by utilizing rigorous methods, postpositivists argue that they can construct a useful explanation that may likely be true. My aim here is no exception; a systematic, reflective, and rigorous research investigation that allows me to construct an explanation or description of the interaction for principals and classroom teachers that is likely to
reflect or echo the way things “really are”—recognizing that we never become privy to this ultimate knowledge.

**Naturalistic Inquiry: Entering the Natural Setting**

In the 1980s, the science education community advocated and supported naturalistic inquiry as a research methodology because of its potential to add a new dimension to traditional scientific inquiry. Advocates espoused that the naturalistic paradigm could potentially revolutionize traditional ways in which researchers conceptualize and conduct science education research and could potentially expand the types of questions research can answer (Aikenhead & Ryan, 1992; Easley, 1982; Palmquist & Finley, 1997; Smith, 1982). According to Smith (1982), with the data coming first, it is “teased [for] descriptive patterns, hypotheses, perhaps theory, or even “a story” (p. 628). Prior hypotheses have a role, but are more fragile and changeable than in traditional inquiry, wherein the research must hold fast to the hypotheses he [sic] stated beforehand and to the operational definition of constructs that he [sic] chose” (p. 628).

In science education, a field historically dominated by experimental inquiry, earlier researchers in science education proposed working definitions to help us better understand and clarify the purpose of naturalistic inquiry (Easley, 1982; Smith, 1982; Welch, 1983). According to Welch (1983), naturalistic inquiry means studying “…a situation without manipulation, and with minimum imposition or constraints. The data are usually derived from observation, interviews, but could come from artifacts, memorabilia, or other nonintrusive measures” (p. 96). Mindful of this, I entered the research experience with beliefs and assumptions that influenced what questions I asked (or did not ask), what data I collected (or did not collect), and what theories were developed (or not developed). Further, naturalistic researchers are aware that when they engage with the participants, the context, and the artifacts within the context, through the process of interpretation, points of view and perceived social realities recursively interact. Although the participants and the context was not manipulated or measured experimentally, as we interacted and engaged in the process of interpretation, this social exchange shaped the conclusions that were drawn and the explanations that were generated.
Naturalistic inquiry was used for this investigation, as the aim was to develop an understanding of how an elementary school principal enacts instructional leadership in the school’s science program and how teachers’ interpret and respond to this instructional leadership. Naturalistic inquiry, adapted from Patton’s text *Qualitative Research & Evaluation Methods* (2002), guided this investigation. According to Patton (2002),

Qualitative designs are naturalistic to the extent that the research takes place in real-world settings and the research does not attempt to manipulate the phenomenon of interest. The phenomenon of interest unfolds naturally in that it has no predetermined course established by and for the researcher such as would occur in a laboratory or other controlled setting. Observations take place in real-world settings and people are interviewed with open-ended questions in places and under conditions that are comfortable for and familiar to them (p. 39).

Utilizing Egon Guba’s treatise on naturalistic inquiry as a premise, Patton (2002) supports the notion of naturalistic inquiry

...as a “discovery-oriented” approach that minimizes investigator manipulation of the study setting and places no prior constraints on what the outcomes of the research will be. Naturalistic inquiry contrasts with controlled experimental designs where, ideally, the investigator controls study conditions by manipulating, changing, or holding constant external influences and where very limited set of outcome variables is measured...[N]aturalistic inquiry replaces the fixed treatment/outcome emphasis of the controlled experiment with a dynamic, process orientation that documents actual operations and impacts of a process, program, or intervention over a period of time (p. 39-40, 42).

It was my desire to develop a holistic and lucid understanding of the interplay between the principal and teachers of science. Examining this phenomenon at one site allowed me to look at the interplay between the principal’s instructional leadership and the teachers’ instructional practices in greater depth, bringing to light data that may have otherwise gone unnoticed if I were to utilize multiple sites investigating each superficially. In addition, examining a single school afforded me the opportunity to focus more on the elements that are fundamental to my understanding. Second, because the actions and interactions of the principal and teachers within the context gave voice to
situations, events, and artifacts, understanding them at the deepest level and from multiple perspectives was favored. Finally, the site was selected because it has been deemed successful according to the Governor’s A+ Plan, receiving an “A” several consecutive years. Hence, the research site was purposively or intentionally selected (Bogdan & Biklen, 1998; Lincoln & Guba, 1985; Merriam, 1998), to serve as an information-rich case where “one can learn a great deal about issues of central importance to the purpose of the research” (Patton, 2002, p. 46). Entry was gained after the principal responded to my request letter asking permission to conduct the investigation at her school.

Meeting of the Minds: A Postpositivist in a Natural Setting

The postpositivist paradigm recognizes that as human beings, we bring judgments, biases, and personal beliefs into research situations; we do not enter as clean slates, devoid of predispositions from which to connect, synthesize, and make interpretations. Postpositivist research is colored by the lens that we use to see the world, the cultural norms within the research context, and the people who inform our understanding of the context. As a postpositivist in a natural setting, I recognize and honor the fluidity that is unavoidable in socially amorphous settings where people, beliefs, and context converge. As such, I realize that value-neutrality is impossible, although I attempted to minimize researcher bias through the methods used and the analysis techniques. The beauty is that postpositivism recognizes the social embeddedness inherent in natural settings, but amidst, provides the flexibility for researchers to generate plausible theories from an inherently imperfect process (Patton, 2002; Phillips & Burbules, 2000).

The following section provides a description of the participants and setting, the role of the researcher, the multiple sources of data collection, data analysis procedures, the treatment of the data, and the quality criteria.
Participants and Setting

General Context of the Snella County School District

This investigation was conducted in the Snella County School district, one of the largest metropolitan school districts in the state of Florida. Because of the size of the district, it was further delineated into zones that are self-governing and free to make pertinent decisions for schools in the zoned areas. Zone leaders included, but were not limited to, the zone superintendent, zone deputy superintendent, curriculum supervisors, and science education specialists. The district served a multi-ethnic and multi-lingual student population with 60% of the students being of Hispanic origin, 28% African American, 10% White, and less than 3% non-white or of Other minority group. To accommodate the vast student enrollment and diversity in student needs, the district had several school configurations including elementary, middle, and high schools; K-8 centers; vocational/adult schools; magnet schools; primary learning facilities; charter schools; alternative schools; fine arts schools; and special education centers. The site for this investigation, Simmons Elementary School, was a public school located in the largest zone in the district, which consisted of over 50 schools further delineated into five feeder patterns.

Simmons Elementary School. Simmons Elementary School was a split level elementary school located on 4.6 acres of land. On the north side, the school was adjoined by one of the feeder pattern middle schools (grades sixth through eighth) that functioned as a separate entity, but shared cafeteria staff. On the east adjoining side was the kindergarten through fifth Exceptional Students Education (E.S.E.) facility, which too operated separate and distinct from the main campus. The E.S.E. program (self-contained, pull-out, and inclusion model) provided service to students with a range of disabilities; from Learning Disabled to Profoundly Mentally Handicapped. The administrators at Simmons Elementary, Dr. Carsona (principal) and Ms. Perez (assistant principal) (also referred to as the administrative team or principals) were the administrators for the E.S.E. facility, but the day-to-day operations were performed by an E.S.E. Specialist.

Simmons Elementary School was located in the city of Gardner, a large, urban metropolitan community in a southeast county in Florida. Centrally positioned, the
school sat in the middle of a working class, residential neighborhood. The community had changed greatly over the years due in part to a growing population, airport expansion that caused tourism to surge, local development, and increased economic opportunities. With an economy that was fertile, bringing with it the potential for endless possibilities, the city as well as the Gardner community began to grow. Accordingly, school demographics changed, serving then and still today a student population that is multilingual, multiracial, and multiethnic.

Although situated in a low to middle S.E.S. (social economic status) community, for several years, the school earned the letter grade of “A” under the state grading system. The school was firm in its commitment to the academic achievement of all students, implementing a curriculum that met the needs of a multicultural student body, putting the academic needs of students first, and partnering with parents and the community to expand student opportunities (School Vision Statement).

**Student Demographics.** The student body enrollment was roughly 600, which was inclusive of the students in the self-contained E.S.E. facility. The student population was largely minority, with 91% of the student population of Hispanic descent; 6% African American; 2% White; and less than 1% Other. A Title I school (a program designed to help disadvantaged children meet high academic standards, participating in either a school wide or a targeted assistance program), 81% of the students participated in the free or reduced lunch programs. I selected a school site that had a large minority population, because as indicated by the U.S. Department of Commerce (1999):

> All racial and ethnic groups will grow in population from 1995 to 2050…The minority population will account for nearly 90 percent of this increase … Among the minority groups, Asian and Pacific Islanders and Hispanics (who may be of any race) are by far the fastest growing populations. The 267-percent increase for Asians and 258-percent increase for Hispanics imply that these two groups will more than triple their 1995 population sizes, reaching 34 million and 97 million people, respectively, in 2050. The Black population is projected to reach 61 million in 2050, an increase of 83 percent (p. 1-2).

Therefore, as society continues to diversify, it is important to conduct research in schools that are representative of many classrooms today and undoubtedly the classrooms of the
future. This will allow for an understanding of science education reform in an evolving, diverse, and multicultural society.

**Staff Demographics.** Collectively there were 114 full and part-time staff members, consisting of the administrative, instructional, and support teams. First, the administrative team accounted for less than 1% (i.e., the principal and assistant principal) of the total staff. The principal, Dr. Carsoa, who like much of the student population is of Hispanic descent, was a spirited and energetic woman who greeted students, parents, and teachers in their native tongue as she circulated the campus each day. Next, the assistant principal, Ms. Perez, also of Hispanic descent, had been an assistant principal for five years, although assigned to Simmons at the beginning of the 2006 school year. Even though her primary responsibility was that of student discipline, she was also very involved with the instructional program, serving on leadership committees aimed at instructional improvement, curriculum planning/monitoring, and teacher instructional supervision, growth, and development.

Next, the instructional staff consisted of classroom teachers, special area/assignment teachers (e.g., P.E., art, reading coach teacher, reading resource teacher), and English Speakers of Other Languages (ESOL) teachers. This group, with teacher experience averaging 12 years in the state of Florida, made up 25% of the staff. The ESE faculty as a whole (e.g., instructional staff, speech pathologist, occupational therapist) made up 27% of the total faculty.

The instructional staff was a great source of information for this investigation because of its continuity; more that 70% of the teachers had been at the school-site 12 years or more and were instrumental in helping me understand changes in the science program over-time. Additionally, one veteran teacher held an Education Specialist Degree in Science Education and she spoke a great deal with me about the school’s science program as interpreted through the eyes of science education reform.

Finally, the support staff accounted for 46% of the total staff, consisting of custodians, main office staff, cafeteria workers, paraprofessionals, a media specialist, a computer technician, a school psychologist, a community involvement specialist, and a security officer.
Participants: Administrative Team, Science Teachers, and Resource Teachers

Participants included the principal and assistant principal who were charged with making final decisions regarding the school in general and the science instructional program specifically (RJE-121406). The school was departmentalized; therefore, each grade level had a teacher of science. First and second grades had one science teacher each. Third grade had two science teachers. Fourth grade was self-contained, so each of the three teachers was responsible for their own science instruction. Finally, there was one fifth grade science teacher. Table 12 identifies the science teachers and the number of groups each teacher was responsible for providing science instruction to each day.

Table 12 Simmons’s Science Teacher

<table>
<thead>
<tr>
<th>Grade</th>
<th>Teachers</th>
<th>Number of Groups Per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ms. Harvey</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Ms. Gilbert</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Ms. Torrez</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Ms. Rappas</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Mr. Claud</td>
<td>Self-contained</td>
</tr>
<tr>
<td></td>
<td>Ms. Hernandez</td>
<td>Self-contained</td>
</tr>
<tr>
<td></td>
<td>Ms. Smith</td>
<td>Self-contained</td>
</tr>
<tr>
<td>5</td>
<td>Ms. Jenson</td>
<td>3</td>
</tr>
</tbody>
</table>

These were individuals who were directly responsible for providing instruction as per the district-wide pacing guide. Finally, there was the science laboratory teacher, Ms. Jefferson. Her primary responsibility was to provide students with “hands-on” science experiences that aligned with the concepts they learned in their science classroom. By including a range of participants, an expansive data set was generated.

Researcher Statement

As the researcher in this investigation, I was the primary instrument of data collection and analysis. My role was one of observer as participant, as my “participation
in the group [was]...secondary to the role of information gatherer” (Merriam, 1998, p. 101). Hence, my primary responsibility was that of researcher as instrument (Patton, 2002). As I embarked upon this research investigation poised to, as much as humanly possible, report explanations that support the data, I recognized that my experiences, skills as a researcher, state of mind, and multiple perspectives, colored by professional experiences, shaped my thinking and influenced my interpretations, understandings, and perceptions.

**Professional Landscape**

My career in education has been varied, allowing me at different points to enter into a realm that may have influenced the findings and conclusions reported in this research investigation. First, I had the pleasure of working as an elementary school teacher for seven years (and a reading specialist for one of those years). I was required to teach science, however, I did not enjoy teaching it (neither was the teaching of it encouraged). When I did teach science, my teaching was very didactic, teacher-centered, and often with the intent of collecting a science grade for the week. Science, unlike the other subjects I was required to teach, I found to be time consuming and challenging because my lack of content knowledge hampered my ability to engage students in meaningful science experiences. But I came to realize then (and still believe now) that although conceived by many elementary school teachers as difficult, science had an element of mystery, surprise, and unpredictability that would help students become great thinkers while doing science. Therefore, it was my professional responsibility to engage in professional development activities aimed at improving my content knowledge and pedagogical repertoire. I enrolled in several summer institutes, inservice workshops, and district developed professional development sessions aimed at science improvement. After completing a Master’s Degree and certification in educational leadership, I embarked upon an Education Specialist Degree in science education (middle and secondary) to continue what had become a personal mission of science literacy, and improved teaching and learning practices. This marked the beginning of what I hoped was a long history in science education and my role as advocate for elementary science education reform and improvement.
My career aspirations then took me in a different direction, accepting a position as a school administrator in a small private school. Although in the position for a relatively short time, this experience allowed me to examine situations through a lens unlike that of a classroom teacher, science educator/advocate, or science education researcher. As a school administrator I quickly came to realize that as I sat amidst competing interests and agendas (i.e., teachers, parents, community, etc.), what was best for the students was negotiated in an often unreceptive, open-forum. In this forum the majority did not always share my views of what was in the best interest of the students. Unlike my position as a classroom teacher, in which issues that directly affected my students was my primary focus, as an administrator my lens was broadened, having to take into account other stakeholders who had an interest in student achievement as well.

Although my administrative duties were demanding and laborious, my interest in science teaching and learning never waned. In fact, I became quite enamored with the art of teaching science, often visiting the science classroom looking for images of effective science instruction and to simply provide support. After completing my Education Specialist Degree, I eagerly enrolled full-time in the doctoral program in science education. I was prepared and excited to enmesh myself in a culture that would continue to shape my beliefs about the teaching and learning of science, influence how I view the world, and shape how I communicate the vision of reform to practitioners. Now, as a science educator/advocate/researcher who stands on the periphery looking in, I am neither “in the trenches” (teacher) so to speak, nor am I mediating competing interests (administrator). Teachers and administrators considered me (as I often did with university personnel when I was at the school-level) the “outsider,” a position that I negotiated with participants at the onset of this investigation.

Within the context of this investigation, I was mindful of the fact that my beliefs, attitudes, assumptions, and dispositions are indivisible. This compilation brings together the whole of who I am, which made a complete disassociation at any point during the investigative process impossible. I appreciate and celebrate the fact that the many angles, faces, and voices of who I am can be accessed at any point during the data collection process to relate to and identify with the participants and setting on a more intimate level. I also realize that this same familiarity, at times, muddled my thinking. Therefore, as I
attempted to maintain a suitable balance between the objectivity I sought, the subjectivity of my multiple voices, and the social interconnectedness of the people within the context, I made every attempt to limit where possible, my personal partialities as to not compromise the integrity of this work. As such, I constantly confronted my own biases, continuously reflecting on how my experiences and multiple selves may be influencing my thinking and interpretations. Central to this task was my reflective journal (discussed below), which was not only an important data source, but also a forum in which “the more subjective side of [my] journey [was] reported [including]…speculations, feelings problems, ideas, hunches, impressions, and prejudices” (Bogden & Biklen, 1998, p. 123). More importantly it was a space where I could just get real and challenge my thinking.

I have disclosed this information because on the one hand, my own experience as a school administrator and teacher proved beneficial because of my familiarity with the culture of schooling. On the other hand however, this familiarity introduced an element of bias and taken-for-granted assumptions that I consistently re-assessed and re-evaluated as I grappled with understandings and attempted to make plausible connections.

**Reform-Minded Science Practices: What this Means for this Investigation**

As an observer as participant and “outsider” within this context, the objective of this investigation was to develop an understanding of how the actions/behaviors employed by an elementary principal influence science teachers; hence the enactment of reformed-minded science practices. Initially, reform-minded science practices were narrowly defined by the presence of inquiry-based science instruction and other inductive instructional methods that promote critical thinking and encourage conceptual understanding. With inquiry as a central precept of the *Science for All* movement, it was my belief that the instructional leadership actions/behaviors of the principal or the process of employing “effective” instructional leadership would lead to inquiry in the classroom.

Inquiry as an instructional method was a rarity in the science classrooms, prompting me to expand and create a broader conception of reform-minded science practice. Whereas inquiry-based instruction was indeed fundamental, reformed-minded science practices included other actions, processes, and behaviors that encouraged,
allowed for, and prepared the environment for science improvements. The expanded
notion of reform-minded practices included a *classroom* and *community* component.
Within the context of the classroom, reform-minded practices included the use and
refinement of science processes to advance scientific understandings, collaboration,
engagement in “intelligent” science discussions, use science-related technologies,
classrooms that have the science resources to engage students in inductive science
lessons, the inclusion of lessons that reflect the science standards stipulated in the NSES
and the Florida Sunshine State Standards for Science, science instruction that reflected
higher order thinking processes, and the use of diverse instructional methods.

From the community perspective as it relates to improving science teaching and
learning, reform-minded science practices included the implementation of a curriculum
framework that aligned with the NSES and the Florida Sunshine State Standards for
Science, clearly articulated goals and objectives for science improvements, collaboration
between science teachers and administrators, collaboration between science teachers
within and across grade levels, and participation in professional development experiences
that promote the vision of science education reform. These practices are key components
of national reform efforts within the science education and educational leadership
communities.

**Data Collection**

“The methodological status hierarchy in science ranks “hard data” above “soft
data” where “hardness” refers to the precision of statistics. Qualitative data, then, carry
the stigma of “being soft.” But “qualitative methods are not weaker or softer than
quantitative approaches. Qualitative methods are *different*” (Patton, 2002, p. 573-574).

The difference between these perspectives does not make the methodological
principles of postpositivism within naturalistic studies devoid of rigor because of its
qualitative application. On the contrary, as one strives to generate conjectural claims that
best support the data, recognizing that claims are theory-laden, changeable, and not
absolute as described in the positivist variety, the use of multiple methods lends itself to a
subtle yet intellectually intricate form of rigor. Although positivist researchers rely on
the safeguards inherent in controlled experimental design and statistical analysis
programs, the postpositivist paradigm uses the data collected from a multitude of sources to assess, evaluate, and challenge the authenticity or credibility of the claims. As a postpositivist researcher embedded in a natural setting, the use of multimethods maximized my ability to recognize intersects as well as scrutinize and contrast the data, establishing relevant and supported claims. The following table outlines the stages of data collection.

Table 13 Stages of Data Collection with Main Data Sources

<table>
<thead>
<tr>
<th>STAGE</th>
<th>DATA COLLECTION METHOD</th>
<th>MAIN DATA SOURCE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>- School Visit</td>
<td>- Reflective Journal</td>
</tr>
<tr>
<td></td>
<td>- Campus Walk-through</td>
<td>- Reflective Journal</td>
</tr>
<tr>
<td></td>
<td>- Formal Meeting with Principal</td>
<td>- Reflective Journal</td>
</tr>
<tr>
<td></td>
<td>- First Interview with Principal</td>
<td>- Interview</td>
</tr>
<tr>
<td></td>
<td>- Classroom Observation of Science Instruction</td>
<td>- Observation Protocol</td>
</tr>
<tr>
<td></td>
<td>- Interview with Science Teachers/Science Laboratory Teacher</td>
<td>- Reflective Journal</td>
</tr>
<tr>
<td></td>
<td>- Classroom Observation of Science Instruction</td>
<td>- Observation Protocol</td>
</tr>
<tr>
<td></td>
<td>- Document Analysis</td>
<td>- Reflective Journal</td>
</tr>
<tr>
<td></td>
<td>- Reflective Journal</td>
<td>- Documents</td>
</tr>
<tr>
<td>II</td>
<td>- Interview with Science Teachers/Science Laboratory Teacher</td>
<td>- Interview</td>
</tr>
<tr>
<td></td>
<td>- Classroom Observation of Science Instruction</td>
<td>- Observation Protocol</td>
</tr>
<tr>
<td></td>
<td>- First Interview with Assistant Principal</td>
<td>- Reflective Journal</td>
</tr>
<tr>
<td></td>
<td>- Second Interview with Principal</td>
<td>- Matrix</td>
</tr>
<tr>
<td></td>
<td>- Document Analysis</td>
<td>- Reflective Journal</td>
</tr>
<tr>
<td></td>
<td>- Reflective Journal</td>
<td>- Documents</td>
</tr>
<tr>
<td>III</td>
<td>- Classroom Observation of Science Instruction</td>
<td>- Observation Protocol</td>
</tr>
<tr>
<td></td>
<td>- Interview with Science Teachers/Science Laboratory Teacher</td>
<td>- Reflective Journal</td>
</tr>
<tr>
<td></td>
<td>- Final Interview with Principal (member checking)</td>
<td>- Observation Protocol</td>
</tr>
<tr>
<td></td>
<td>- Final Interview with Assistant Principal (member checking)</td>
<td>- Reflective Journal</td>
</tr>
<tr>
<td></td>
<td>- Document Analysis</td>
<td>- Observation Protocol</td>
</tr>
<tr>
<td></td>
<td>- Reflective Journal</td>
<td>- Documents</td>
</tr>
</tbody>
</table>

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Data Collection Methods

Data collection for this investigation began in Fall 2006 and ended Summer 2007. I spent an extensive amount of time talking with, shadowing, and observing the participants throughout their day; usually four to five days a week. I immersed myself into the culture, making the transition from unwanted outsider to wanted outsider rather painlessly. I attended social events, participated in cultural programs, chaperoned fieldtrips, assisted with after-school and Saturday tutoring, as well as other school and community events. In accord with the postpositivist and naturalistic perspective, I used the following methods: interviews, document analysis, reflective journal, observations, as well as an Instructional Leadership Action/Behavior Questionnaire (ILABQ) (see Appendix B). Too, informal dialogue with all of the participants throughout this investigation (e.g., exchanges over lunch, phone conversations, chatting while walking the campus, etc.) also contributed greatly to my understandings. Some of the informal exchanges were recorded and transcribed, while others I reflected upon in my journal. As it relates to the context of this investigation, each method is discussed below.

Interviews. The words people utter are great sources of data, as they make researchers privy to internal beliefs, ways of thinking, feelings, or intentions that cannot be observed. Interviewing the participants or engaging them in what Merriam (1998) calls purposeful conversations, granted me access to their innermost thoughts and convictions, allowing me to capture “a holistic picture” (p. 83) of the individual. Several semistructured interviews (Merriam, 1998) or Standardized Open-Ended Interviews (Patton, 2002) were conducted ranging in length from 30 minutes to over two hours, with the principal, assistant principal, science laboratory teacher, and science teachers in grades one, three, four, and five. (Note: The second grade teacher did not wish to participate in the study. She did, however, allow me to observe the teaching and learning of science in her classroom and engaged me in a few informal discussions.) Interview protocols were developed for initial interviews. Subsequent interview questions were written to clarify responses and to shape my budding interpretations.
Transcribing the spoken language compiled from interviews (and informal dialogues) was a significant part of the research process as the practice situated the dialogue in a familiar form of expression: written text (Bogdan & Biklen, 1998). To these ends, all interviews were recorded and transcribed verbatim throughout the data collection process. I transcribed all interviews within three weeks of the interview at which time I typed pertinent information about the interview (when, where, who, time, purpose, and interview number) and a brief at-a-glance summary for each. Although the conversational context captured the voice tones, emotions, and temperaments between interviewer and interviewee, once transcribed, I was able to deemphasize these elements, which although revealing, diverted my attention away from the essence of the conversation. Transcripts were then used to facilitate the process of data analysis and member-checking as I clarified the thoughts, ideas, and conceptions of the participants.

**Document Analysis.** Documentary data are particularly good sources for naturalistic inquiry investigations, because as Lincoln & Guba (1985) postulates, they are quite often available for public viewing and free of charge. As Patton (2002) describes, “an oft-intriguing form of analysis involves comparing official statements found in public
documents (brochures, board minutes, annual reports) with private memos and what the evaluation observer actually hears or sees occurring in a program” (p. 293). Analyzing context-specific documents allows a researcher to make sense of a social context across time, revealing, as a snapshot, what organizations or people therein do, don’t do, and what they value. The gathering and analyzing of documents was essential to my understanding of the science program at Simmons. Reviewing the documents helped me to develop a sound understanding of Simmons’s science program, make connections across data sources, and illuminate contradictions. Table 15 lists the primary documents that were analyzed along with a description of each.
<table>
<thead>
<tr>
<th></th>
<th>Table 15 Primary Analysis Documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Action Research Plan</strong>&lt;br&gt;A plan that targeted an area (science) that the school needed to improve upon. The document was prepared for district/zone leaders.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Annual Yearly Progress Report</strong>&lt;br&gt;A report that provided a breakdown of how Simmons made AYP as per Florida Department of Education.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Articulation Documents</strong>&lt;br&gt;Documents that were developed by the science teacher(s) in one grade (e.g. 5th grade) for science teachers in the grade below (e.g. 4th grade) that stipulated the most important skills/concepts they should focus on to prepare students for the grade they will be entering (these meeting were held after FCAT).</td>
</tr>
<tr>
<td>4</td>
<td><strong>Crunch-Time/Class Schedules</strong>&lt;br&gt;An amended schedule given to schools by the district in the months (2 ½) leading up to FCAT. Teachers’ class schedules.</td>
</tr>
<tr>
<td>5</td>
<td><strong>District/School Calendars</strong>&lt;br&gt;Calendar of events from the district and the school.</td>
</tr>
<tr>
<td>6</td>
<td><strong>District Science Online Pages</strong>&lt;br&gt;The Division of Science website contained information about the district’s science program including School-to-Careers.</td>
</tr>
<tr>
<td>7</td>
<td><strong>District Scope and Sequence</strong>&lt;br&gt;A guide that stipulated concept(s)/skill(s) teachers should be teaching, key vocabulary concepts, activities/resources/labs that supported instruction, textbook alignment, and the week(s)/quarter the concept(s)/skill(s) should be taught.</td>
</tr>
<tr>
<td>8</td>
<td><strong>District/Zone Emails</strong>&lt;br&gt;Science-related emails from the district to the school/science-related emails from the zone to the school.</td>
</tr>
<tr>
<td>9</td>
<td><strong>District/Zone/School Memorandums</strong>&lt;br&gt;Science-related memorandums from the district to the school/science-related memorandums from the zone to the school.</td>
</tr>
<tr>
<td>10</td>
<td><strong>FCAT Focus Points</strong>&lt;br&gt;Document that identified content assessed on the FCAT and the point values attributed to those items.</td>
</tr>
<tr>
<td>11</td>
<td><strong>FCAT Science Results</strong>&lt;br&gt;Florida Comprehensive Assessment Test results for assessed areas (reading, mathematics, science, and writing).</td>
</tr>
<tr>
<td>12</td>
<td><strong>FCAT Science “Time-Till-Test” Schedule</strong>&lt;br&gt;A modified scope and sequence schedule teachers followed to target those skill that were on the upcoming FCAT.</td>
</tr>
<tr>
<td>13</td>
<td><strong>Lesson Plans</strong>&lt;br&gt;Teacher-develop lesson plans for science instruction.</td>
</tr>
<tr>
<td>14</td>
<td><strong>Mathematics and Science Plan: School-to-Careers Initiative</strong>&lt;br&gt;The district’s science plan that articulated the vision and goals for science teaching and learning.</td>
</tr>
<tr>
<td>15</td>
<td><strong>Principals’ Meeting Agenda/Principal Notes</strong>&lt;br&gt;District Principals’ Meeting dedicated to science. Areas discussed: science professional development, scope and sequence, science laboratory, science block, and FCAT.</td>
</tr>
<tr>
<td>16</td>
<td><strong>Professional Development Site</strong>&lt;br&gt;Website which housed the district’s professional development opportunities.</td>
</tr>
<tr>
<td>17</td>
<td><strong>Reading, Mathematics, and Social Studies Documents</strong>&lt;br&gt;These included various school and district documents that provided insight into the reading, mathematics, and social studies, programs.</td>
</tr>
<tr>
<td>18</td>
<td><strong>School Improvement Plan</strong>&lt;br&gt;Document developed that targeted specific objectives, providing a plan of action to achieve the stipulated objectives.</td>
</tr>
<tr>
<td>19</td>
<td><strong>School-based Quarterly Science Assessments</strong>&lt;br&gt;The formative science assessment and results (FCAT Sample Test) that were administered to the students each quarter.</td>
</tr>
<tr>
<td>20</td>
<td><strong>Teaching Materials</strong>&lt;br&gt;These included textbooks, worksheets, assessments, tutoring materials, supplementary materials, and computer software.</td>
</tr>
<tr>
<td>21</td>
<td><strong>Teacher Evaluation Performance Reports</strong>&lt;br&gt;Teacher performance reports that measured performance in areas such as instructional planning, student progress (linked to quarterly science assessment), instructional delivery, professionalism, etc.</td>
</tr>
<tr>
<td>22</td>
<td><strong>Visitation Logs</strong>&lt;br&gt;Logs located in every teacher’s classroom where the principal/assistant principal signs when they visit the classroom.</td>
</tr>
<tr>
<td>23</td>
<td><strong>Zone March to March Instructional Plan</strong>&lt;br&gt;Zone-generated document that provided suggestions for what teachers should teach in each grade level following the FCAT. This document explicitly outlined strategies to support the state standards.</td>
</tr>
</tbody>
</table>
**Reflective Journal Entries.** I kept a reflective journal throughout the entire data collection process. The entries ranged from extensive fieldnotes to one word sentences that recounted my thoughts and feelings at a particular point in time. This was also a space where I recorded observations, ideas, and questions as they related to my understanding of the investigation. I also put in writing “description[s] of the people, objects, places, events, activities…conversations…strategies, reflections, and hunches, as well as note[d] patterns that emerge[d]” (Bogdan & Biklen, 1998, p. 107). My reflective journal was invaluable to my sense-making, as I often referred to the entries to help me recall specific points in time that were muddled and unclear in my mind and recollect on experiences that helped me to better understand specific instances.

**Observations.** Observations maximize the researcher as instrument allowing one to corroborate spoken claims with what participants do as part of their daily routines. Within the context of this investigation, observational data allowed me as observer as participant to “see things firsthand and [use my] own knowledge and expertise in interpreting what is observed rather than relying upon once-removed accounts from interviews” (Merriam, 1998, p. 96). I spent a great deal of time surveying the campus, observing teachers as they taught science, examining the interplay between science teachers and principals during team meetings, and shadowing the principal as she performed daily activities, collecting observational data during the process. A Classroom Observation Protocol (see Appendix E) was used to collect data that captures the essence of classroom instruction, with each observation lasting roughly an hour. All other observational data (i.e., campus walks, science teachers meeting, articulation meetings) were described in my reflective journal. Table 16 summarizes the classroom observation data reported in the Classroom Observation Protocol.
Table 16 Portrait of Classroom Observations

<table>
<thead>
<tr>
<th>Teachers</th>
<th>Number of Observations</th>
<th>Cognitive Level of Activity (See Appendix E: Classroom Observation Protocol)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Receipt of Knowledge</td>
</tr>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>Ms. Harvey</td>
<td>8</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>Ms. Gilbert</td>
<td>2</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Ms. Torrez</td>
<td>6</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Ms. Rappas</td>
<td>4</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Mr. Claud</td>
<td>4</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Ms. Hernandez</td>
<td>4</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Ms. Smith</td>
<td>4</td>
</tr>
<tr>
<td>5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Ms. Jenson</td>
<td>24</td>
</tr>
<tr>
<td>Lab</td>
<td>Ms. Jefferson</td>
<td>13</td>
</tr>
</tbody>
</table>

**Instructional Leadership Action/Behavior Questionnaire.** As discussed in Chapter II, educational leadership researchers have utilized instructional leadership definitions, models, and frameworks to guide principals as they transitioned into their role as instructional leader. To better identify and understand how the instructional leadership actions/behaviors employed by Dr. Carsona influenced teachers and the science program, I compiled the views and perspectives of several researchers (Blasé & Blasé, 1999a, 1999b; Gupton, 2003; Halverson et al., 2007; Keefe & Jenkins, 1984; King 2002; Wanzare & Da Costa, 2001) into what I have titled the *Instructional Leadership Action/Behavior Model* (see Table 11). The model encapsulates the many “hats” that today’s principal as instructional leaders must wear. I utilized the model as a data collection tool to get a collective view of Dr. Carsona’s instructional leadership from multiple perspectives.
Utilizing the Instructional Leadership Action/Behavior Model

To ascertain what instructional leadership actions/behaviors the principal employed in science, I converted the Instructional Leadership Action/Behavior Model (see Table 11) into an opened-ended questionnaire—the Instructional Leadership Action/Behavior Questionnaire (see Appendix B). The questionnaire was given to Dr. Carsona, Ms. Perez, and the science teachers (grades 1, 3, 4, 5 and the science laboratory teacher) during stage one and two of data collection. I met with each participant individually to ask that they complete the questionnaire and return it to me within three weeks. All questionnaires were returned and used during data analysis. Once returned, I compiled all of the responses into one document. Then during follow-up interviews and informal exchanges, I verified the accuracy of data claims, discussed uncorroborated instances of instructional leadership, and clarified how the actions/behaviors employed by Dr. Carsona influenced the science program.

Inductive Data Analysis Procedures

One of the most fundamental processes central to the postpositivist perspective and naturalistic inquiry is the comprehensive and rigorous analysis of data. Bogdan and Biklen (1998) define data analysis as “the process of systematically searching and arranging the interview transcripts, fieldnotes, and other materials that you accumulate to increase your own understanding of them and to enable you to present what you have discovered to others” (p. 157). Postpositivists assert that research involving human subjects in social settings can indeed be “scientific” when data analysis is rigorous and meticulously carried out. Researchers must therefore competently gather evidence to support the interpretations presented and the theories generated (Phillips & Burbules, 2000). Hence, of immense importance is the intensive and careful interpretation and analysis of the data.

For qualitative inquiry, Patton (2002) recommends using the inductive data analysis and creative synthesis process, which immerses the researcher “in the details and specifics of the data to discover important patterns, themes, and interrelationships; begins by exploring, then confirming; [is] guided by analytical principles rather than rules; [and] ends with creative synthesis” (p. 41). Salient to this process of analysis and synthesis is
the method of analysis referred to as constant comparative (Merriam, 1998; Patton, 2002). As data were collected, I constantly tested it against emerging theories. This occurred throughout the process of data collection. Rules governing the assignment of data to emerging categories were developed, establishing an inbuilt evaluation system that ensured the constant scrutinizing of the data and that only the data supporting the categories were included. According to Lincoln & Guba (1985), “It is this dynamic working back and forth that gives the analyst confidence that he or she is converging on some stable and meaningful categories” (p. 342).

**Processing of the Data**

**Unitizing**. Unitizing is a coding procedure, in which raw data are aggregated and transformed into individual units of data that describe content expressed by research participants (Lincoln & Guba, 1985). The units of data emerged from interview transcripts, documents, reflective journal entries, observations, and the questionnaire.

Prior to entering the setting, I generated a “start list” (see Appendix C) of codes (Miles & Huberman, 1994, p. 58), which provided a framework for systematically organizing the wealth of data collected according to common themes. The start list was based on current research in science education, educational leadership, and instructional leadership as well as the research questions I hoped to answer. As initial data units from all sources were being analyzed, other codes were added to the start list. Including other codes in this manner, often referred to as open coding, allowed me to identify, analyze, and make note of phenomena that was not accounted for on the start list. Coding text was not limited to single words, but paragraphs, sentences, and phrases, as to not compromise or distort the intended meaning.

Once the data were analyzed using the start list and the open coding method, axial codes were developed, whereby data were intentionally organized using a coding scheme that organized the data systematically based on commonalities (Lincoln & Guba, 1985). I used code words and phrases that captured the essence of the category and corresponding data to make preliminary connections and to identify relationships between the different data sources. As codes changed, theories developed, and initial interpretations failed to inform my understanding, they were disregarded or modified.
Throughout the process of data collection and analysis, modifications to the coding scheme and the emerging categories happened continually. Disregarded codes and corresponding data were kept in a separate computer file, which I examined periodically to see if they could be reintegrated into the emerging coding scheme. According to Patton (2002), this recursive analysis process allows for the development of provisional categories that relate and provide a reasonable explanation for the data; the formulation of rules that govern the inclusion of data under a particular category; and “…the foundation for case write-ups” that is situated in the data (p. 58).

**Categorizing.** The next phase in the analysis process was *categorizing*. Categorizing is defined as “a process whereby previously utilized data are organized into categories that provide descriptive or inferential information about the context or setting from which the units were derived” (Lincoln & Guba, 1985, p. 203). After axial codes were established, I organized the data into themes that were reflective of the data represented and defined by the core category. Because of the conceptual overlaps, some of the provisional categories were combined while others were placed into independent yet interconnected subcategories because of slight, yet significant distinctions. For example, one of the initial coding categories was FCAT. The category generated a great deal of data. However the school also administered a quarterly science assessment (FCAT Sample Test), and there was teacher reaction to FCAT, administrative team reaction to FCAT, activities targeting FCAT, and other related activities that warranted subcategories. I concluded data analysis when the data being collected no longer informed my understandings, but rather confirmed existing themes and became redundant.

To trace data back to the original sources, a signifying code followed all direct quotes and reflective journal entries included in the body of this document. The source (i.e. interview), type of respondent (i.e. principal), and the date obtained are represented by the abbreviated code. For example, for a data unit extracted from the principal’s interview on November 3, 2007, the code that follows reads: P-I-110307. When data is extracted from a reflective journal entry dated November 3, 2007, the code that follows reads: RJE-110307. Another example is for data collected and reported from analyzing documents. In these instances, these data are reported as followed: DA-The number of
the document indicated in Table 15-Date document obtained. Data collection methods codes and an example of a document analysis code follows in Table 17. Also following is the abbreviated code for the respondents with an example for audiotaped informal dialogue recorded on November 3, 2007.

Table 17 Data Collection Methods Codes and Examples of Use

<table>
<thead>
<tr>
<th>Data Collection Methods</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interview</td>
<td>I</td>
</tr>
<tr>
<td>Informal Dialogue</td>
<td>ID</td>
</tr>
<tr>
<td>Document Analysis</td>
<td>DA</td>
</tr>
<tr>
<td>Reflective Journal Entry</td>
<td>RJE</td>
</tr>
<tr>
<td>Observation/Observation Protocol</td>
<td>O/OP</td>
</tr>
<tr>
<td>Instructional Leadership Action/Behavior Questionnaire</td>
<td>ILABQ</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Document Analysis Example</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data extracted from the <em>FCAT Focus Point</em> document on March 14, 2007</td>
<td>DA-13-031407</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade</th>
<th>Teachers</th>
<th>Code</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ms. Harvey</td>
<td>H1</td>
<td>H1-ID-110307</td>
</tr>
<tr>
<td>2</td>
<td>Ms. Gilbert</td>
<td>G2</td>
<td>G2-ID-110307</td>
</tr>
<tr>
<td>3</td>
<td>Ms. Torrez</td>
<td>T3</td>
<td>T3-ID-110307</td>
</tr>
<tr>
<td>3</td>
<td>Ms. Rappas</td>
<td>R3</td>
<td>R3-ID-110307</td>
</tr>
<tr>
<td>4</td>
<td>Mr. Claud</td>
<td>C4</td>
<td>C4-ID-110307</td>
</tr>
<tr>
<td>4</td>
<td>Ms. Hernandez</td>
<td>H4</td>
<td>H4-ID-110307</td>
</tr>
<tr>
<td>4</td>
<td>Ms. Smith</td>
<td>S4</td>
<td>S4-ID-110307</td>
</tr>
<tr>
<td>5</td>
<td>Ms. Jenson</td>
<td>J5</td>
<td>J5-ID-110307</td>
</tr>
<tr>
<td>Lab</td>
<td>Ms. Jefferson</td>
<td>Jlab</td>
<td>Jlab-ID-110307</td>
</tr>
<tr>
<td>Principal</td>
<td>Dr. Cardona</td>
<td>P</td>
<td>P-ID-110307</td>
</tr>
<tr>
<td>Assistant Principal</td>
<td>Ms. Perez</td>
<td>AP</td>
<td>AP-ID-110307</td>
</tr>
</tbody>
</table>
Contextual Factors Matrix. As instructional leaders, principals must make every effort to ameliorate unfavorable conditions that may have adverse affects on teachers’ enacted practice (Blasé & Blasé, 2004; Blasé & Kirby, 2000; Fullan, 2001, 2007; Spillane et al., 2001; Wanaze & Da Costa, 2001). As the TCSR model outlines (see Figure 1), these interconnected systems or contexts—national, state, & district context; school context; department & subject area context; and the classroom context— influence teachers’ thinking, hence their practice. In an effort to understand which broad context(s) teachers believed was hindering or had previously hindered them from teaching and engaging students in science effectively, I utilized the TCSR model to create the Contextual Factors Matrix (see Appendix D). To create the matrix, I extracted the contexts and the elements included in the TCSR model and arranged them into matrix form.

Woodbury and Gess-Newsome (2002) list the contexts (national, state, & district; school; department & subject area; and classroom), that influence teacher thinking, therefore the outcomes of reform. Interview transcripts, my reflective journal entries, and school and district-generated documents were scrutinized to identify elements that participants indicated had a positive influence on the science program and those factors that hindered the teaching and learning of science. I then situated those factors on the matrix underneath the corresponding context (e.g. school context, classroom context, etc.). In so doing, I was able to see (as indicated by the frequency) the context that Dr. Carsona and the science teachers saw as having the greatest influence on the teaching and learning of science. I was also able to determine which contextual elements the principal had attempted to mediate. The contexts and elements identified on the Contextual Factors Matrix were discussed with participants in follow-up interviews and/or informal conversations.

Ensuring Quality in Research

As the instrument and interpreter during both the data collection and analysis process, it was imperative that I establish methodological trustworthiness, so that the findings are deemed credible and are useful to researcher and practitioners alike. As I strived to be impartial, I attempted to understand the reality of the context and the varied
perspectives of those operating within the context. I also attempted to accurately describe
the data that corroborated and supported the findings as well as present the data that
contradicted. According to Patton (2002), “Any credible research strategy requires that
the investigator adopt a stance of neutrality with regard to the phenomenon understudy.
This simply means that the investigator does not set out to prove a particular perspective
or manipulate the data to arrive at predisposed truths” (p. 51).

I accomplished this by maintaining high levels of internal validity. Internal
validity is concerned with how trustworthy and credible the conclusions are, while
external validity is concerned with the generalizability of conclusion to a larger
population (Lincoln & Guba, 1985). Because of the study’s objective, internal validity
was prioritized, and can be understood as a researcher’s ability “to carry out the inquiry
in such a way that the probability that the findings will be found credible is enhanced,
and to demonstrate the credibility of the findings by having them approved by the
constructors…” (Lincoln & Guba, 1985, p. 296). Trustworthiness, by way of balance,
completeness, and fairness (Patton, 2002), was established by employing the following
techniques.

Criteria of Trustworthiness: Establishing Credibility

Persistent Observation/Prolonged Engagement. A keystone of naturalistic
inquiry is that researchers are emerged in the setting for long periods of time so as to
examine at a deeper level the experiences of people within a social context that is
dynamic and constantly in flux. I spent seven months at Simmons attempting to develop
an understanding of the science program. Because I was immersed in the context for an
extended period of time, I was able to get a better understanding of the setting,
participants, cultural norms, routines, and behaviors, as they related to science. Too, I
was able to determine if school-wide activities for science persisted overtime or if they
were isolated and random. Further, prolonged engagement allowed me to build trusting
relationships and to authenticate the data when triangulated using the multiple data
sources.
**Triangulation**

In qualitative investigations, utilizing multimethods is encouraged, because “studies that use only one method are more vulnerable to errors linked to that particular methods…than studies that use multiple methods in which different types of data provide cross-data consistency checks” (Patton, 2002, p. 556). Triangulating across data sources imbibes confidence in the findings, interpretations, and conclusions. Because of the wealth of data collected from a multitude of sources, triangulation helped me to make better informed deductions and understand the complexity of the relationship between principals and teachers in an evolving and synergistic system. In the qualitative research tradition, Janesick (1998) identifies five modes of data triangulation.

**Table 18 Models of Triangulation**

<table>
<thead>
<tr>
<th>Data Triangulation</th>
<th>The use of a variety of data sources in a study.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigator Triangulation</td>
<td>The use of several different researchers or evaluators.</td>
</tr>
<tr>
<td>Theory Triangulation</td>
<td>The use of multiple perspectives to interpret a single set of data.</td>
</tr>
<tr>
<td>Methodological Triangulation</td>
<td>The use of multiple methods to study a single problem.</td>
</tr>
<tr>
<td>Interdisciplinary Triangulation</td>
<td>The use of other disciplines to inform the research Process. (p. 46)</td>
</tr>
</tbody>
</table>

Considering the nature of this investigation, I used data and methodological triangulation to substantiate emerging theory and to pinpoint contradictions and inconsistencies within the data.

Because of the complex nature of this investigation, I needed to take into account more than one perspective as to verify that the emerging themes accurately reflected the true nature of what was occurring in the setting. Analysis of data began with interview data as these data were the first sources available. Using the star code list, each data source, particularly interview transcripts, documents, data obtained from the observation protocol, and the questionnaire were analyzed, affixing the data clip and/or document dates reflected by the code underneath. Once themes began to emerge and as data continued to be collected, I compared the reportings of different participants, document
analysis findings with participant reports, and observations with information provided on the questionnaire. The objective was to validate the findings as I checked for consistencies over time, between participants, and across all available data. Triangulating data using multiple sources allowed me to identify themes that provided answers to the research questions and generate implications for practice from this research investigation.

*Developing Negative Cases*

Negative case analysis allows one to consider “…the instances and cases that do not fit within the pattern. These may be exceptions that prove the rule they may also broaden the “rule,” change the “rule,” or cast doubt on the rule altogether” (Patton, 2002, p. 554). Although no exception would be ideal, it is unlikely with human subjects who consciously or unconsciously are self-delusional or intentionally deceptive. When ideas did not mesh with emerging themes, I re-examined them to understand conceptually why the case was atypical. In such instances, I modified the emerging theory to reflect the discrepancy. Therefore, negative case analysis shaped my conclusions, implications, and recommendations.

*Member Checking*

To further establish credibility, I gave the participants an opportunity to react to the interpretations made, the conclusions draw, and the broad theories generated from the data. Participants were given interview transcripts, which included my interpretations, and a document I prepared, which summarized the theories generated. The administrative team and the science teachers were asked to provide commentary, clarifying misunderstandings and misinterpretations in some areas and elaborating and giving details in others.

Member checking were conducted throughout the data collection and analysis process. In the first and second stages of this investigation, as themes and ideas emerged, I constantly checked my understandings through phone conversations, interviews, and informal dialogue sessions. During the final stage of data collection, participants were asked to react and provide feedback when provided with written accounts of my findings and understandings. I provided the administrative team and the first, third, fourth, and fifth grade science teachers with an abstract and discussion of the themes with supporting
data and the rationale for the conclusions. The participants read and checked the
document for accuracy, completeness, and clarified any misunderstandings that were
present. Ms. Perez and the science teachers agreed with the findings, offering additional
commentary affirming that my interpretations in fact accurately reflected science at
Simmons Elementary and in the district. Dr. Carsona agreed (for the most part) with the
final assessment; her only objection was with how the district was portrayed. She
attempted to clarify the district’s actions reflected in my conclusions when faced with the
reality of their miscues. This difference in analysis was resolved by reporting Dr.
Carsona’s perception of the district’s efforts in the final document.

Peer Debriefing

Simply put, peer debriefing involves “asking [my] colleagues to comment on the
findings as they emerge” (Merriam, 1998, p. 204). As the researcher in this investigation
responsible for collecting and analyzing data, my connectedness to the research site often
clouded my judgment and caused me to overlook glaring inconsistencies and make hasty
judgments. It is for this reason that I constantly engaged in extensive discussions with
my peers, academicians and practitioners, throughout the process of the investigation. In
these debriefing sessions my peers demanded that I clarify and justify my positions, they
challenged my ideas, and they helped me to make connections that were obscure as well
as those that were rather obvious. According to Denzin (1994), peer debriefing increases
"the credibility of a project" (p. 513). It too contributed to confirming the findings and
the interpretations and provided a network of support to cope with the stresses associated
to fieldwork.

Fitness and Transferability. Fittingness and transferability in qualitative
research is concerned with findings that are presented in a manner that are meaningful to
recipient and are able to be recognized as a good “fit” to inform their own context
(Lincoln & Guba, 1985; Patton, 2002). Because words bring to life the mere essence of
qualitative research, it is therefore imperative that qualitative findings provide thick
descriptions of the context and participants. Therefore, I provided the readers with
sufficient descriptive data to help them determine if the research findings can be
transferred in whole or in part to their particular context. I included a clear description of
Simmons’s academic program, the participants in the site, the science program, and the elements of the principal’s instructional leadership that shaped the science program and teacher practices.

**Summary**

This study utilized a postpositivistic lens within the context of a natural setting as a research design. This chapter included detailed descriptions of the context, participants within the context, the methods used, and the treatment of data, as I attempted to illuminate their beliefs, thoughts, attitudes, and experiences (Bogdan & Biklen, 1998; Denzin & Lincoln, 2000; Lincoln & Guba, 1985; Patton 2002). Multiple data sources were utilized and allowed for multiple voices that aided in the corroboration of research findings and conclusions. An analysis of the feedback provided by the participants was completed and generated various categories, themes, and theory for me to examine throughout the process of this investigation.

The following chapter presents the findings of this investigation. Included is a description of the principals, Simmons’s science program, and the science teachers within the context. Also included is a discussion of the type of instruction that was prioritized within the science program, and the goals and vision for science teaching and learning from the vantage point of the school and district.
CHAPTER IV

FINDINGS

My use of naturalistic inquiry as a research methodology allowed me to understand and describe through non-intrusive means how Dr. Carsons’s instructional leadership influenced teaching and learning within the science program. In this chapter, I present the research findings from this investigation. The following discussions are included:

- Snella County School District’s “public” vision for science contrasted with the “actual” vision disseminated through internal correspondence;
- A description of the professional leadership attributes of Dr. Carsons and Ms. Perez;
- A portrait of Dr. Carsons’s instructional leadership in the science program and the influence of this leadership on teachers’ instructional practices;
- A description of Simmons’s science program and the efforts toward improvement; and
- Science teachers’ response to Dr. Carsons’s instructional leadership in science.

Looking at the Reality of a Context

*No Child Left Behind,* and consequently *Florida’s A+ Plan* has placed an enormous amount to pressure on schools in Florida to increase student achievement. This federal and state mandate requires schools to report measurable learning gains each year in academic areas they are held accountable for or face strict sanctions, staff reassignment, or closure (Center on Education Policy, 2006). As a result, subjects such as science (and social studies) have been largely overlooked (Griffith & Schermann,
2008; Johnson, 2007a) despite science plans like the one developed by the Snella County School District, which promoted reform-minded science practices.

The decision to conduct this investigation in the Snella County School District was prompted by my “stumbling” upon the science plan that reflected what I consider to be an earnest effort to enact reform-minded science practices that align with the national vision for science education reform. However, the district’s “public” science plan, while reform-minded, progressive, inclusive, and several years into its district-wide implementation, was not central to what Dr. Carsona was asked or encouraged to do within the school’s science program. In fact, there was no evidence that any feature of the “public” science plan was launched at Simmons.

**A District’s Disregard for its “Public” School-to-Careers Science Initiative**

The district, with the School-to-Careers Science Plan, articulated a vision in which all students, upon graduation, would have the scientific capacity to succeed in post-secondary endeavors as well as possess the necessary skills to thrive in the workplace. Science literacy was a recurring theme throughout the “public” science plan and it outlined a reform-minded agenda to achieve the stated goals.

The School-to-Careers Science Plan was the document available for “public” viewing on the district’s website and presented to all as the vision to achieve scientific literacy through the use of innovative, reform-oriented practices. However, the “actual” science plan—the one driven by FCAT results and disseminated through internal correspondence, was most important to district science leaders, was at the forefront of district/school discourse, and dominated the district’s agenda for science. None of the internal documents (i.e. emails, memorandums, instructional materials, etc.) that I analyzed made reference to the “public” science plan. Rather, the documents suggested materials that were deemed high-quality test preparation materials; reminded teachers of the test preparation materials available from the district (e.g., practice tests); and reiterated the fact that the district expected “schools to show growth on this year’s FCAT administration” (DA-11-120706, 011007, 012307, 013007, 020807, 021307, 022007, 040307, 040507). This district suggested changes that made very little difference in the quality of science teaching and learning; hence, perpetuating a long-standing supposition
of change without difference amidst a national science education reform movement (Goodman, 1995; Woodbury & Gess-Newsome, 2002).

For science education researchers and reformers, the “public” science plan represents reform that aligns with national efforts and seeks to fundamentally change how science has traditionally been taught, learned, and conceptualized. However, Dr. Carsons indicated that she had not been trained on how to incorporate the science plan into the school’s science program, so it had been sitting on her shelf, unopened since she received it several years before (P-I-011507).

A “Plan” of Action or a Shelf Stacker?

With the onset of FCAT Science, there had been some indication that the district was now “paying attention” to science (e.g., holding principal meetings exclusively dedicated to science, ordering textbooks, strategic planning, and adding science to the district-wide conversation) (DA-15-011607). These small changes for the administrators and teachers were a huge step forward when compared to what the district had done in previous years with regard to science, which was “pretty much nothing” (AP-I-051007). Instead, the district focused much of their efforts on the NCLB areas of reading/language arts and mathematics (DA-17-011907 through 051707). In spite of these subtle and nuanced efforts, the “public” science plan, which was to lay the foundation for true inquiry (DA-14-042104), equip school administrators to implement reform-minded science programs, and reform the teaching and learning of science in all grades (particularly at the elementary level) (DA-14-042104), did not make a substantial difference in how science was taught and learned at Simmons Elementary. Despite the ambition “public” science plan, it did not change the dynamics with regard to the teaching and learning of science (RJE-032907). One might ask why this is.

Although the “public” science plan was very specific with regard to the attainment of scientific literacy for all graduates (DA-14-042104), what the district was to provide (e.g., district organized summer institutes for principals and teachers, district appointed science specialist, school visits from zone team leaders, etc.) and what was expected of principals and teachers (e.g., implement science-based television programs, organize school-based science leadership teams, 30 minutes of science daily, etc.), the
science plan was not central to the district’s efforts in preparing students for what was deemed important: the FCAT. Many of the activities stipulated in the “public” science plan that were to be initiated and monitored by the school district and those activities that were the responsibility of the school, were not in operation at Simmons (DA-14-042104; RJE-021507). Unsettling was the fact that most in the school had never heard of the science plan (1 of 2 administrators and 2 of 10 teachers), although a major component was on-going summer institutes for principals and professional development opportunities for teachers that focused on pedagogical enhancements, professional growth, and school-based science revitalization (RJE-022307; AP-I-031907).

A copy of the science plan sat on a shelf in Dr. Carsona’s office amidst a host of other binders with school related titles. Dr. Carsona turned and pointed to the three inch binder admitting, “I haven’t looked at it that much….How can you when you are constantly trying to raise reading and math scores. They [reading and math scores] count” (P-I-011507). It appeared as if the science plan had become just another document on her shelf among many others. I struggled to understand why the district’s “public” science plan had little meaning for Dr. Carsona.

It appeared that, although the “public” science plan was a formal document available and offered as the district’s vision for science with the plan of action delineated, this plan was not primary in governing the district’s activities. Document analysis and interview data revealed that much of the correspondence (memos, emails, practice materials, etc.) from the district with regard to science made explicit or implicit reference to the FCAT or the “actual” science plan, but made no reference to the “public” science plan (DA-8-120506, 011807, 012307; DA-9-011907, 032007; DA-20-021207, 032007; DA-23-021207). The participants agreed that correspondence from the district chiefly centered around “suggestions” for classroom activities or science technology that would develop student skills, ultimately bolstering FCAT scores. Communication also reminded teachers of the content/concepts (FCAT) that should be the focus of classroom instruction; outlined a seven week “crunch time” FCAT preparation schedule; and reminded teachers to use the FCAT materials and resources available.

With the district making “suggestions” that principals were “strongly encouraged” to follow, controlling when schools would receive the new science textbook series,
providing no monetary support to make changes in the science program, and managing
the professional development options, the district shaped Dr. Carsona’s instructional
leadership in terms of science teaching and learning. Combined with this, Dr. Carsona
saw herself as the liaison between the district and her school, a role in which there was
“very little variance in whatever they [the district] force[d] us or decide[d] we [were]
going to [do]” (P-I-062007).

Simmons’s curriculum was therefore inundated with activities that were to
“increase student achievement” in science (e.g., working through FCAT practice tests and
science content area reading passages with comprehension questions) (DA-13-091806
through 052507; DA-18-010907). Certainly, one of the objectives of the “public” science
plan was student success on the FCAT, and scientific literacy or meaningful learning.
But many of the activities the “public” science plan included, which were designed to
change how principals and teachers conceptualized the teaching and learning of science,
were not executed. Some of these omitted experiences included summer science
institutes that would help teachers and principals understand national reform; professional
development experiences that would assist teachers and principals in increasing students’
level of scientific literacy; weekly professional development sessions with teachers
knowledgeable about science education reform; and individual professional development
plans crafted with zone-assigned specialists (DA-14-042104). Despite the systemic and
district-wide efforts toward reform-based science instruction included in the “public”
science plan, Dr. Carsona was expected to refocus the school on science, develop a
program (or implement the district’s program) that prioritized test preparation, and do so
with limited resources and very little knowledge of what effective, reform-minded
science was to look like.

Despite a “public” science plan that supported the goals and vision espoused by
AAAS (1990) and NRC (1996), what was written in the plan was not translated into
practice at the district or school level. The discord between the “public” document and
the articulated expectations of the district greatly influenced Dr. Carsona and the science
program at Simmons. The science program was shaped by the district’s “actual” goal for
science (that of success on FCAT—not those included in the district’s “public” science
plan), the resources available (or lack thereof), and the suggestions for programmatic
restructuring. With the “public” science plan, the district claimed to have reform-minded instruction as a goal, but with a different message being pushed (in memorandums, through emails, verbally, in meetings, etc), the message for science was incongruous and dualistic (DA-9-021907, 021907; DA-8-022707; DA-15-011607). But because Dr. Carsona saw it as her responsibility (as liaison between the district and school) to work towards the district’s vision (“actual” vision), she was relentless in her efforts as an instructional leader who implemented a science program that was consistent with district expectations. Even the “actual” goal of the district necessitated a restructuring of the science program, in which Dr. Carsona was to lead the charge.

**Dr. Carsona: A Principal’s Instructional Leadership in a Science Program Under Construction**

**Personal Profile**

When I began this investigation, Dr. Carsona had been a dedicated and committed educator from K-12 to higher education for over 25 years. She taught elementary school, was a zone elementary education specialist, assistant principal, and a principal. Though inexact on the number of years she taught, finally settling on “over ten” (P-I-011507), Dr. Carsona admitted that science was one of her favorite subjects, pointing out proudly that her students enjoyed doing experiments and “hands-on” science activities. Dr. Carsona also taught education courses at a local university for several years, an experience that she described as “electrifying” (P-I-011507) because the students constantly reminded her of why she became an educator. In the 1980s, Dr. Carsona received her Doctorate of Education in Curriculum and Instruction, something she deemed one of her greatest accomplishments. Dr. Carsona had been the principal at Simmons Elementary for 10 years, the only school where she has served as principal.

Dr. Carsona, standing about five feet three inches tall, was a small, petite, woman in her late fifties to early sixties with a youthful spirit. A contemporary and flamboyant dresser, one could say her outward presentation reflected her lively personality. Married with two children in their 30s and 40s, Dr. Carsona had a very close relationship with her family. Her husband visited the school almost daily and participated and helped in any way he could with things such as minor repairs to the facility, running errands for the
tutoring program, and setting up for special programs/assemblies to name a few (RJE-012507). Her children and grandchildren (one also attended Simmons) also visited the school quite often such that the staff and some students knew them by name. These visits were unsolicited, but somewhat expected because they were such a close-knit family. Dr. Carsona loved her family dearly, enjoyed having them around, and believed that you have to let your family know that they are loved and appreciated. This is important to understand as the same beliefs that Dr. Carsona held regarding the affection between her and her immediate family was imparted to her Simmons Elementary “family” (P-I-011507).

Although the Simmons “family,” was not technically a part of her nuclear family, she viewed them as such, showing them the same affection and appreciation extended to her immediate relatives. This expressive, caring, and “touchy-feely” leader could often be observed greeting the staff with “cheek kisses” common in Latin cultures, hugging teachers and staff as she saw them throughout the day, and expressing sentiments of affection such as “Thank you very much,” “I love you,” and “You are so wonderful!”

Dr. Carsona led with a great deal of zest and passion that seemed to radiate from the inside out. She had a charismatic nature that allowed her to “play politics” to get services and resources for her school (e.g. community classes such as money management and English language, library book drive, workshops, child identification card, etc.), and she was approachable, cultivating a relaxed, trusting, and comfortable work environment. Establishing caring and trusting relationships, wherein positive reinforcement was not a chore and a person’s worth was treasured most, Dr. Carsona nurtured an atmosphere of compassion, warmth, sincerity, collegiality, and openness that ignited creativity and engendered dedication from the faculty and staff.

**Dr. Carsona: A Principal Leading with Care and Compassion**

Care and Compassion Personified: An Excerpt from My Reflective Journal

*I sat at the desk in my makeshift office planning my day. I knew that I wanted to observe the second grade science teacher’s classroom and she said this was a good week to stop by. Considering it was Friday, I planned to visit her classroom first thing in the morning in the event my schedule was derailed. On my way to Ms. Gilbert’s classroom, I*
stopped by the office to wave good morning to Dr. Carona. As often the case, Dr. Carona was in the main office chatting with the office staff and teachers who were present. In her animated and vociferous tone she called out, “Kimberly come here listen to this!” I approached an ensuing conversation about a teacher’s new hair cut. Dr. Carona paid the teacher many compliments until she was red in the face with embarrassment. After chit-chatting for a couple of minutes, I wished everyone a good day and headed to Ms. Gilbert’s classroom. When I entered, she was teaching math. I took my usual seat in the back of the classroom in a corner inconspicuous to those entering the door. As she transitioned into science, Ms. Gilbert realized that she did not have the necessary copies for the lesson. She asked if I could watch the class while she goes to the office to make copies. She also opened the adjoining classroom door and let the teacher next door know that she was going to the office. As she was walking to exit the classroom, I heard the door open. From my little corner of the room, I heard Dr. Carona’s voice. Curious she asked, “Where are you going?” Ms. Gilbert replied, “To the office to make copies.”

From my experience as a classroom teacher, I just knew this was not going to be an amiable exchange. As I sat, posture erect and doom on my face, I expected Dr. Carona to chastise the teacher for not being prepared for the day and a litany of other things; I lived this moment before so I feared the inevitable. But to my surprise, I heard nothing I expected! The next words out of Dr. Carona’s mouth were, “No, no, no you stay here, I’ll make them for you.” Her pitch and jovial tone radiated with such understanding, care, and compassion, that I knew this was the “quiet,” but there would most definitely be a “storm” in a far less public forum. Surely this could not be over. After a brief exchange about the number of copies, Dr. Carona rushed off and Ms. Gilbert carried on with class. She instructed students to open their science textbook.

Dr. Carona returned about five minutes later with the copies. When she walked into the classroom our eyes met. Appearing surprised to see me, she spoke once again while giving the copies to Ms. Gilbert. They exchanged pleasantries, Dr. Carona spoke to the students in the classroom thanking them for their good behavior, and exited the room. (RJE-020107)
“I Work for the Teachers... We are like Family”. In the educational environment of high-stakes testing and accountability in the United States, it is often difficult to strike a balance between encouraging teachers to strive everyday to reach higher levels of student achievement and showing teachers that their efforts are appreciated. The requirements are numerous such that the enormity of the tasks may appear unattainable. Monetarily, all principals do not have the luxury of eradicating many of the external or circumstantial pressures that make teachers’ jobs challenging. In this regard, principals must invest in and cultivate a school community where teachers feel valued and staff morale is high (Protheroe, 2006; Whitaker, Whitaker, & Lumpa, 2000). Although Dr. Carsonsna admitted that “it [cultivating a positive school environment] takes some time; it doesn’t happen in a day” (P-I-040707), she made it a priority to ensure that the staff and “teachers feel happy enough so they feel like part of the family and want to do it [work hard] because they are part of the group and...not because they are afraid that I am going to punish them. You know that’s not the way, at least not for me. Who can be productive when they are afraid?” (P-I-040707).

Contrary to popular belief, research has demonstrated that creating a positive school climate and maintaining high staff morale has little to do with salary and work conditions (Evans, 2001; Lumsden, 1998), but much more to do with teachers’ working in a school environment in which they feel valued and that they enjoy. Indeed the demands are great on teachers; from the district and local organizations to state legislators and federal officials. There is an enormous amount of pressure placed on teachers to improve student achievement (Hamilton, Stecher, Marsh, McCombs, Robyn, Russell, Naftel, & Barney, 2007; Hinde, 2003; Wideen, O’Shea, Pye, & Ivany, 1997). However, amidst the pressure, Dr. Carsonsna made it her personal mission to create a school culture where teachers felt that they were valued. She related the type of culture she cultivated to that of a “family.” As she described, “We all have families and we all have issues in our families. But even if we [our families] are bickering, we band together. That’s what we do here at Simmons...we love and trust each other” (P-I-062007).

Central to this idea of school community as “family” was the entire staff and community partners working collectively so that the students would have positive in-
school experiences. Dr. Carsona conceptualized her role in the “family” as that of “worker” not revered matriarch. Although Dr. Carsona recognized that as principal she had been chosen to lead within the hierarchal system of schooling, she also recognized that when teachers are happy and feel valued, they work hard despite unfavorable conditions. As a result, she conceived herself as a principal who worked for the teachers. She made copies, covered classes, located resources to support instruction, and even supported teachers during personal crises. According to Dr. Carsona,

I have been around and I have seen a lot of things good and bad…I have to say that I lead by putting my teachers first. I don’t feel like the teachers work for me, I work for the teachers and I really do mean that. Of course when I need to make a decision I make it, but in the meantime you know I spend my time trying to find out what they need to make their job easier. I try to make them happy any way that I can…we are like family. They work hard everyday; not for me [but] for the children. They never complain…hardly ever. It is my job to make them happy to come to work even sometimes when they don’t want to (P-I-011507; P-I-040707; P-I-062007).

Although constructing a school community as “family” and “working for the teachers” to make their jobs easier are not novel approaches to eliminating the stressful pressures teachers face, Dr. Carsona endeavored to create a comfortable and relaxed work environment where teachers always felt supported and uplifted as they worked hard to provide students with exceptional educational experiences in an era of high-stakes testing, accountability, and unremitting demands. She was eager to defend teachers’ work ethic at principal/zone meetings, offered words of encouragement when teachers were having a challenging day (e.g., “Thank you for all your hard work.” “Great lesson!” and “I love you.”), and showed teachers’ how much they were appreciated; things that she conceived of as typical, but uncharacteristic holistically speaking in the principalship today (P-I-011507).

“My Door is always Open”. Dr. Carsona believed that teachers have one of the most stress-filled and challenging jobs in the world. With pressures from local, state, and federal legislative entities, she saw providing emotional support as critical to her leadership style. She maintained an open-door policy wherein teachers could drop by
anytime to speak with her. “If I want to make things easier for them I need to keep the lines of communication open so that they know I am available…I need them to feel comfortable communicating with me….This is the only way we can make things better for the children you know; by working together” (P-I-040707).

She asserted that a sure way to cause conflict within a school is to stifle teachers’ ability to speak freely about matters that are of concern to them; she understood this silence to be destructive and counterproductive. Dr. Carosa declared that, as the appointed leader of the school, she was the “voice” that the district and zone leaders “heard.” But that voice was an amalgamation of ideas and perspective from a school community that was “verbal…relentless…proactive [and] always trying to find ways to help [the] kids succeed” (P-I-062007). While not all teachers took advantage of the open-door policy, Dr. H. expressed that it was part of her leadership style and the school’s fabric. “I will always have an open-door policy…until I retire you know…teachers are always welcomed” (P-I-040707). The open-door policy provided a forum for teachers to be heard. Someone to listen, she contended, is something teachers’ desire but are often denied (RJE-041007). Teachers throughout the school indicated that they were able to go to her to request instructional resources, vent their frustrations or concerns, make instructional suggestions, and even to discuss personal matters.

**Other Elements of Principals Leading with Care and Compassion.** Authentic leadership befalls from internal commitments that principals hold dear and are externalized in their leadership of learning, within the school community, and amongst the people within the community (George & Gergen, 2007). Dr. Carosa was caring and compassionate in many other ways. She protected teachers from outside scrutiny. At Simmons Elementary, the demands of the district were filtered through a lens of care in an effort to analyze the potential influence on staff morale. For example, Simmons had the lowest science FCAT score in the zone. Despite Simmons’s successes over the years in reading, mathematics, and writing, Dr. Carosa informed me that in zone meetings, the school’s poor performance in science was often referenced in zone meetings, with zone leaders using Simmons as an example to make curricular suggestions to improve their dismal science performance (RJE-011607). Although the district and zone leaders exerted pressure (and a hint of embarrassment by using Simmons as an example in zone
meetings) well into the school year to prompt schools to make dramatic changes in order to improve science test scores, Dr. Carsona chose not to add to the pressure science teachers were already experiencing; knowing Simmons had the lowest science FCAT scores in the zone, she believed was motivation enough (DA-11-122706). She supported teachers as they implemented the science program already in place and worked towards the goals and objectives stipulated in the School Improvement Plan (SIP). Too, she defended teachers (when applicable) in parent/teacher meetings when their professional integrity was in question (e.g., parent charges grading policy is unfair).

For years, schools have been the scapegoats for many of the ills that American society faces (Mishel & Rothstein, 2007), even though many of the problems are beyond their control (Remaley & Hasan, 2003). But because Dr. Carsona knew that her staff was dedicated and committed to the students, she shielded them from divisive parents (e.g., defending teachers when parents criticized their classroom practices) and scrutiny from district/zone leaders to improve science test scores. She trusted the wisdom of her teachers and shared school-wide decision-making with them, stressing “…we know our students and this community” (P-I-011507).

Although a caring environment may be associated with lack of rigor, Dr. Carsona had high expectations for teachers and student learning. In the process of monitoring student progress with the resources provided, she expected continuous improvements on formative assessments and AYP progress reports each year as reflected in district, state, and federal guidelines. She encouraged teachers to come to her at any time if they needed science materials for instruction. Too, Dr. Carsona was a visible presence in the school and visited classrooms often not to criticize, but to uplift, support, cultivate a positive school climate, and to simply lighten the mood (P-I-011507). These positive gestures generally happened as she circulated the campus visiting classrooms. According to the Classroom Visitation Log posted in every classroom, Dr. Carsona visited each science teacher’s classroom from one to four times per week throughout the duration of this investigation (DA-22-120406 through 052507).

Dr. Carsona most often entered the classroom with a smile. During these visits, she did not offer suggestions in the way of pedagogical ideas or improvements. Rather, she talked with students, observed instruction, asked students questions, and/or left
teachers’ notes of praise (e.g., “Keep up the good work!” “Great lesson. I loved how…” and “Very creative [lesson].” etc.) (RJE-021407, 032807, 041007). Although Dr. Carvona sometimes slipped out of the door unnoticed, she more often said something to make the teacher or students chuckle. According to the study conducted by Hurren (2006), principal humor contributes greatly to whether teachers are satisfied with their job. He asserts,

> Teaching is a very stressful job, and principals play a very important role in determining teachers’ job satisfaction…There are times when the job stresses encountered by teachers are too difficult and/or too many to manage alone, but principals are able to relieve teacher stress and improve teacher job satisfaction by creating a supportive structure that invites humor into the environment (p. 383).

Dr. Carvona also valued an individual’s professional and personal growth. She kept an ‘eye out’ for professional development opportunities for teachers in areas directly and not directly related to their teaching responsibilities (e.g., reading leader workshops, gifted workshops, etc.). She also encouraged teachers to use personal days to tend to personal matters, recognizing that a teacher who is emotionally “whole” has the wherewithal to challenge students, and encourage excellence (P-I-011507). The ability to recognize the emotional needs of teachers and hone in on those needs to promote organizational success is referred to as emotional intelligence and social intelligence. Emotional intelligence is a person’s ability to manage his or her behavior to get a particular result. Social intelligence is defined as a person’s ability to lead and manage others’ behaviors to get a particular result (Druskat & Wolff, 2001; Williams, 2008). Williams (2008) reports in her examination of the social and emotional intelligence of “typical” and “outstanding” urban principals, that of the 20 competency clusters examined (e.g., self-awareness [3], self-management [6], social awareness [3], and relationship skills [8]), 12 of the competencies differentiated typical principals from outstanding principals. Outstanding principals are focused, utilize an expansive set of resources (internal and external) to achieve school goals, and are concerned with instructional quality and overall school climate. Druskat and Wolff (2001) go on to say that when leaders manage the emotional culture, they can expect “greater collaboration, creativity, and productivity” (p. 81). Dr. Carvona considered the affective dimension of
emotion and social intelligence as critical to the school’s success, recognizing that, “if the teachers are right there with you and not against you, you can accomplish much, much more than you ever thought possible” (P-I-040707).

By Dr. Carsons own admission, she was a self proclaimed “rebel” who did not have a problem challenging the status quo (P-ID-031207; P-I-062007). As I reflect on one of our many conversations, Dr. Carsons proudly stated that, although she was able to, she had elected not to join D.R.O.P. (Deferred Retirement Option Program). Citing she wanted the flexibility to leave at will, Dr. Carsons was at Simmons “…for the students. I don’t need the money; that’s not why I’m here. I want the students to be successful. I want them [the students] to learn to read and write; do music and instruments; be able to solve the most difficult math problems…I want them to learn science and how it relates to them” (P-ID-031207). Although most Americans work because they need money to support their families (Barajas, 2008), Dr. Carsons did not see her job at Simmons as essential to maintaining her standard of living. As a result, she asserted that whatever she did within the academic program was for the students in an effort to help them be “the best citizens for their community” (P-ID-031207).

The excerpt above describes one such instance in which Dr. Carsons exhibited care, compassion, and understanding. Although the above scenario may describe the actions of many principals across the country, Dr. Carsons, admitting that she had seen some really good and some really bad principals in her years as a principal and assistant principal, acknowledged that the manner in which she handled the situation was a rarity in the principalship. Recognizing that teaching is a human endeavor, Dr. Carsons understood and was compassionate when teachers found themselves in unexpected predicaments. In such cases, she tried to help in any way that she could if it was not to the detriment of the students. Deeming herself the “compassionate leader” who puts the teachers’ first, compassion was central to Dr. Carsons’s leadership style and an element that she continued to hone.

**Beliefs about Teaching and Learning**

Dr. Carsons felt that all students, regardless of social class, level of ability, or circumstances, were entitled to receive a “good” education. Acknowledging that this
position sounds much like the clichés hurled quite often by educators, as evidenced by her elevated tone, fluttering hands, and lengthy declaration, she truly believed and wanted all of the students at Simmons to receive a “top notch” education (P-I-040707). Dr. Carsona adopted this stance because she saw herself in many of Simmons’s students. As someone who faced enormous challenges herself (e.g., an immigrant immersed into a homogeneous society, economically underprivileged, little command of the English language, etc.), she understood that the students at Simmons faced many challenges—economically disadvantaged, culturally different, and physically disabled. Acknowledging these challenges, she wholeheartedly felt that students should have in-school and out-of-school experiences that contributed to their continued growth and development. As she explained:

…all students should get a good, quality education you know. They [students] need to come to school everyday and learn the basics to get high quality careers and then we need to push their thinking to the next level; higher order thinking by having them read and write and answer questions; challenging questions you know. They [students] need to be able to think…I want, you know I encourage them [teachers] to use different techniques—reading, writing, the ACTIVBoard, group work, computers, whatever. They [students] learn in different ways; you have to capture their attention. We are competing with video games and all those things. We have to prepare them to survive in the world out there you know….They [students] need experiences outside of school too, so they go on fieldtrips; we don’t have money, but I have to find it you know. I have to…Teachers are critical [to ensuring a good, quality education] and I have some great, dedicated teachers here and they help students excel. They [teachers] are the reason we’ve been an “A” school…I make sure, well I try to give teachers everything they need to teach their best you know…I send them to workshops to grow and encourage and support them when they want to try new things…The students benefit from teachers who are committed to their success. We have a lot of disadvantages—no money, a large minority population, ESE you know, this community is poor. So what! We do what we have to do (P-I-040707)!
Although Dr. Carsona recognized that the school bore much of the responsibility for providing students with a good, quality education, she also recognized that students also had some responsibility in their development, explaining that students too must view learning and school as important. She explained, “…students have to do their part too. I am not one who believes that if students don’t learn or make progress, we [the school/teachers] did something wrong or we need to completely change everything we are doing you know; now that may be the case sometimes you know because you have to make changes…But students have to want to learn or nothing that we [the school/teachers] do will work” (P-I-040707).

**Beliefs about Science Teaching and Learning**

Dr. Carsona’s beliefs and convictions about science learning were not as grounded as her beliefs about teaching and learning in general. She believed that teachers should have high expectations for student learning and encourage them to think critically, within a facilitative, active, and student-centered learning environment. Ideally, Dr. Carsona thought that the most effective classroom environments were those where students “participate[d] in ‘hands-on’ experiments…[to] learn science [content]” (P-I-040707), citing this as the “best way for students to learn science” (P-I-040707). Incompatibly, however, she felt that students should learn science vocabulary (rote memorization and out of context) and “do science” as a means of learning science content (as facts), because students needed to know science to secure a job in today’s society. Dr. Carsona also adopted the position that science materials (textbooks, science kits, manipulatives, technology, etc.) would automatically assure effective science teaching and learning. Dr. Carsona’s views about the teaching and learning of science can be perceived as both dualistic and naïve. On the one hand she advocated for an inductive, student-centered leaning environment, at the same time encouraging a drill and practice approach to acquiring science knowledge (RJE-032907).

Although Dr. Carsona was very passionate, advocating for the use of “hands-on” in science classrooms, her rationale for the utilization of this approach was shaped by her years as a classroom teacher and the district’s rhetoric. Because her thoughts and understandings had not evolved much over the years and the district’s championing of
“hands-on” instruction was not supported by the district-wide professional development opportunities, “hands-on” science instruction was conceptualized by Dr. Carsona as valuable for the mere fact that students were doing, touching, or manipulating something. Therefore, as I attempted to clarify what was meant by “hands-on” science, Dr. Carsona was unable to coherently describe the purpose, outcomes, and benefits of engaging students in these experiences stating, “I wanna see students doing something [in science]; looking through the microscopes, planting seeds, something you know. If they’re “doing science” they’re learning” (P-I-040707).

**Dr. Carsons’s Instructional Leadership in Science**

Dr. Carsons considered herself to be an effective instructional leader in the school’s academic program, employing leadership activities ranging from praising teachers for excellence in teaching and learning to soliciting parental support and assistance with school-wide events. Science however was an exception. Admittedly, Dr. Carsons’s instructional leadership repertoire from which she could offer suggestions for improvements in science was not as developed as her repertoire in other disciplines (e.g., reading). As a result, accountability, as suggested by the district, was adopted as the primary goal of science instruction and the necessary impetus for Simmons’s recommitment to science. Therefore, accountability drove much of Dr. Carsons’s decision-making in science (RJE- 032207). Accountability dictated:

- What science materials were purchased (e.g., supplementary text resource for fifth grade to augment the antiquated series);
- The focus of after-school/weekend tutoring (e.g., open to fifth grade students only; FCAT preparation activities and test-taking strategies);
- Classroom teachers’ instructional responsibilities (e.g., classroom teachers’ primary responsibility was to teach science content); and
- The decision to departmentalize (e.g., hire/assign teachers who “enjoy” or “like” teaching science).

There was pressure from district/zone leaders to implement a science program that would improve FCAT science scores. This need for improved FCAT scores was packaged and sold as a unified and collective vision for science. Therefore, Dr. Carsons made
decisions that supported accountability oblivious to the fact that these same decisions undermined reform-minded science instruction.

With the district acting as the stimulus behind this renewed interest and revivification of science (or the fact that science became a part of accountability measures), Dr. Carsona worked to achieve the accountability goals set forth by the district and embraced by the school with much assiduity and determination. She wanted to craft a science program that would meet the demands of accountability, but also enhance student experiences in science such that they learned science content (P-I-011507). However, preparing students for success on the FCAT was prioritized based on Simmons’s instructional focus and many of the decisions that were made. Consequently, Dr. Carsona was much more of an instructional leader in fifth grade science (and to a lesser extent the science laboratory because the laboratory was perceived as not having a direct effect on improving FCAT scores) (ILABQ-042607), rather than other grades, as this was when students were assessed in science. Using data from interviews and the Instructional Leadership Action/Behavior Questionnaire (see Appendix B), Table 19 captures the variation in Dr. Carsona’s instructional leadership in the science program in relationship to the academic program in general. Although I observed and noted evidence of the indicators in fifth grade in my reflective journal (RJE-041707), these data were self-reported by administrators and science teachers.
Table 19 Distribution of Instructional Leadership in Science

<table>
<thead>
<tr>
<th>INSTRUCTIONAL LEADERSHIP INDICATORS</th>
<th>Academic Program</th>
<th>1st-4th Grade Science</th>
<th>5th Grade Science</th>
<th>Science Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THEME: Engage in and Promote Professional Growth/Development</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Praise teachers for jobs well done</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2. Provide a Supportive Environment</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>3. Foster Collaborative Relationships (Mentor/Coaching)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>4. Promote Teacher Professional Development</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>5. Supervise Teachers’ Performance/Give Feedback</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>6. Promote Teacher Reflection</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>7. Lead Learning</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>8. Look for Effective Teaching</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>9. Models Instructional Practices</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>THEME: Monitor Student Progress</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Monitors Student Progress</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>11. Organizes Classroom For Instruction</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>12. Promote Orderly Learning Environment</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>13. Consider Students in the Learning Process</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>14. Set High Standards</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>15. Promote Student Learning</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>16. Data-driven Decision-Making</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>THEME: Make Available the Necessary Resources for Instruction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Allocate Resources for Instruction</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>THEME: Prepare the Culture for Change</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Articulate a School Vision</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>19. Define School Values</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>THEME: Develop Teacher Leadership</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. Develop Leadership Capacity</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>21. Teachers as Decision Makers</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>THEME: Use Leadership Skills to Promote (Science) Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22. Positive/Informal Leadership</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>23. Human Relations Skills/Expertise</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>24. Participation in the Decision-Making</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>25. Solicit Parental Support</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

*Italicized – Action or behavior is taken from definitions*

*Bold – New Instructional Leadership (Halverson et al., 2007)*

Despite the fact that Dr. Carsona employed an array of instructional leadership actions/behaviors in the academic program, in science, her efforts were concentrated primarily in fifth grade followed by the science laboratory. However, she recognized that for the science program to be successful, she needed to provide the vision, a vision that
had to extend beyond fifth grade. As she confessed, “…we [the district] ignored science for so long. To make it a priority it has to start with me. This is the first time in a long time that science has gotten any attention and we had to start small” (P-I-011507). Although the year of the study was the first year instructional changes were being implemented in the science program, Dr. Carsona explained that as she continued to learn and grow, and with the support and resources provided by the district, the science program would continue to flourish (P-I-062007). Even though my research investigation ended before the start of the 2007–2008 school year, while there, Dr. Carsona used me as a resource to learn about the goals and vision for science education reform. She asked questions such as, “What is this reform all about?” “Can you teach science literacy?” “What should they [the students] be learning?” and “What should we [teachers] be doing?” Because she had little to no understanding of reform, her questions were quite basic (P-ID-012407, 022107, 022307, 031907; P-I-062007).

**Major Influence on Dr. Carsona’s Instructional Leadership in Science**

**The District.** These data revealed that the school district greatly influenced Dr. Carsona’s instructional leadership in science, a revelation that I did not expect. It was my contention prior to embarking upon this research investigation that, within the school’s context, principals like teachers are critically important if science education reform is to be embraced, implemented, and sustained. Although I still argue that principals are important to long-term reform efforts in science, principals and teachers at Simmons were working within a reality constructed and constrained by district “suggestions” (requirements that were perceived by all as true). Dr. Carsona explained that the district expected principals to implement their requirements, although they were generally presented during principal’s meetings as “suggestions” (RJE-013107). As she explained,

> You know they [the district] sold the science lab to us [principals]. You know with the “It will be good for the kids and they [the kids] can practice collecting information [data] and making predictions and do experiments.” It sounded like something I wanted here [Simmons]…They said it would be a good addition in science and your student can do experiments and the science methods for the science fair. Like with a lab, you know, students—you are like almost
guaranteeing that they do some kind of “hands-on” or experiment each week. They said that it would help students out so much you know with learning science and the test [FCAT]…I believed that it [science laboratory] could help our students you know learn much more science…We can see how much they [the students]—how much growth they [the students] made on the quarterly science tests…It [the lab] was a good idea you know—it makes sense…But you know, to be truthful, I don’t feel like the choice was mine (P-I-040707).

Because Dr. Carsons conceptualized her position as liaison between the district’s vision (or mandated suggestions) and the school, teachers, and enacted science curriculum, there was an overwhelming reliance on the district for guidance, support, and direction (RJE-013107).

Within this rigid configuration, as the district prepared for the FCAT science assessment, many of the primary decisions regarding the science program were made at the district level and Dr. Carsons and teachers were expected to implement them (P-I-040707). But from what I gathered from my discussions with Dr. Carsons, the district was not clear or explicit in their expectations or intent for schools where science was concerned. As an outsider or onlooker, one would assume that the “public” science plan would provide a logical explanation of the district’s goals and expectations. However, this document did not guide their decision-making. The changes in science were based on FCAT achievement and were disjointed, disorganized, and most importantly reactive, as the district scrambled aimlessly as national accountability measures added science. The pathway to this success was neither predictable nor foreseeable, but rather erratically responsive to a science situation they “…did not prepare for” (P-I-040707). Therefore, the district sought to ensure that each principal knew that FCAT “success” was the primary goal through informal means. The district therefore “gently nudged” and attempted, with great success in Dr. Carsons’s case, to influence what science was taught, how science was taught, the science programs that were implemented, and streamline the instructional focus. Dr. Carsons responded to the bombardment of curriculum “suggestions” determined to implement the ideas (those that were feasibly possible) and to make science at Simmons a success according to the district’s standards.
Two examples discussed earlier are departmentalization and the inclusion of a science laboratory. Although these were presented as “suggestions” to enhance elementary science programs in elementary schools across the district, as Dr. Carsona explained, “…they [the district] have a way of saying something so you know you need to do it. It’s not like they [district leaders] say you better do this or you better do that, but they have there ways of saying a lot with little words” (P-I-040707). Dr. Carsona explained that she did have some latitude, but this was for making what she considered to be less significant decisions. For example, she instituted afternoon/weekend science tutoring and supported the science laboratory teacher’s inclusion of a Science Club (RJE-041007).

The most reverberating message from the district, however, was FCAT preparation as evidenced by district correspondence, Dr. Carsona’s description of dialogue at principals meetings, the science practice materials, and the classroom activities (FCAT) that were suggested (DA-15-011607; DA-9-032007; DA-8-120506, 020107, 022107; RJE-022107). Such activities “suggested” by the district included: administering quarterly assessments (third – fifth); incorporating science-related technology programs (first – fifth); teaching science vocabulary (first – fifth); instituting teacher performance assessments (fifth); FCAT preparation exercises (fifth); reteaching FCAT concepts after FCAT administration until the close of school (third – fifth); and FCAT science tutorials (fifth) (P-I-011507, 040707; P-ID-012307; DA-9-011107).

Although some of the suggestions may be considered noteworthy instructional strategies, they were for the sole purpose of increasing student achievement and reaching the stated goals for accountability. The district purported to want reform-minded science instructional practices as evidenced in their “public” science plan that was to be a result of professional development experiences provided by the district and changes that built learning communities, respected cultural norms, and developed leadership capacity in teachers. But what the district emphasized was success on FCAT and it was apparent through what they supported and suggested (e.g., infusion of science laboratory, departmentalization, etc.). The district suggested changes to elementary science programs that were presumed to be operating satisfactory and as intended, but in need of some “tweaks” and minor structural adjustments (first-order changes).
Ms. Perez: An Assistant Principal Leading in a New Environment

At the time of this investigation, Ms. Perez had been a devoted educator for 16 years. Starting her career as a middle school reading/language arts and mathematics teacher, she made the transition to elementary school after working in the middle school setting for three years. As an elementary educator, she was a generalist, taught many different grade levels, and after several years, was appointed lead teacher. Thereafter, Ms. Perez accepted a position at the district as an education specialist, where she provided instructional support to teachers in her assigned zone. Her first assistant principalship appointment was a temporary assignment which lasted for half of the academic year. The following school year, she received a permanently post, where she served as assistant principal for two years before requesting a transfer.

For the 2006–2007 school year, Ms. Perez accepted the position at Simmons. Two months into the school year, she went out on maternity leave, resuming her position in March 2007. She was therefore not a member of the faculty during the planning and restructuring phase of Simmons’s science program—much of this was done by Dr. Carsona, the former assistant principal, and the leadership team prior to Ms. Perez coming on board. Therefore, Ms. Perez did not play a significant role in the initial instructional decisions that were made in the science program. She was however actively involved in carrying out the decisions and supervising the science program.

Supporting Teachers

Ms. Perez perceived her foremost responsibility to be that of supporting the teachers in any way possible. As she explained,

It is my first year [at Simmons]…There are probably some things that need changing—I don’t know yet. In the meantime I wanna help teachers—I wanna support them until I can see how or what would make science better…Now, I’m pretty much here to listen, get supplies that they need…I try to find workshops, but there are not many. I do evaluations, so I try to give some constructive criticism to support teachers’ growth… There’s not a whole lot going on in science so there is not much I can do, but I just try to support and help them in any way I can cause this year science counts (AP-I-031907).
In this way, Ms. Perez and Dr. Carsons’s leadership styles were complimentary. Understanding the seemingly insurmountable challenges that teachers faced, she availed herself to teachers by visiting classrooms several times during the week, promptly responding to teachers’ concerns, and as much as possible, not making hasty or unnecessary changes. As she reflected: “I don’t know how successful I would be if I came in and just started changing things; that would have been disastrous. [I was] like a duck patiently waiting and watching before crossing the road. I had to make a slow transition…” (AP-I-031907). Observing the teachers interact with Ms. Perez, it was apparent that teachers appreciated this approach. In the process, she was earning teachers’ respect and nurtured relationships with the ultimate goal of student success.

Ms. Perez’s leadership style was somewhat informal. This quality seemed to work well at Simmons; a school environment that too was laidback, warm, and inviting (RJE-020107). Although she was not “touchy-feely,” her small office was often filled with parents, teachers, and staff, who looked, from my vantage point, to be quite comfortable in that space. Frequently, in my quest to meet with her or to just say hello, I had to wade through crowds of people in her office. In the way that individuals addressed her as “Ms. Perez,” complied when she asked the crowd to decrease the noise, and requested that teachers go back to class, this casual atmosphere did not minimize the fact that she was very profession, methodical, intuitive, direct, and practical. While admittedly absentminded at times, she circulated the school with a notepad in tow, jotting down comments and “things to remember” throughout the day.

**Science Resurrected**

When Ms. Perez began her career as an elementary school teacher, science was not a subject she was looking forward to teaching. “Like a lot of elementary teachers I knew, we never thought about teaching science, we basically focused on reading and language arts” (AP-I-031907). Although she recognized that science is invaluable in helping us understand the world around us, she feared that she would not be much help to teachers, because her experiences in science had not adequately prepared her to be the most effective science teacher. Ms. Perez’s lack of science teaching efficacy coupled with a district’s mediocre investment in science made it much easier for Simmons to put
very little effort towards quality science instruction (RJE-032107). It was not until she accepted a position as a lead teacher that she realized how important science was to students’ overall schooling experience. As she described:

I had the opportunity to observe several teachers teaching science during that time. Some of them [the teachers] were very, very good and some were awful… It was hard watching the students’ faces. They looked confused, bored, just awful… In classrooms with good science instruction and teachers who were excited about science, students were active, asking questions, everything…a big difference. I began to appreciate science; I’ll never forget it because I could tell by their [the students] little faces, they were learning…in a way that was different than other classes [subjects] (AP-I-031907).

This, according to Ms. Perez, was a pivotal moment in her “thinking” about science. She recognized that because science challenged students to think critically and investigate to better understand scientific concepts, “science was just as important if not more important than other subjects” (AP-I-031907), where I surmised from our exchange, she saw knowledge in language arts, mathematics, and social studies as static and matter-of-fact (RJE-032107).

Her appreciation for and commitment to science as a discipline was apparent as she spoke candidly about how her previous experiences influenced how she envisioned science at Simmons.

Ideally, science should be “hands-on.” But it needs to go a step future than just “hands-on.” I know this may sound like a cliché, but it should be minds-on as well. It’s not just about doing a science experiment, did it work, and was the hypothesis proven or not. It should be a step beyond…They [the students] should be asking themselves, “What does this give me?” [or] “What is it going to give to society or the community?” It should not just be a “hands-on” experiment with no connection to the real-world…I would love it if every teacher used “hands-on” in the classroom, but that may be unlikely considering science has been on the back burner for so long (AP-I-031907).

Despite her hopefulness and optimism, Ms. Perez appeared to have a very naïve conception of science teaching and learning. First, when asked to define science as a
discipline, she was unable to do so. Struggling, she simply defined science as a “core subject taught in elementary school” (AP-I-031907). Further, although she thought it necessary to teach science using a variety of instructional strategies, she believed that most scientific concepts could be taught through “hands-on” activities, an approach that when further explored was for her more about the act of “doing something” as opposed to “doing science” to better understand the natural world and engaging students in science processes as utilized by scientists (RJE-032107). Ms. Perez was hopeful that teachers at Simmons would embrace a more “hands-on” approach to science instruction now that, with the inclusion of FCAT science, the district had “decided to pay a little bit more attention to what science is.” The pinnacle and “first step towards their [the district] vision [was that] they finally adopted a new science series [textbook]” (AP-I-031907) for the 2007–2008 school year, a purchase that was perceived as integral to teachers’ inclusion of “hands-on” science in the classroom. (The new textbook was adopted at the district level; no one at Simmons had seen the textbook or had a copy. However, the fifth grade teacher was scheduled for training during the summer at which time she was to train the other science teachers.)

Within the school, Ms. Perez was primarily responsible for supervising the school’s academic program, including science. She was responsible for locating and scheduling professional development opportunities for teachers; teacher evaluations; providing instructional materials; monitoring the administration of the pre/post science assessment; establishing the tutoring program (including science for only fifth graders); and analyzing science data to identify areas of weakness to guide instructional decision-making. In addition, she met with teachers on a consistent basis (generally monthly) to discuss any issues or concerns regarding the academic program. In science, she disclosed, all teachers were initially included in such discussions, but upon her return from maternity leave, she informally and sporadically met with only the fifth grade teacher.

Despite admirable intentions, Ms. Perez’s views about science were haphazardly formulated and based on an uninformed perception of how science should be taught and learned (RJE-051307). She acknowledged a need for and desired professional development opportunities that would help her and teachers better understand how to
employ contemporary and informed science practices. Despondent, she admitted that “much of what’s available from the district is about FCAT and teaching science is about more than preparing kids to take a test” (AP-I-051007). Ironically, she was elated that “science [had] been resurrected” (AP-I-031907) by the new inclusion of science in FCAT and hoped that “positive changes were on the horizon” (AP-I-051007).

Science Program at Simmons Elementary: A Principal’s Efforts to Change

On several occasions Dr. Carsons verbalized that science was an important part of Simmons core curriculum and a subject students needed to learn not only to pass the FCAT, but to be successful in an increasingly scientific world (P-I-040707; AP-I-051007). Although Dr. Carsons and Ms. Perez did not clearly define or articulate the specific science skills and knowledge students needed to learn to be successful, in order to prepare students to understand the world beyond the classroom, teachers were expected to use differentiated modes of instruction. Differentiated instruction was conceptualized by Dr. Carsons as the incorporation of “hands-on” instruction, reading, writing, technology (ACTIVBoard, powerpoint, internet, educational videos), higher order thinking questions (using critical thinking strategies), group work, using process skills, visuals, explicit vocabulary development, science through literature, and weekly visits to the science laboratory (P-ID-021507). Dr. Carsons and Ms. Perez wanted to see science classrooms that were multidimensional as to accommodate the range of academic levels and student differences. Differentiated instruction and the use of many of the aforesaid strategies were evident in the fifth grade classrooms, but traditional, teacher-directed instruction was the predominate mode of instructional in the other grade levels (OP-011007 through 050307; see Table 16).

Since Dr. Carsons appointment as principal at Simmons, a self-contained classroom model had been employed (each classroom teacher taught their own science). However, upon the district’s “recommendation,” during the 2006–2007 school year, a departmentalization model was instituted. Although ultimately the decision to departmentalize was that of the school, Dr. Carsons adopted the belief that departmentalization could be particularly beneficial considering some teachers “are not as comfortable teaching science…[and] are not as likely to venture beyond their comfort
zone in science.  [S]o starting out with teachers who specialize [in science] and can put their heart and soul and teach it (science) with passion has its advantages” (P-I-011507).

**Departmentalization**

In many elementary classrooms across the country, students receive instruction in self-contained classroom structures, generally with one teacher—the Jack or Jill-of-all-trades—responsible for teaching language arts, math, science, and social studies throughout the academic year (Chan & Jarman, 2004). This model assumes that teachers have the prerequisite content and pedagogical knowledge, as well as a fundamental interest in engaging students in the subject areas with the same level of commitment. However, the Snella County School District supported and encouraged principals to employ a departmentalization model in K–5 classrooms. According to Dr. Carsona, the district supported departmentalization in elementary schools because if instructional time was allotted daily, it would allow teachers to specialize in a particular subject area and students would be taught by teachers who were trained and knowledgeable in a specific area of concentration (RJE-020107). This theory was debunked in Simmons’s case because most of the science teachers where not formally trained in science, did not like teaching science, and did not have a rudimentary understanding of scientific concepts.

All departmentalization configurations were based on students’ FCAT reading scores (ability grouping), but students were often moved between groups when teachers saw inconsistencies between the test scores and individual student’s classroom aptitude. Configured with this student population in mind, the departmentalization model implemented was fashioned after traditional models seen in secondary schools across the country (Gess-Newsome, 1999). The first grade science teacher had two groups that she saw for a “two-hour Science/Math Block” per group (but she was also required to teach social studies). The first grade groups did not visit the science laboratory. Teachers in grades two (one teacher) and three (two teachers) taught only mathematics and science during a two-hour block. The second grade teacher saw two groups while the third grade teachers served two groups each. This time included an hour at the science laboratory per week for both grade levels. The three fourth grade classes were self-contained and each teacher was responsible for teaching their own science. (Fourth grade was not
departmentalized because the schedule adjustment allowed for an additional writing class to develop students’ writing skills for FCAT Writing. This assessment was only administered to fourth graders at the elementary level.) On their schedule, each teacher had between two and five hours of science instruction per class each week. This was also inclusive of a one hour science laboratory session per week. Fifth grade science was taught by one teacher who cycled between three groups for one hour of science instruction per day. This time was also inclusive of one hour at the science laboratory for each group per week (DA-4-120806). Table 20 summarizes the departmentalization model at Simmons and the subjects taught by each science teacher.

Table 20 Simmons Elementary Departmentalization Model

<table>
<thead>
<tr>
<th>Grade</th>
<th>Science Teachers</th>
<th># of Group Cycles</th>
<th>Science</th>
<th>Social Studies</th>
<th>Math</th>
<th>Reading/LA</th>
<th>Visited Science Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Ms. Harvey</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td>Ms. Gilbert</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>Ms. Torrez</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>Ms. Rappas</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4th</td>
<td>Mr. Claud</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4th</td>
<td>Ms. Hernandez</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4th</td>
<td>Ms. Smith</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5th</td>
<td>Ms. Jenson</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Indicates subjects teachers taught and/or classes that visited science laboratory.
Indicates subjects teachers did not teach and/or classes that did not visit science laboratory.

Dr. Carsona and Ms. Perez hoped that school-wide departmentalization would undo several years in which “science had been pushed to the side…” (AP-I-051007). Central was a structure wherein science teachers were responsible primarily for teaching science content, while engaging students in labs or “hands-on” science activities intermittently and weekly visits to the science laboratory. Dr. Carsona described departmentalization as an “opportunity for students to learn in classrooms where teachers are excited about what they are teaching,” admitting that very few teachers wanted to teach science and even less would teach it “[well] and with excitement” (P-I-011507).

Dr. Carsona did not conceal the fact that many of the science teachers did not like teaching science and had very few opportunities to develop their content knowledge and
pedagogical skills (i.e., workshops, professional development sessions, conferences, etc.). Even with this admission, Dr. Carsona did not express that teachers’ lack of content knowledge and pedagogical skills was problematic. It appeared as if she saw the science teachers as capable of stepping up to the challenge, despite the obvious limitations. However, Dr. Carsona, while expressing concern for science across grade levels, only showed true concern for fifth grade science as evidenced by the allocation of resources and deliberate thoughts. Dr. Carsona’s rationale for implementing school-wide departmentalization appeared to be rhetoric that served to justify her decision (RJE-011907). However, in reality, science teachers were not equipped to make the most of the departmentalization model.

Despite a desire to improve student learning in science, Dr. Carsona indicated that Simmons lacked resources, financial support, and professional development opportunities, which required her to narrow the school’s science restructuring focus. Lacking what she deemed as necessary to restructuring the science program at all grade levels (funding, resources [textbooks], technology), and with FCAT science approaching, Dr. Carsona made the decision to focus exclusively on fifth grade science and the science laboratory (which served grades two through five) (DA-1-010907; DA-18-121307; DA-19-012207). The science professional development opportunities that were available and monies/resources that were mobilized for science improvements were funneled into fifth grade and the science laboratory. First through fourth grade teachers were excluded from year one of restructuring (DA-18-121307; DA-19-012207).

The first order of business prior to the opening of the 2006–2007 school year was to conduct a needs assessment to identify areas of concern and develop a plan of action to overcome identified deficiencies. Because the school received the lowest science FCAT score in the zone and one of the lowest in the district, Dr. Carsona concluded that improvement was needed in all state assessed areas. For this reason, the school leaders developed an Action Research Plan (ARP), targeting fifth grade science, the grade level in which students were administered the science FCAT.
Taking Action to Improve the Science Program

Although science was recognized as important to the academic and social development of all students, admittedly, the administrative team and teachers explained that there had been very little if any emphasis on improving the science program prior to the 2006–2007 academic year. Dr. Carson did think however, that science was important. “[S]tudents need to know it [science] to survive in this world. But as a district, reading, math, and writing was the district’s concern…unfortunately science wasn’t” (P-I-040707). Elaborating on the lack of attention in the science program, according to the science laboratory teacher, “we [teachers] knew we had to teach science, but no one was checking to see if we were teaching it or even what we were teaching….we were flying by the seat of our pants; that’s how we did it [taught science] around here… Everybody was focused on reading and math and writing; everything else was pushed by the wayside” (Jlab-I-011807).

Incorporating science into accountability measures that had long focused on reading/language arts and mathematics would be a difficult feat considering the time constraints many schools face (Darling-Hammond, 2004; Diamond & Spillane, 2004; Johnson, 2007a; Marx & Harris, 2006). As Marx and Harris (2004) discuss, accountability that prioritized reading/language arts for 10 years prior “pushed” science out of elementary classrooms. They do contend however, that accountability may be the driving force behind the return of science. Simmons’s ARP, with accountability as the central tenet (DA-1-010907), was doing just that, albeit through test preparation, accountability measures, rote memorization, drill and practice, and a science laboratory that although a “new” addition, was traditional in its instructional delivery.

Action Research Plan. Every school across the district was required to develop an ARP to address an area of weakness at their school, although additional resources or funding were not provided to defray the costs associated with addressing the deficiencies. Utilizing state and school-wide assessment data and anecdotal records, Simmons identified areas in need of restructuring. Simmons elected to focus on the science program because according to science FCAT results, only 10% percent of fifth grade students scored Level 3 or above, 25% lower than the state average (Florida Department

According to Dr. Carsona, “the ARP helped us to see what we were doing wrong and what we need to do to bring those deficiencies to a good standing. Yes, we were teaching science, always of course, but never to the intensity that we were doing it in writing, reading, and math. We needed to change that” (P-I-011507). Correspondingly, Ms Perez saw the development of the ARP as the school’s recommitment to science after many years of disregard (AP-I-031907). Teachers, however, did not make reference to the ARP as the guiding force behind their instructional focus, because they did not receive the ARP. Rather, teachers referred to the School Improvement Plan (SIP) and the goals stipulated (orally and in print) by the administrative team. The “Outcomes” and four of the “Solutions” included in the ARP were also included in the SIP (DA-18-010907). The ARP simply explained in greater detail what Simmons was going to do to score above the district mean score in science.

However, as evidenced by the Action Research Planning Matrix as well as the SIP, Dr. Carsona, Ms. Perez, and the science teachers acknowledged that the underlying reason for recommitting to science was to increase FCAT science scores above that of other schools in the zone, striving optimistically for increases above the state average (RJE-050307). Funneling what little resources were available into fifth grade as opposed to spreading them sparsely across all grade levels, was seen as the approach with the greatest possibility of success and “…the fastest way to achieve” (P-I-011507). While an “A” school several consecutive years, having the lowest FCAT science score in the zone warranted immediate action. This was because with the onset of FCAT science, zone superintendents, while praising Simmons’s successes, did not look favorably on their low performance in science. Despite the fact that as a district, science was not prioritized, improving FCAT science scores “…was a school problem that needed to be addressed in a short period of time, with limited resources” (P-I-011507). This logically made fifth grade science the primary point of emphasis.
<table>
<thead>
<tr>
<th>Problem (Question)</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>The problem is that students in fifth grade are performing below the state and district mean scale score for science.</td>
<td>Fifth grade students will score at or above the district’s mean scale score.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ten percent of students in fifth grade scored Level 3 or above on the 2006 administration of the FCAT Science.</td>
<td>Thirty-nine percent of fifth grade students will score Level 3 or above on 2007 administration of the science portion of the FCAT.</td>
</tr>
<tr>
<td>One hundred percent of students scored below mastery level on the 5&lt;sup&gt;th&lt;/sup&gt; Grade Science Pretest (70% mastery level).</td>
<td>Seventy percent of fifth grade students will score at or above mastery level on the 5&lt;sup&gt;th&lt;/sup&gt; Grade Science Posttest.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Causes</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Due to emphasis placed on reading and mathematics instruction, the science curriculum was not stressed.</td>
<td>Utilize the District’s Science Scope and Sequence.</td>
</tr>
<tr>
<td></td>
<td>Weekly visitations to the Science Laboratory.</td>
</tr>
<tr>
<td></td>
<td>Provide additional resources to the classroom teacher (additional textbooks and workbooks, science centers, and worksheets targeting specific benchmarks).</td>
</tr>
<tr>
<td></td>
<td>Science tutoring classes will be offered after school.</td>
</tr>
<tr>
<td>Time allotted to science instruction was not sufficient.</td>
<td>All fifth grade classes will be departmentalized. Students will receive one hour of science instruction daily.</td>
</tr>
<tr>
<td>Teachers did not have adequate professional development targeting science instruction.</td>
<td>Science teachers will attend science workshops targeting specific needs in the classroom.</td>
</tr>
<tr>
<td>Data were not utilized to drive instruction.</td>
<td>Disaggregate and analyze pertinent data from the 2006 FCAT Science and ongoing assessments to identify areas of weaknesses in student performance to guide instructional practice.</td>
</tr>
<tr>
<td>Technology was not utilized in the science classroom.</td>
<td>Students will use United Streaming software in the science classroom.</td>
</tr>
</tbody>
</table>
Science in Fifth Grade

Although departmentalization required a philosophical shift for many seasoned teachers who had taught under the self-contained model for most of their career, the newly hired teacher who was to take the lead in teaching science in fifth grade was not fazed by the restructuring or the task at hand; preparing fifth grade students to pass FCAT science. The novice, excited about the appointment, was not in the least bit dissuaded. As she indicated, “Dr. Carsona said I had to prepare them [for the FCAT science test] and I tried to do my best” (J5-I-062007).

A General Description of Ms. Jenson. Standing about 5’4”, Ms. Jenson was a twenty-five year old Hispanic woman. Beautiful as described by her students, Ms. Jenson had long cascading brunette hair that flowed and bounced with every turn, intense brown eyes that emitted twinkles of innocence, and a poised and self-assured stature that reflected her confident and apt disposition. She was energetic, fast-talking and a very theatrical person who quite often expressed herself through hand gestures and body movements. Blessed with a bold and captivating smile, smiling was like second nature. Ms. Jenson was always happy and chose to view the world using a “positive” lens, trying to find and illuminate the good in any situation, with her colleagues, and with every child. Working as a youth advisor at her church, she confessed that working with young people keeps you “young at heart,” allowing you to laugh at life, laugh with others, and make others laugh. Her wonderful sense of humor was evident in her classroom rapport with students as well. You could often find her telling funny stories or making amusing comments that caused students to laugh uncontrollably. Ms. Jenson was a newly-wed with no children and lived in an adjoining community fairly close to the community where Simmons was located.

Experience with Science as a Student

Ms. Jenson began primary school in a Hispanic country before migrating to America. Like many elementary teachers, her memories of science were poor if not absent altogether. As she reflected on her experience, she recalled:

I don’t remember my experiences in science. I guess that means they were not very good…I can remember looking back at my journal, and what I remember
from my elementary school years…I remember reading. I remember language arts more than anything and math. I really liked language arts. I loved, loved, loved writing; that was my thing in [my home country in] elementary; actually first and second grade… I would go into competitions for that [writing]…I loved math probably because of the numbers and I could do it. I really didn’t have a lot of experiences in science at all, not that I remember (J5-I-012207).

As she reflected, science was the subject that only smart people could learn and often “not well represented and taught by the teachers” (J5-I-052907). This led Ms. Jenson to conceptualize science as not an important part of the curriculum and not necessarily important if students were to be successful students or adult learners (RJE-011607).

Overall, Ms. Jenson pointed out that her experiences in middle and high school science classes did little to advance her understanding of science concepts or build her confidence, remembering very little about those times. She did recollect however, that once again, she was in science classrooms where a traditional approach to teaching was favored, relegating her to a position of “outsider” amongst the group. She did however delight in her memories of middle and high school Biology classes. “…[W]hen I was in elementary school, I was turned off [from science]…not interested…did not like it…hated science…but in middle school, I had Biology and I loooooved dissecting. It was disgusting, but I just loved it!” (J5-I-012207). For Ms. Jenson, Biology—learning while dissecting in Biology—provided the first real indication that learning science could be enjoyable and that scientific understandings were attainable.

Unfortunately however, Biology classes were an anomaly in the midst of an array of traditional and ineffective science learning experiences. This most notably included experiences that were overly traditional, specific cases in which the Chemistry teacher did not have command of the English language to a “terrible,” out-of-field Physics teacher. Although she remembered liking her teachers, enjoying the learning process, and having good overall school experiences, these were but a few of the problems Ms. Jenson experienced in her science classes. These experiences left her feeling responsible for her failures—“I just wasn’t meant to learn it [science]” (J5-I-012207), but hopeful as she prepared for college.
Ms. Jenson was accepted into a teacher preparation program at a small private university. In addition to other courses that were required for elementary education certification, Ms. Jenson also took *Introduction to Science Methods for Elementary Education Majors*. Ms. Jenson referred to this experience as “probably the most positive experience in science as a whole” (J5-I-012207), because up to now her science experiences had been so poor. According to Ms. Jenson, her teacher radiated an excitement and love for science that she herself had never experienced. “You could tell that she loved, loved and enjoyed science tremendously. That was nice” (J5-I-012207).

Ms. Jenson was taught to teach science using a variety of approaches (DA-13-081806 through 052507; OP-011007 through 050307). However, in spite of the science reform movement’s long-standing history, Ms. Jenson’s teacher preparation program did not provide her with a functional understanding of the goals espoused in current reform documents. Even though the learning environment was rich in the teaching and modeling of a variety of teaching methods, Ms. Jenson received very little exposure to and was unable to articulate the theoretical and philosophical underpinning of the science education reform movement. Ms. Jenson had a good “gut sense” of science teaching and the need to engage learners, but little theoretical knowledge as to why engaging students in science is encouraged over other instructional methods.

Ms. Jenson did her student teaching at Simmons and upon graduation, was offered a temporary teaching position as a kindergarten teacher. As her temporary assignment came to a close, Dr. Carsons elatedly called Ms. Jenson into the office and offered her the science position, a subject that was less than favorable in Ms. Jenson’s mind. However, without hesitation she accepted. As she explained, “You know what…you want me to be honest; I don’t even remember reasoning it. I said let’s go for it and that was it” (J5-I-012207).

*Ms. Jenson the Fifth Grade Science Teacher: The Person Inside of the Teacher*

Ms. Jenson explained that Dr. Carsons did not ask her about her science experiences prior to offering her the position. This prompted me to ask her, “Why would you accept a position as a fifth grade science teacher in a departmentalized program considering your experiences in science?” I asked Ms. Jenson this very revealing
question during one of our many lunch meetings. During this exchange, I not only learned a great deal about Ms. Jenson’s belief constructs as they relate to teaching and learning, but a strong link between what she valued professionally and what she experienced as a learner.

Accepting the science position was scary for me. It really was. But, then again, I didn’t give it much thought because I don’t live my life in fear. I guess I could have told Dr. Carsona “You know Dr. Carsona I really hate science and I would rather have the first grade class.” But why? That would have made me feel defeated. I always wanted to learn science; I guess as fate would have it, I learn it with my students instead…You know, I see life as a challenge with mountains to climb and rivers to cross and I was determined to do the best job possible…When I found out [I would be teaching science], I took my textbooks home and studied them like I did when I was in school. Remember, I did not have strong content knowledge. I studied, I researched topics I did not understand, and I tried to educate myself as much as possible…Despite what you go through in life, you can’t always rely on the negative to hold you back; you have to believe in yourself and try to improve and learn…I shared my experience with my students and they knew that I was trying my best like they were trying their best. And it helped that they could tell me about the things they were learning and do good on assessments. That gave me confidence to keep going you know. I believe in them; they are awesome. (J5-ID-031307)

I found this conversation, coupled with the way in which Ms. Jenson engaged with her students, to divulge a great deal about her personal nature. A central tenet of Ms. Jenson’s temperament was to appreciate the good in every situation, maintain a positive attitude, and encourage success, irrespective of the circumstances. This unrelenting attribute revealed itself time and time again as Ms. Jenson interacted with challenging and pessimistic colleagues (e.g., “You are a first year teacher, talk to me in three years.”), faced unexpected or problematic situations (e.g., classroom break-in), or consoled a student who was despondent (e.g., unsatisfactory marks on an exam). Indeed, the teaching profession challenges the most optimistic and hopeful of persons. But I can
say that during my time with Ms. Jenson, I never saw her angry, agitated, or disconcerted. She later described how she had a strong faith that kept her cheerful and in good spirits because “negativity is all around us; there is no more room for negative energy” (J5-ID-020907).

Ms. Jenson's Beliefs about Teaching and Learning Science

Researchers support the assertion that teachers’ practices are greatly influenced by their perceptions of science as an enterprise (Davis, 2003; Elmore, 1995; NRC, 1996; Pajares, 1992; Smith & Southerland, 2007). Such was the case with Ms. Jenson, as her experiences, which produced a dislike of science and a conception of science as the discipline for only “smart kids,” catapulted her into what she considered a naïve approach to teaching. Idealistically, she thought that conceptual understandings would be the unobstructed byproduct or outcome when students were engaged in a fun and enjoyable science classroom environment; she quickly realized the naivety in this perception. She recalled:

I can remember my first couple of months planning for science. I tried to find activities that had the ‘ah’ and ‘wow’ factor, you know? Students would be having fun and enjoying what we were discussing or what they were observing or what they were reading about or whatever; just having fun while learning…It was so time consuming looking for this and looking for that…[I realized] that not every lesson had to be fun and exciting, I had to create a learning environment were they [the students] felt safe and appreciated. I did not feel appreciated as a student. I felt like a bother to my teachers [of science] because I did not speak English and that’s why they ignored me. I never want my students to feel like this place is not safe for them. They can laugh and learn and feel like an individual even though the class is a group. That’s important. I guess my way of doing this is, you’ve seen it, is through a lot of laughter…This has helped me connect with my students [in ways that] the other [fifth grade teachers] haven’t. This has helped me to figure out who they are and what they need [as learners] (J5-ID-020107).
As we further discussed her beliefs regarding the teaching and learning of science, Ms. Jenson described that a student-centered environment was optimal. By student-centered, she meant that students are active participants in the learning process. Important, however, was the fact that she associated a student-centered learning environment with “fun,” which she perceived as necessary to foster positive attitudes toward science. This environment was characterized most notably by “hands-on” activities, cooperative grouping, using science process skills, discussing, listening, making noise, laughing, questioning, answering, doing labs, writing, reading, using technology, and experimenting, while having “fun” (RJE-012207).

Ms. Jenson excitedly declared that her approach kept her students excited about learning science concepts. “My students love coming to my class—they tell me all the time and they always ask me when they see me out [around the school] “What are we doing in science today?” This [makes me feel like] they enjoy it [science class]” (J5-ID-041707). Her role in this environment was to develop engaging science lessons, facilitate classroom activities, and create a classroom environment that provided opportunities for learning and the cultivation of a love for science. With empathy in her voice, Ms. Jenson justified her stance: “What kind of teacher would I be if I didn’t do everything possible to help them [her students] love science as much as I [have come to love it]” (RJE-041707).

Indeed Ms. Jenson thought it important for students to learn science. Accordingly she declared, at the elementary level, “students are inquisitive and curious and nosy you know—always trying to figure things out and how things work. That’s just how kids are. So with science, they [the students]—I have to make sure they have every opportunity possible to be Curious George’s or Georgina’s” (J5-I-052907).

Ms. Jenson, as the intermediary of quality instruction and person who could make science less intimidating through the cultivation of a “warm” learning environment, operated from what appeared to be a take-for-granted notion that conceptual understanding would result because students had positive feelings and experiences in science. Teaching for conceptual understanding did not emerge as an intentional undertaking, but rather something that happened “by chance” as she induced excitement about science and taught in ways that aligned with her beliefs about how science should
be presented and learned. There seemed to be a deliberate effort to make certain the students’ experiences where more favorable than her own; hence, an overcompensation.

Although unintended, the data revealed that a number of Ms. Jenson’s classroom practices had the potential to create conceptual shifts in students’ understanding of science. For example, a signature strategy Ms. Jenson often used was eliciting prior knowledge. The intent was “to figure out what they [students] know you know so I can know how far to take the lesson. I want it to be a little challenging you know” (J5-ID-031307). Ms. Jenson also had a “knack” for asking higher order thinking questions. While she often asked “knowledge” and “comprehension” questions, she too asked questions that required students to make connections and apply their understandings (e.g., “Why do we have different nerves?” or “What might happen if stomach nerves get damaged?”) (OP-011007 through 050307). Moreover, Ms. Jenson used structured inquiry (Colburn, 2000) as an investigative tool; she utilized cooperative groups in which students were encouraged to ask and answer questions from their peers and discuss science ideas; students conducted science-based research projects and presented the findings; and she used science assessments that, in addition to multiple choice and fill-in-the-black questions, incorporated essay questions and questions in which students had to demonstrate their knowledge (e.g., draw a picture of the connection for different circuits).

**Science Instruction in the Fifth Grade.** Ms. Jenson taught three sections of science in which 76 students were divided and grouped according to ability levels as predetermined by FCAT reading scores. As per the FCAT leveling system (see Table 4), Group I consisted of those students who ranged between Levels 1 and 2; Group II consists of students who scored at Levels 2, 3, and 4; and Group III consists of those students who scored at Levels 4 and 5 (Refer to Chapter I for discussion of FCAT Levels). Even though I inquired, I was not provided with a rationale for why students were grouped according to abilities. It appeared to be a practice that was common and done without much contemplation or regard.

Dr. Carsona and Ms. Perez’s goal for fifth grade (which was embraced by all science teachers) was to increase students’ scientific knowledge and skills so that they could be successful on the FCAT. In spite of this articulated objective, and echoing in many ways the science aim and direction of the district, the administrative team and Ms.
Jenson wanted above all for students to learn science content that resonated with the goals of FCAT, with opportunities for “hands-on” science “sprinkled” throughout the week on occasion.

We [Simmons] want our students to learn science; to truly learn it and enjoy it in the process. We [district and school] haven’t given science the attention it deserves; it’s unfortunate. Our students have suffered because we were not proactive. The only thing that we can do at this point is do better this year than we did last year and do better next year than we did this year. I do believe that our science program will be top notch because that is what we want for our students (AP-I-051007).

The idea of top notch rested on the idea that Ms. Jenson would incorporate different modes of instruction, visit the science laboratory on a weekly basis, and engage students in “hands-on” science investigations a minimum of once a week. When Dr. Carsona and Ms. Perez were asked, a clearly defined vision or understanding of what “hands-on” meant or would entail, a cogent answer could not be established. It was apparent from their responses however, that “hands-on” or physically engaging in science was presumed to be beneficial and necessary if students were to be successful in science (RJE-021207, 031907).

The resources needed to employ differentiated instructional strategies, incorporate activities to accommodate diverse learners, and engage students in “hands-on” activities required funds to purchase materials. However, Simmons did not have a science budget to replace textbooks that had been lost or damaged in the antiquated series currently in use (nor were they available through the publisher). Too, ordering a new science series was not an option; this purchase was made at the district level. Furthermore, because there were so few books available, students were not assigned textbooks and could only use them while in school. Faced with these daunting dilemmas, Dr. Carsona and Ms. Perez pulled together funds from different school-based accounts to purchase one class set of more updated science textbooks (5th grade only), one class set of supplemental textbooks (5th grade only), and science investigation kits (kits were purchased for all grades and stored in the science laboratory). Ms. Jenson was also provided:
• **An ACTIVBoard** – A wall-mounted whiteboard that was connected to a teacher-station computer. It enabled interactive science lessons, whole-group questions/answers review sessions, and an assessment medium.

• **Science-related technologies** – These technologies allowed Ms. Jenson to broadcast an interactive instructional tool (e.g., BrainPOP).

• **FCAT science website** – Ms. Jenson used the FCAT Explorer website to help prepare students for the test. The district also compiled a list of websites that teachers could visit to help with FCAT preparation.

• **FCAT preparation materials** – The district provided the school with sample FCAT test, FCAT review packages, and “Question of the Day” options often written in the language of FCAT.

• **Scholastic News** – Ms. Jenson received this supplemental resource each week to incorporate into classroom instruction. (OP-011007, RJE-121406, 021407; DA-20-021207)

The textbooks and resources made available to Ms. Jenson and the fifth grade students were conceived of as a “gradual but aggressive” (P-I-011507) step in the right direction. “We have been failing in science; I know this. But for first graders they have four years to practice and practice with science. Fifth graders only have one year…this year the obligation is to make sure that they [fifth graders] know it [science content] before testing. We want them to be successful” (P-I-040707), with “success” being defined by their performance on FCAT.

As Dr. Carsona explained, she did not want the students to be successful so that she could receive personal accolades and commendations, although she admitted that recognition is rewarding. Instead, she wanted her school “to be the best” so that her staff and students could be recognized for their hard work and effort. Describing the students with a prideful smile, “They [fifth grade students] work so hard everyday…even on Saturday’s and during the week for tutoring. They are here and not just one of two almost all of them; you’ve seen it. How could we not want the best for them when they are giving 100%” (P-I-040707)? Dr. Carsona saw Ms. Jenson as eager, enthusiastic, capable, and just the right person for the challenging task at hand.
After being immersed in the setting for several days, Dr. Carsons wanted me to spend some time in Ms. Jenson’s classroom. I conducted Ms. Jenson’s first interview before I observed her teaching science. I must say that before walking into her classroom, I didn’t know what to expect. As I learned in our initial interview, she for the most part had very poor science experiences (made to feel incapable of learning science, traditional, lecture-based, didactic) throughout K-12 and during her post-secondary studies. As a result, Ms. Jenson wanted her students to have positive experiences in science.

Her experiences shaped how she conceptualized her role as “science teacher,” deliberately setting out to develop instructional activities that appealed to students’ affective sensibilities. She wanted students to develop a love and appreciation for science, while leaving the classroom with a more expanded knowledge-base than when they entered. She embraced the philosophy that students learn science best when they are in positive, student-centered classroom environments where they have “fun” while learning (RJE-012407). The notion of developing a love and appreciation for science is echoed in reform documents, as a goal of school science is to have students “experience the richness,…excitement and personal fulfillment that can come form understanding and learning about the natural world” (NRC, 1996, p. 1 and 13). This she perceived as the optimal learning environment to foster positive attitudes towards science.

To foster these positive attitudes (and secondarily promote science learning), the fifth grade classroom environment was characterized most notably by cooperative grouping, laughing, students making models (i.e., cell, volcano, and lungs), whole/small group discussions, listening, productive noise, “hands-on” activities, projects, debating, writing and reading, using technology (i.e., ACTIVBoard and the internet), asking/answering questions, investigations, science research projects (e.g., famous scientist), and the use of science process skills during investigative labs (DA-13-091807 through 052507; OP-011007 through 050307). Some of the lessons included: Chemical Changes, which was an inquiry-based lab; Cell Structures, which employed technology to review concepts and terminology already discussed in class; Fingerprint Patterns, which was a kit-based “hands-on” activity that examined different fingerprint patterns;
Sensitive Body: The Nerve of You, which was an inquiry-based activity to explore which sensory nerves were more sensitive; and Electrical Circuits, which was a group activity where students were asked to construct closed and open circuits.

Despite the fact that she was not well-informed on the national goals and vision for science education reform, Ms. Jenson’s instructional approach can be considered reform minded in two critical ways. First, she engaged students in inquiry-based science lessons, the instructional approach suggested in current reform. Although the school’s current structure stipulated that science teachers were responsible primarily for teaching science content with labs occurring intermittently, when I observed Ms. Jenson teaching science, she engaged students in two inquiry-based lab activities. When classified using Colburn’s (2000) model of scientific inquiry, the lessons would be considered structured inquiry, because the students were given the questions and specific directions for answering the questions (e.g., “How does the concentration of vinegar affect how big a balloon grows?” and “What part of your body is more sensitive to touch?”). If one were to classify the lessons more specifically using Abrams, Southerland, and Evans (2008) classification system as a referent, the purposes of the lessons were to develop students’ science process abilities and to learn science content.

Second, according to NRC (1996) “The importance of inquiry does not imply that all teachers should pursue a single approach to teaching science. Just as inquiry has many different facets, so teachers need to use many different strategies to develop the understandings and abilities described in the Standards” (p. 2). Ms. Jenson was committed to using various methods and strategies to engage students in science. For example, I observed Ms. Jenson’s science instruction over a one month intensive period and at least once a week during regular session throughout the duration of this investigation. During this time I was able to construct a fairly accurate portrait of her instructional commitments. Using the Classroom Observation Protocol (see Appendix E), I conducted 24 observations. Of the observations that were conducted, Ms. Jenson utilized most of the Types of Instruction listed with varied levels of effectiveness (see Part IV of the Classroom Observation Protocol). The most common types of instruction were cooperative grouping, using technology, class discussion, reading from the textbook, and writing work. (Inquiry or “hands-on” was not an instructional strategy that
Ms. Jenson used often not because she did not wish to incorporate these instructional methods into her practice. At Simmons, the classroom teacher was primarily responsible for teaching science content. Ms. Jenson did express an interest in engaging students in more “hands-on” lessons, however.) She also employed Other types such as library research, debates, and modeling (see Table 16; OP-011007 through 050307). Therefore, her commitment to and use of various teaching methods and strategies aligned with the vision for science education reform.

Ms. Jenson indicated that she utilized an array of instructional strategies so that all of her students would have an opportunity to experience a feeling of “success” and “accomplishment” in science. She commented, “…not all students are good at science you know…problem-solving or debating and asking questions to their peers…Some may read better than others or sketch you know maybe a model for a project better. So even though they may not be right on with a correct response or figure something out as quickly as someone else, they can be successful too” (J5-I-052907). Ms. Jenson took into consideration student differences when assessing them in science. The current science education reform movement supports alternative methods of assessing student achievement, citing the benefit of “assortment” rather than relying on the more traditional means of assessment (i.e., paper and pencil test) (NRC, 1996, 2000). This position is also supported by the findings of Waters, Smeaton, and Burns (2004) which finds that students prefer to be assessed through alternative means rather than multiple choice tests. Students report that non-traditional assessment methods make learning personal and self-expressive; provides opportunities to work with and learn from others; and increases their learning.

According to Ms. Jenson, Dr. Carson often spoke of her and the fifth grade science program with high regard commenting that she (Ms. Jenson) was “doing a wonderful job…has the students excited about science…has the students ready for the FCAT [and, has] motivate[d] the students to learn [science]” (J5-I-052907; J5-I-062007; RJE-011607; P-I-040707, 062007). Dr. Carson was very elated with Ms. Jenson and the fifth grade students, praising her before and after FCAT for what she conceived of as the success of the science program (i.e., renewed student interest in science, highest FCAT science point increase in the zone during the 2006 – 2007 administration, Ms. Jenson’s
enthusiasm about science). It became clear during our final interview that Dr. Carsona’s satisfaction was based most significantly on the positive classroom environment Ms. Jenson engendered and the fact that students made such a significant increase on the science FCAT, rather than how science was taught and whether students had the experiential and conceptual understandings necessary to flourish in subsequent grades (RJE-062007). Dr. Carsona credited Ms. Jenson with “turning the [fifth grade] science program around [because of] her dedication…[and] eagerness” (P-I-062007). She subtly suggested that Ms. Jenson and her approach to teaching science, not the principal, was the primary reason for the “turnaround” in the science program. She did however chuckle, giving herself credit for making such a “magnificent” (P-I-062007) hiring acquisition.

**Science in the Science Laboratory**

The science laboratory was also central to Simmons efforts toward science improvement; albeit to a lesser degree. Taught by a teacher who had over 25 years of teaching experience and was excited about the appointment, administrators and science teachers shared sentiments that a science laboratory would be a great addition to the science program, providing opportunities for students to “do” science. Students in grades two through five, as well as classes from the E.S.E program, visited the science laboratory for one hour each week.

It was thought that in the science laboratory, students would learn science and use science processes while engaging in “hands-on” science; an environment that was to be starkly different from what had been conceived of as traditional science instruction (P-I-011507; Jlab-I-011807; RJE-011907). Science investigations, while described by the nebulous and often ambiguous construct of “hands-on”—were expected to be “purposeful” (AP-I-031907). For Ms. Perez, “purposeful” science learning was to entail “mak[ing] connections to the real-world…[and] making it [science] relevant to their [students] lives” (AP-I-031907). Hence, the administrative team insisted that Ms. Jefferson, the science laboratory teacher, plan weekly with classroom teachers. Fundamental to the objective of purposeful “hands-on” science, the science laboratory teacher was allotted time on a weekly basis to plan with teachers she serviced to align
laboratory activities with the science content students were learning in regular science classrooms. “When I was assigned to the science lab, one of the things she [Dr. Carsona] stressed was that she needed me to plan with the teachers. I thought, “Wow that’s a lot of people to see every week!” But it has worked out okay…When the students come to see me, they have some ideas about what I’m teaching and it helps reinforce what they are learning with their teachers” (Jlab-I-011807).

Dr. Carsona explained that she loved science and articulated the need for the science laboratory to be a venue where student learning was enriched by the inclusion of a “hands-on” connection (RJE-011607). She envisaged the science laboratory as an environment where engagement in “hands-on” science was the primary instructional approach, with other modes of instruction incorporated sparingly (P-I-011507). With available resources—science kits, technology, supplemental materials, models, visuals, and other miscellaneous materials—students could think critically as they try to “figure out how this world works” (P-I-062007).

A Portrait of Science Instruction in the Science Laboratory. Ms. Jefferson was selected to be the science laboratory teacher at the close of the 2005 – 2006 school year. From her perspective, she did not know why she was selected, but was excited at the possibility of teaching science, a subject she had come to love from a former colleague (Jlab-ID-13007). Like Ms. Jenson, Ms. Jefferson believed that the learning environment in science should be one in which students had “fun” and were excited as they engaged in the learning of scientific concepts. Ms. Jefferson understood Dr. Carsona’s plan for her within the reconceptualized vision for science improvements, calling herself the “reinforcer” making reference to her task, which was to “reinforce what the teacher does…giving them [the students] the “hands-on” experience” (Jlab-I-011807). This, as she understood, was also “to include experiments” (Jlab-I-011807).

The notion of making science “fun” and exciting aligned with Ms. Jefferson high-spirited and comical nature. I often called her the “jokester,” which she adopted as her nickname, because she always told jokes and made students (and staff) laugh. This I found was central to her teaching style, the classroom climate, and her personality. Despite sustaining considerable memory loss and limited use of one arm, Ms. Jefferson attempted to teach science in a manner that aligned with the school’s vision, although she
had difficulty organizing the materials for instruction and did not remember (or did not have an understanding prior to) basic scientific concepts.

Although students were always “doing something” in the science laboratory, from my observations very little teaching or learning was going on (RJE-020107; OP-011007 through 050307). As will be described, the instructional approach was quite often simplistic, particularly for the older students; students entered the science laboratory with some basic notions about the concepts, but the lesson did not challenge their thinking or ask them to apply their understanding of the concept; the concepts were taught in a superficial manner; conceptual misunderstandings were passed along to the students (see Reflective Journal excerpt below); and there was a considerable amount of class time used for non-lesson/non-class related tasks (e.g., treasure chest prizes, looking at a new gadget she had purchased for the classroom, story telling).

Although Ms. Jefferson was charged with reinforcing science concepts taught in the regular science classroom, this quite often became a learning environment where vocabulary words associated with the lesson were drilled (students copied the definitions off the board and then the papers were collected); students “touched” or drew pictures depicting the concept; and rewards were given unsystematically from the “treasure chest” (which the students looked forward to) to those students who participated or were well behaved (RJE-020107, 020807, 021007, 031307, 032207, 041707; OP-011007 through 050307). An excerpt from my Reflective Journal may coalesce a portrait of a typical day in the science laboratory.

Well today I observed Ms. Jefferson and entertaining it was. She always has a way of making the students laugh uncontrollably. But that has come to be expected. Today she was teaching a lesson on properties of liquids from the Solids and Liquids Module from the FOSS Kit (Full Option Science System) to students in fourth grade (this is a first and second grade kit). Ms. Jefferson began the lesson by writing the vocabulary words on the board (opaque, viscous, colored, bubbly, transparent, and translucent). Students were asked to fold their papers into six squares, where she directed them to copy a word in each box. The students did as they were asked to do. As I observed the students, many looked
disconnected, uninterested, and well, simply bored, as they copied with their heads on the desk and their cheeks resting in the palm of their hand. Some others were not copying at all until she prompted them to do so. Ms. Jefferson wrote the definition following each word—opaque, viscous, bubbly, colored—directing students to copy the definition. She then proceeded to write the definition of transparent: liquid you are unable to see-through, but light can pass through. I paused thinking that this was a teaching strategy that I used as a classroom teacher wherein I wanted students to identify an error I had made. Well, no such luck. Ms. Jefferson carried on writing the definition of transparent: liquid you are able to see-through, but light can not pass through. It was apparent to me that Ms. Jefferson had simply mixed up the definitions; we as teachers sometimes make mistakes that we have to go back and correct at some point in the lesson. God knows I have made my share. Ms. Jefferson then made the connection between the definitions and the liquid by showing students an example of the liquid that she had prepared in sealed bottles (the bottles were labeled with the liquids’ properties). Again she confused the terms transparent and translucent showing students the cooking oil for transparent and water for translucent. She wrapped up the lesson by asking students to draw a picture of the corresponding liquid. As Ms. Jefferson circulated the classroom, she came upon a student who, despite the fact that she had incorrectly identified the transparent and translucent bottles, had accurately represented them on her paper. She teased the student about drawing the bottles in the incorrect box on her paper and asked her to change them. The student, challenging, began to speak: “I thought that…” Ms. Jefferson cut her off stating with a scornful yet pleasant grin, “Correct this; [pointing at the student’s paper] it’s almost time to go.” The student complied, tearing her paper as she erased. Ms. Jefferson wrapped up the lesson, repeating the same mistake. She gave out “treasure chest” prizes and dismissed the class. Wow! This is the second time. Do I detect a pattern? (RJE-020807)

After similar occurrences during subsequent observations, I tactfully broached the subject with Dr. Carsona. I asked, “Have you been in to see Ms. Jefferson lately?” I can only
assume that I had an expression of concern on my face and trepidation in my voice, because with a look of empathy, apprehension, and distress in her eyes, Dr. Carsona replied, “Yeah. I know. She doesn’t realize it…she has good intentions” (P-ID-031307). She described a situation wherein Ms. Jefferson had experienced something traumatic, a serious car accident which had her hospitalized for several months that, unbeknownst to me, had apparently affected her professional capabilities. Yet, she was assigned to the science laboratory, a new facility that, with all of the materials and equipment, had great potential.

**Science in Grades One through Four**

Because Dr. Carsona’s primary focus of improving science instruction was on fifth grade science and the science laboratory, science in grades one through four was ignored. In each of these classrooms, science instruction was largely traditional, with the textbook or content-based science handouts serving as the primary instructional tools. Science instruction, holistically speaking, was teacher-centered, unidirectional, lecture-based, superficial, and taught for the purpose of collecting a grade for each student (OP-011007 through 050307). On any give day, I could expect to walk into any classroom and observe the teacher standing at the front of the room, students sitting at their desk with an open textbook or handout, the teacher or students reading the text aloud, and students completing a follow-up assignment (generally a workbook page) that asked them to use the text to answer content questions about the reading. On rare occasions, teachers would engage students in “hands-on” science activities (e.g., growing a plant, examining miniature models of dinosaurs, etc.), which was primarily for the purpose of confirming what was already known or to make visual connections (RJE-012307, 021407, 021607, 041807, 042307, 042607). Didactic, teacher-directed instruction was common, despite the fact that when interviewed, teachers explained that the school’s vision for science was instruction that employed differentiated instructional strategies as to reach as many students as possible (H1-I-032007; R3-I-022307; H4-I-030707). According to a third grade teacher, “Dr. Carsona told us in the beginning of the year at the faculty meeting, that she wanted us to use a lot of teaching strategies and go to the lab and use United Streaming videos oh and “hands-on” teaching…” (R3-I-022307).
Although Dr. Carcona’s vision included using multiple instructional strategies in science, regrettably for the students in these grades, this was not happening. On a continuum, there were teachers who expressed interest (very little but some) in using an array of instructional strategies, but cited lack of time as a disincentive (4th grade teachers). To the other extreme, there were those teachers who were overly traditional and employed teacher-directed instruction quite often, although they did not see their science instruction as such (RJE-022207, 022307).

Teachers in grades one through four “bought into” and supported Dr. Carcona’s decision to only focus on grade five particularly and the science laboratory, and the support was unwavering. As discussed by Ms. Harvey, “…we support her [Dr. Carcona]. The kids here—probably every where in the district—haven’t had much science for a very long time. It has been reading, writing, and math. It was the best way to prepare the kids [for FCAT] in a short amount of time. I don’t blame her because they [the kids] have to pass the test. That’s what matters at the end” (J1-I-032007). Ms. Torrez commented, “All of the teachers support her; she always makes good decisions, you know and students perform time-and-time again; far beyond our expectations” (T3-I-021607). As a result, teachers in grades one through four did not require (or desire) much from the administrative team in the way of resources, instructional support, and professional development opportunities. Although all of the teachers endorsed the approach to focus solely on the fifth grade and saw it as a practical option, their reasoning behind this support was revealed when Ms. Smith, a fourth grade teacher, boldly stated, “I hate teaching science. I’ve always hated science even when I was in school” (S4-ID-021507). This gave the impression that the approach to science improvement taken by Dr. Carcona benefited those science teachers who truly did not have a desire to teach science at all.

As evidenced by the Classroom Visitation Log posted in all of the teachers’ classrooms, Dr. Carcona and Ms. Perez visited these classrooms on a regular basis (DA-22-120406 through 052507). However, there appeared to be very little concern about the type of science teaching and learning that was taking place; in the case of these teachers, visiting classrooms appeared to be a formality or a ritual that was an expected part of the school culture. In this regard, supporting teacher and being a visible presence in these
grade levels appeared to be the extent of Dr. Carosa and Ms. Perez’s involvement in science. Whenever I attempted to broach the conversation about science in grades one through four, Dr. Carosa reminded me that the focus was on fifth grade; the other grades are not a priority this school year and the conversation would be reverted to the wonderful science teaching and learning that was going on in fifth grade (RJE-011607). This reiterated the points that FCAT was the priority, science learning was not for all, and Dr. Carosa truly does not understand how students learn science. Although Dr. Carosa explained that the school’s efforts would be expanded to include all grades the following school year, in the interim the students in grades one through four were being educated in science classrooms in which ineffective traditional and teacher-centered instruction was the norm.

**Influence of Principal’s Instructional Leadership on Science Teachers**

Dr. Carosa made what she perceived as competent instructional decisions within the science program, decisions that she believed were in the best interest of students and optimal decisions based on the scarce resources available to her. Teachers, too, assumed and trusted that the decisions Dr. Carosa made were sound and would potentially resuscitate an ailing science program (H1-I-22207; R3-I-022307; T3-I-021607; C4-I-030607; H4-I-030707; J5-ID-011907). This resounding optimism was because, as both Ms. Harvey and Ms. Jefferson defended, Dr. Carosa had a long history of effectively managing school operations as well as making instructional decisions that produced the desired outcomes (Jlab-ID-020807; H1-032007). For this reason, the teachers trusted that the decisions made with regard to the science program would too prove successful and have a greater if not be equally beneficial as other decisions made since the beginning of Dr. Carosa’s tenure at Simmons.

Because Dr. Carosa’s decisions in reading and mathematics had brought the school much recognition—accolades from district/zone leaders, several years as an “A” school according to the Governor’s A+ Plan, and distinction as a “model” school for others to take notice of (new administrators, administrators from failing school, district visitors, etc.), the science teachers did not question the plan of action proposed by Dr.
Carsona for science (RJE-052207). Teachers accepted the vision as their own and worked towards its success. According to Ms. Jefferson,

…it well, usually when she [Dr. Carsona] makes a decision, we [teachers] see how it affects the students. They learn they excel. She’s usually right on [with the decisions for the school] and year after year our scores increase, we win chess championships, and the kids shine when they represent the school in different you know contests… I’ve been with her a long time and she does right by the kids (Jlab-I-052407).

The data revealed that the science teachers “loyally” and without question worked towards the goals and vision for science articulated by Dr. Carsona. Teachers did not question Dr. Carsona’s instructional leadership in science not because they were incapable of doing so or were not allowed to make instructional suggestions; indeed Dr. Carsona welcomed the input (P-ID-042507). The teachers simply saw her as a capable and skillful instructional leader who had a history of success making sound decisions.

It was apparent to me the learning needs of one grade level (fifth) were prioritized over the needs of others (one through four) and deprived the latter of resources, experiences, and professional growth opportunities for teachers (RJE-050307). Concerned, I asked the teachers about whether the instructional decisions Dr. Carsona’s made could be denying students and teachers in grades one through four the same opportunities as those students in fifth grade. One third teacher’s statement captured the quintessence of most of the science teachers. Ms. Torrez explained, “Sometimes you have to make hard decisions. This was probably one of them. We [first through fourth grade teachers] still teach science and we know…we know that she made the decision because she didn’t see any other options. It may seem a little one-sided, but like I said they [the students] are still learning. Next year it will be school-wide…” (T3-ID-032707). However, one fourth grade teacher, Ms. Hernandez, stated, “I could benefit from a workshop or two [in science], but I don’t know” (H4-I-030707), alluding that her needs as a life-long learner were being ignored. Needless to say, Ms. Hernandez was not sent to any professional development workshops and taught science in a self-contained situation as instructed.
This Research and the TCSR Model

I utilized the Contextual Factors Matrix (see Appendix D) to identify the contexts (national, state & district; school; department & subject area; and classroom) teachers identified as having the greatest impact on their practice. The three most noted contextual factors that teachers cited were: 1) the pressure to prepare students for FCAT science 2) limited teacher professional development opportunities, and 3) lack of resources. There was consensus amongst the science teachers that these factors influenced their practice, albeit in a way that I did not expect.

Table 22 Teachers Cite the Contextual Factors that Influence Their Practice

<table>
<thead>
<tr>
<th>Context(s)</th>
<th>Pressure of FCAT</th>
<th>Limited Professional Development Opportunities</th>
<th>Lack of Resources</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>- National, State &amp; District</td>
<td>- National, State &amp; District - School</td>
<td>- National, State &amp; District - School - Department/Subject Area</td>
</tr>
<tr>
<td>1st</td>
<td>Ms. Harvey</td>
<td>*</td>
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</tr>
<tr>
<td>2nd</td>
<td>Ms. Gilbert</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>3rd</td>
<td>Ms. Torrez</td>
<td>*</td>
<td>*</td>
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<tr>
<td>3rd</td>
<td>Ms. Rappas</td>
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</tr>
<tr>
<td>4th</td>
<td>Mr. Claud</td>
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<td>*</td>
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<tr>
<td>4th</td>
<td>Ms. Hernandez</td>
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</tr>
<tr>
<td>4th</td>
<td>Ms. Smith</td>
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<td>*</td>
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<tr>
<td>5th</td>
<td>Ms. Jenson</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Lab</td>
<td>Ms. Jefferson</td>
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</tbody>
</table>

The science teachers in this investigation did not conceptualize these contextual factors as constraining to their classroom practices, but rather “things that happen” (H1-I-032007). According to Ms. Harvey, “…all schools have problems. I don’t have all the supplies I need and yes the FCAT takes up a lot of time in the school day, but we [teachers] work really hard and things are not that bad” (H1-I-032007). Another teacher acknowledged that preparing students for the FCAT had taken much of the fun and spontaneity out of school, but saw it as incumbent upon the teacher, as they plan for instruction, to ensure that students have positive school experiences (RJE-021607). According to Ms. Torrez, “testing has taken a lot of the fun and spontaneity and
excitement out the classroom. But we [teachers] have to prepare kids for the test; it’s not going away…We gotta do it with creativity though. So we [teachers] have to do both things; we gotta get them ready [for the test] and we gotta make sure they have good experiences” (T3-I-021607).

I assumed prior to embarking on this investigation that factors teachers identified as having an affect on their practice would be perceived of as barriers that would engender negative, disapproving feelings. Hence, these would be factors that had to be ameliorated by the principal in order for teachers to work to their maximum potential. Ironically, this was not the case. Teachers did not see these factors as inhibiting, but rather inevitabilities in school systems that are striving to prepare students to be great stewards of science knowledge. For example, there was resounding agreement that in striving for excellence in student performance on the FCAT, pressure is a normal occurrence (national, state & district context). Although some of the teachers described it as excessive at times, it was not perceived of as debilitating or encumbering (J5-ID-021507; H1-ID-022607; R3-I-022307; C4-I-030607 J5-I-040707; H4-I-030707). The science laboratory teacher did not cite the pressure as being problematic, as her position was not recognized as contributing to student success on the FCAT. Based on the administrative team’s treatment of the science laboratory (a place to go to have classroom concepts reinforced), I would venture to say that they did not understand how the science laboratory could be used to help prepare students for the FCAT, when “hands-on” or active learning was far removed from how students were assessed (traditional and paper pencil).

All of the science teachers made reference to the fact that professional development opportunities in science were limited. However, this too did not evoke negative feelings from teachers. Instead, they attributed this to the long-standing neglect of science, pardoning this shortage, optimistic that this would improve in subsequent years (district context/school context/subject areas context).

Finally, the fifth grade science teacher and the science laboratory teacher did not cite a lack of resources as factors that influenced their practice, as the school’s efforts made these classrooms priority (school context/subject areas context/classroom context). On the other hand, the other science teachers pointed out that science resources were in
short supply, if available at all. The teachers referenced different reasons as justification (and acceptance) for not having the materials they needed to teach science:

1) The new science series, which they would be receiving the following year, would solve the problem of limited resources.
2) The school’s emphasis was on science in fifth grade.
3) There were limited funds available for science. It was therefore acceptable that available resources be used in fifth grade.

Only one teacher (Ms. Harvey) felt a lack of resources negatively affected her practice in the teaching of science. In my attempt to clarify why a lack of resources was seen as a negative contextual factor, she indicated that it was because she often did not have the materials necessary to teach particular activities. Aware that Dr. Carosa encouraged teachers to come to her if they were in need of resources or sign them out from the science laboratory, I asked had she done these things. Humbly, she said no, indicating that she did not wish to bother anyone (H1-I-032007). This suggested to me that there was a lack of communication between Ms. Harvey and Dr. Carosa or Ms. Dotres. I would further assert that Ms. Harvey may have lacked confidence in her ability to articulate and justify what she needed as a professional.

**Summary**

Dr. Carosa took what she (as well as science teachers and other content area teachers who had been on staff prior to “restructuring”) perceived to be aggressive steps to change Simmons’s science program from that of ineffective and nominal in school-wide emphasis to effective. In comparison to previous years, the changes implemented were perceived of as vast, revitalizing, and making successful a once overlooked academic program. Fifth grade was the primary emphasis of the school’s efforts, with the FCAT serving as the primary means of measuring school success. Changes were incorporated (e.g., science laboratory, departmentalization, materials, etc.) that sought to make the current science program function better, but beliefs about science teaching and learning were not changed.

Although Dr. Carosa expressed a sincere interest in implementing a science program that would provide students with a range of science experience through a
multitude of instructional strategies, she did not have the knowledge and skills needed to truly develop a reform-minded science program that aligns with science reform documents. The district’s “public” commitment to science education reform failed to inform Dr. Carsono’s understanding of the major tenets of the science education reform movement. She therefore adopted the district’s articulated message of accountability (“actual” science plan) as the nexus for school-wide decision-making in science. Unfortunately however, as will be discussed in the next chapter, first-order modifications, changes that amount to insignificant adjustments to an ineffective science program, and affixing an emphasis on accountability that prioritizes drill and practice, rote memorization, and vocabulary develop, impedes efforts toward second order modifications coveted in the Science for All movement.
CHAPTER V

DISCUSSION, IMPLICATIONS, AND RECOMMENDATIONS

With the reality of FCAT science forthcoming, Dr. Carsona set out to make changes in the Simmons Elementary science program that would meet the school and district’s objective of higher levels of student achievement. Leading the charge with the district’s rhetoric and notion of what was regarded as success in science, Dr. Carsona made adjustments to the curriculum, reorganized the teaching space, and fashioned a unified approach to change, albeit with an emphasis largely on fifth grade. Dr. Carsona for all intents and purposes is a champion for change. But could her change efforts be characterized as transformational in the eyes of elementary science education reformers?

When viewed through the lens of reform, Dr. Carsona’s instructional leadership did not support the implementation of an elementary science program that promoted student learning as portrayed in reform documents (AAAS, 1990; NRC, 1996). For example, Dr. Carsona championed a science program that deprived students in first through fourth grade of the resources pooled for science; she failed to ensure that quality science teachers were in every classroom; she allowed mediocrity in teaching practices to exist and persist unchallenged; and she lead change efforts that fell short in embracing goals and objectives that would promote a sound curriculum framework, elevate the level at which teachers taught, ensure that student inquiry was present in every classroom, or bring about assessment practice which necessitated higher levels of student thought. Through trusting relationships (teachers/principal), Dr Carsona was able to gain teacher support for school-wide departmentalization, the incorporation of a science laboratory, fifth grade science emphasis, and other program modifications. In introducing and implementing these site-based changes, Dr. Carsona employed many instructional
leadership actions/behaviors in the process (see Table 19). However, these efforts were directed towards an end that in many ways was counter to national efforts.

I embarked upon this investigation to better understand how an elementary principal as instructional leader influences elementary science in their school and how teachers respond to this leadership. The broad themes identified from this investigation include:

- Variability of Instructional Leadership: Does the Subject Matter?
- Generic Instructional Leadership: Does One Size Fit All?
- All Change is not for the Better: First Order Changes vs. Second Order Changes
- Teachers Respond to Dr. Carsona’s Instructional Leadership: Trust as an Intermediating Factor

Each theme is discussed below. Also discussed are the implication for this research, how this research complements existing research that speaks to principal influence, and recommendations for future research. It is my desire that this discussion will not only contribute to the budding conversation about how principals’ instructional leadership practices play a fundamental role in the outcomes of reform within the science education literature, but also offer valuable information about this leadership within the context of science that will be useful to the educational leadership community as well.

**Variability of Instructional Leadership: Does the Subject Matter?**

Although an instructional leader in many areas of Simmons’s academic program, the data revealed that this instructional leadership varied between academic subjects; for example between science and reading/language arts. It seems that Dr. Carsona felt more comfortable leading instruction in reading. Principals and teachers reported that Dr. Carsona was much more proactive and innovative in the reading program, suggesting instructional inclusions and modifications that appeared to come “right out of the 2007 Your School Should Try This manual” (JLab-ID-011907). Fulp (2002), Templeton (1999), and Spillane (2005) report that this is not uncommon, because principals feel more confident in their ability in the area of reading. Principals tend to grasp the subject matter and the latest research implications. Researchers find this to be the case for elementary science teachers as well. Teachers feel much more comfortable in their ability to teach
reading and are able to incorporate more innovative and novel instructional approaches (Fulp, 2002). This confidence and self-assured efficacy in her instructional astuteness in reading, unmasked variations in Dr. Carsona’s instructional leadership.

The data support the assertion that variation in instructional leadership can be attributed to Dr. Carsona’s lack of knowledge about the science education reform efforts, limited pedagogical knowledge in science, Dr. Carsona’s relatively small pool of ideas from which to suggest curriculum changes that had instructional depth, and her insistence that she was obligated to comply with the district’s “suggestions” for elementary science. Dr. Carsona often said there was very little variability where the district was concerned as it relates to science; she was obligated to implement their curriculum “suggestions.”

Dr. Carsons characterizes herself as a “rebel,” a designation that she contended allowed her to make decisions that other principals would be afraid to make (P-ID-031207; P-I-062007). However, her rebellion was celebrated in the reading program, working with teachers to craft a program that was mindful of the district’s agenda, but inclusive of instructional activities and curriculum modifications that were indicative of the school’s communal beliefs about the teaching and learning of reading. Therefore, Dr. Carsons was not obligated to implement the district’s “suggestions” as she often alluded to. Perhaps being able, or not, to think “out of the box” is more of an intellectual function than one of instructional leadership. Specifically, if one does not have the pedagogical knowledge for a particular content area to include the most recent research and reform implications, then one may not have the intellectual platform from which to draw upon to suggest changes that do no more than meet the requirements as opposed to the spirit of the same.

When the academic program was examined as a whole, an imbalance of instructional leadership in science could not be easily identified. However, when contrasted with other academic subjects (reading/language arts and mathematics) and across grade levels in science, the difference is overt (see Table 19). This supports the work of Burch and Spillane (2003) and Spillane (2005) in that the subject is a major determinant in the instructional routines of principals and other school leaders. Spillane (2005) examines the leadership practices in mathematics and literacy across several schools. Viewed as the subordinate subject to reading, “school principals and assistant
principals were more likely to be involved in the performance of leadership routines for language arts, less likely to be involved in leadership routines for mathematics and even less likely still to be involved in leadership routines for science” (p 388). Dr. Carsona’s leadership role within the science program was similar to the principal identified in another investigation (Spillane et. al., 2001). According to Spillane and his colleagues (2001), the work of principals’ who are involved in science restructuring is “typically confined to supporting the work of external partners, recruiting specialist faculty for science, and allocating discretionary school resources to science” (p. 925). This, they report, “contrasted sharply…for language arts, where leadership for instruction in all schools involved the principal and/or assistant principal in addition to other leaders” (p. 925).

As instructional leaders, principals are viewed as having “strong ‘enhancing effects’ on teachers, emotionally, cognitively, and behaviorally” (Blasé & Blasé, 2000b, p. 137). This research supports this proposition. At the heart of Dr. Carsons’s leadership was her ability to nurture relationships that facilitate a healthy school culture, encourage professional innovation, and guide practices. However, Dr. Carsons lacked the pedagogical wherewithal to offer reform-oriented curricular improvements or to make prudent instructional modifications to a district’s often conflicting approach to change; this was evident in the curriculum modifications she supported and implemented. Dr. Carsons’s inability to lead the charge for elementary science education reform resulted in an often vague institutional rationale, and Dr. Carsons’s use of that rationale for the inclusion of particular instructional approaches. Too, regarding the district’s vision for science as unyielding, mandatory, and rigid (i.e. success in science was to be achieved by whatever means necessary to increase scores on standardized assessments); this was linked to Dr. Carsons’s lack of functional and informed decision-making abilities where science was concerned. She, echoing the district, described elementary science in terms of student achievement on assessments. Dr. Carsons failed to recognize that science must also be described in terms of what instructional practices are used in the classroom, what formative assessments are being used and how the assessment data shape instruction, how teachers teach, and whether teachers are well-versed in the latest instructional innovations.
Burch and Spillane (2005) find that mathematics educators in top-tier and middle management positions describe mathematics success in terms of student performance on standardized assessments when they do not have the discourse or conceptual underpinnings to describe it in other terms. When these leaders do not have the language (or conceptual underpinnings—not only do they not know how to discuss it, they really don’t know what reform minded teaching and learning is) to define mathematic goals in terms of teaching and learning, they describe them in terms of policy requirements and guidelines. They report that “administrators were seven times as likely in mathematics than in literacy to identify a particular policy or programmatic initiative (state standard, testing policy, and funding guidelines) as the primary driver for districts’ reform in mathematics” (p. 63). District administrators (only 15% of them) describe reforms in mathematics by the quality of classroom instruction. Dr. Carsona therefore did not understand reform; did not have an informed stance from which to articulate and implement change that aligns with the national vision; did not have the ability to effectuate reform-minded changes in classroom practices; and did not have the capability to encourage teachers to implement strategies that deepened students’ knowledge of science concepts and processes. This was apparent in her discussions about science and mirrored in conversations by those in higher leadership positions (Burch & Spillane, 2005).

Initially, Dr. Carsona was oblivious to her glaring contradiction of leadership in science and reading. She later confirmed that she was more comfortable and better prepared to lead in reading when compared to science (or even mathematics) because of the range of professional growth opportunities available from the district; hence the variations in her leadership. This admission is similar to the sentiments of elementary science teachers who cite the low priority of science and lack of direction from the school district as central to their inability or avoidance for honing their science teaching craft (Appleton & Kindt, 2002). The fact is schools, while somewhat independent and self-regulating, operate within a broader, reticular social context that is influenced by national, state, and district regulations (Woodbury & Gess-Newsome, 2002). This by no means discounts the need for elementary principals to be informed leaders or the reality that elementary principals are more confident in their instructional leadership abilities in
reading/language art. There is a wealth of literature that supports this contention (Ediger, 2001; Fulp, 2002; Spillane, 2005; Spillane et al., 2001; Templeton, 1999). But leadership practices within and across subject areas at the school level can be linked to leadership (and financial allocations) in the broader institutional and political context (Burch & Spillane, 2005; Johnson, 2007a). The federal government, through policy, funding opportunities and accountability emphasis, has prompted states to target reading/language arts and mathematics, while minimally addressing science and social studies (Burch & Spillane, 2003; Burch & Spillane, 2005 Marx & Harris, 2006). The funding disparity with regard to reading/language arts was evident at Simmons (e.g., the vast difference in the number and quality of professional develop opportunities available), and indeed influenced Dr. Carsona’s instructional leadership.

The findings of this study made clear that schools are indeed interrelated systems wherein leadership in a particular subject is influenced by the larger social and political climate. The variability in funding and policy emphasis at the national, state, and district levels propagates differences in the programs that are available to increase science teachers and principals knowledge, as well as determines what is deemed important (e.g., literacy, physical fitness) (Appleton & Kindt, 2002; Griffith & Scharmann, 2008). In this case, the administrative team or science teachers, however, did not perceive this to be a barrier to effective elementary science instruction. Rather, the administrators and science teachers in this study viewed testing, policies, and guidelines as standard protocols in the operation of schools.

Although researchers cite the multifaceted layers within the national and state context as contributory to how site-based leadership is executed (Appleton & Kindt, 2002; Burch & Spillane, 2005), Goldsmith and Pasquale (2002) offer four ways that principals and other school administrators can learn about the basic tenets of science education reform: 1) do some research; 2) do some science; 3) seek professional development; and 4) network at professional conferences. I believe that the recommendations would be viable if the context of schooling was idyllic and one-dimensional or if schools’ valued the aforementioned principle as constructive growth activities. However, the broader societal context indirectly influences school-based decisions, what schools make priority, where funds are funneled, and the monetary
allotments ascribed. Simmons’s school district prioritized reading and this was reflected in the smorgasbord of professional growth opportunities and resources available to ensure teachers and principals were aware of and attuned to the latest instructional advances. Offerings in other subjects, specifically science, were much less. (For example, when I examined the professional development website, there were 16 pages of professional development opportunities in reading compared to three and a half pages in science. I must note that almost half of those professional development offerings were advertised for secondary teachers.) Such disparity is made possible by policies enacted at the federal, state, and local levels of government that dictate in subtle ways what should be the main emphasis of schools’ academic programs (Burch & Spillane, 2005; Johnson, 2007a).

In science, the budget was substantially less and there were very few growth opportunities available, particular those designed specifically for elementary teachers. Those professional growth opportunities focused overwhelmingly on preparing elementary science teachers specifically and science teachers in general to teach skills and concepts mandated in the curriculum and assessed on the FCAT. Therefore, if principals set out to embrace elementary science education reform, despite how hard they work to implement a science curriculum that prioritizes reform, the districts’ infrastructures can potentially undermine or make school-wide sustainability of reform-based practices even more challenging. As Smith and Southerland (2007) point out, “effective school change and new program implementation is more dependent on local elements within particular contexts (e.g., the classroom teacher, school administrative support, available resources, etc.) than on federal mandates or other top-down methods of promotion, reform efforts have traditionally neglected or undervalued the effects of such factors” (p. 397). The findings of this investigation make a strong case for a more aggressive bottom up approach that brings principals, teachers, community partners, and other site-based leaders together to design and implement elementary science programs that meet the needs of all students.
Generic Instructional Leadership: Does One Size Fit All?

Within the educational leadership literature, instructional leadership continues to be a “passing fancy that refuses to fade away” (Hallinger, 2005, p. 221), despite other leadership models that have emerged (e.g., distributive leadership, transformative leadership, etc.). Research that examines instructional leadership has endured, spanning from the effective school’s movement of the 1980s continuing still today.

Over the past 30 years, research conducted within the educational leadership community on principal instructional leadership has informed the understandings of researchers in many areas of academia. Researchers have prepared reports and conducted investigations that have utilized this body of research to understand the principals’ influence within the teaching and learning of mathematics (Weast, 2000; Bartholomew-Mabry, 2005), reading (Cobb, 2005; Ediger, 2001; Hallinger et al., 1996), social studies (King, 1990; Ediger, 1993), and science (Kelly & Staver, 2005; Saka, Southerland, & Brooks, in press; Spillane et al., 2001). Other studies examine the influence of principal instructional leadership on student achievement in general (Gaziel, 2007; O’Donnell & White, 2005); principal instructional leadership on the achievement of at-risk African American students (Pollard-Durodola, 2003); the influence of principal instructional leadership on the under-representation of African American students in the gifted program (Granatham & Ford, 1998); and the ways in which principals who are instructional leaders work collaboratively with counselors to improve students’ academic achievement (Stone & Clark, 2001). Undoubtedly, the wealth of research on instructional leadership amassed by educational leadership researchers has contributed to the understanding of principal instructional leadership across disciplines. Because the research on principal instructional leaders is so expansive and robust, I too found it quite helpful in developing the instructional leadership model used for this investigation (see Table 11).

Utilizing the Instructional Leadership Action/Behavior Model (see table 11), I was able to chart the distribution of Dr. Carson’s instructional leadership in science (see Table 19). For example, she articulated a vision for science that all science teachers were aware of and supported. Too, she helped teachers build leadership capacity by making instructional suggestions and decisions about the science program. She also utilized
formative and summative data to develop and make modifications to the science program. In fact, the data revealed that Dr. Carsona employed many of the instructional leadership actions/behaviors discussed broadly in the literature in the science program. The “subject-neutral” frameworks made available by educational leadership researchers were effective in identifying general application of instructional leadership in science. However, the model did not have a built in mechanism that differentiated practices that promote the vision for science education reform from those that were misaligned and counterproductive. How then does an instructional leadership model, which reflects that an array of instructional leadership actions/behaviors was employed in an elementary science program, fail to advance the national vision of reform?

Instructional leadership, as described in the educational leadership literature, offers for use a “generic” model that can and has been used to examine principal instructional leadership in many academic areas (Spillane, 2005). As a result, the instructional leadership model promoted in the literature was not particularly useful for this investigation in identifying those actions/behaviors that advance the vision of science education reform. Of the 25 Indicators identified in the Distribution of Instructional Leadership in Science (see Table 19), there were nine Indicators that Dr. Carsona did not show evidence of promoting in the science program during this investigation (two in the academic program in general). But the models described in the literature and the model developed for this investigation, although multidimensional and inclusive of an array of actions/behaviors necessary for today’s principal, did not differentiate between those instructional leadership efforts that promoted the vision of accountability from those that promoted the vision described in reform documents. In this case, examining principal instructional leadership in the area of science mattered in determining whether the model identified those actions/behaviors that promoted reformed.

According to Spillane (2005), “[r]elationship between school leadership and the school subject are not well understood because scholarship on leadership treats instruction as a generic variable” (p. 383). The findings of this investigation make a case for science-specific instructional leadership models, which must be rooted in the context of reform. Such models can help to define with specificity the principal’s role in promoting and nurturing a school culture of reform-minded change, redefining values
such that they promote a progressive vision for elementary science, identifying and suggesting effective classroom instruction, and making curricular modifications that take into consideration the goal of scientific literacy. Instructional leadership models must embody the practices and skills, definitions of success, and the cultural elements necessary to promote the type of change that will promote scientific literacy for all elementary students. Therefore, examining leadership as a nonspecific and subject-neutral variable fails to acknowledge the dynamic nature of science. As Spillane (2005) points out, there is value in research that examines leadership in specific subject areas independent and distinct of each other, as he asserts and these data support, differences do exist.

All Change is not for the Better: First Order Changes vs. Second Order Changes

Teachers described Dr. Carsona as an effective instructional leader who puts the needs of students first, respected them as people, and supported their professional decisions. This was their general description of her and it applied in science as well. For these reasons, teachers were motivated and reenergized as she took what they perceived as “huge” steps to recommit, refocus, and restore the science program, making it once again a priority, and subject that was an important part of the school’s core curriculum. But “reform” as defined by reform documents did not mean the same thing as “reform” meant to these elementary practitioners.

Dr. Carsona and the science teachers conceptualized the inclusion of a science laboratory, departmentalization, science tutoring, the use of diverse instructional strategies, etc. as reform. Essentially, anything that allowed for more instructional time allotted to science (when compared to previous years) or infused science into the curriculum in ways that had never been done before was considered to be change or reform. When science education reformers use the term “reform,” they are referring to fundamental shifts (second order change) in beliefs and practice (e.g., cultural traditions, teacher beliefs, the organization’s structure, etc.). In this case, “reform” was used as an all-embracing reference to any and all change that was implemented.

Defined operationally, reform to these elementary practitioners meant changes made within the science program that were seen as improvements from previous years.
This did not necessarily include a complete reconceptualization of what constitutes effective science instruction, changes in how science is taught, or the incorporation of school-wide activities that incited interest in science as an enterprise. For Simmons, they primarily channeled their energy into making changes “that have a highly symbolic value” (Elmore, 1995, p. 24) and provides anecdotal evidence that things are indeed being done. This unfortunately epitomizes the notion of change without difference (Goodman, 1995; Woodbury & Gess-Newsome, 2002).

It is important to recognize, however, that these changes were first order changes or changes to structures (Goodman, 1995; Woodbury & Gess-Newsome, 2002). First order or ameliorative changes can be conceptualized as superficial, failing to call into question deep-seated beliefs that guide practice, cultural norms, and shared values about how science is best taught and learned. Simmons reconfigured the science program, changed schedules, added programs, and focused efforts primarily on the grade level that would determine the school’s FCAT score, valuing FCAT-specific vocabulary and test preparation drills. These changes targeted institutional structures concerned with “efficient” use of time (surface changes), but was not “effective” in improving the quality of students’ educational experience (Goodman, 1995). Elmore (1995) contends that “[m]ost school reformers and practitioners take for granted that changes in structures produce changes in student learning” (p. 23). But changes that modify structures do not ensure that there will be changes in how science is taught and learned (Lumpe, 2008; Roehrig et al., 2007; Southerland et al., 2007).

The Science for All movement seeks to make second order or radical changes that not only target structures, but looks to fundamentally transform beliefs about the teaching and learning of science. Second order changes seek to alter the underlying philosophical beliefs driving practice, reshape the cultural beliefs shared by members of the school community, and reform what principals and teachers conceive of as effective science instruction. However, substantive changes as defined by national reform documents were not the emphasis of change or “reform” efforts at Simmons. Administrators and science teachers’ beliefs about science teaching and learning or the core values held regarding science were never considered as Simmons made changes. Dr. Carsona assumed that providing resources would lead to changes in teacher practice because teachers now had
the “stuff” to teach and engage students in science (Gess-Newsome, et al., 2003; Fullan, 2007).

She did not understand that reform as defined nationally requires a deeper level of transformation. She also did not see a connection between what teachers believe about the teaching and learning of science and their practice. Research is clear on this issue: beliefs influence what teachers’ think, say, do, and intend to do in their classrooms, as well as influence how they translate the curriculum into practice (Bencze & Hodson, 1999; Davis, 2003; Elmore, 1995; Kang, 2008; Keys, 2007; Pajares, 1992). Changing beliefs will require much more than just “stuff” to truly transform science practices. “[P]ossession of resources does not automatically translate into their use in meaningful instructional innovation…” (Spillane et al., 2001, p. 921), despite Dr. Carsona’s belief that it would.

**Breach in the District’s Bridge to Second Order Reform**

This research supports what other researchers have concluded: despite being aware of the national push to change the acquisition of science knowledge, most attempts at reform focus efforts on changing structures or first order changes, as they are perceived of as easier, observable, and alludes that one is “serious” about school improvement (Elmore, 1995; Goodman, 1995; Woodbury & Gess-Newsome, 2002). This district, well aware of national science education goals (as outlined in the School-to-Careers Science Plan), focused district efforts on accountability, communicated this message to site-based leaders both verbally and in written correspondence, and offered professional development opportunities that reinforced the district’s commitment to accountability as the primary goal. In essence, the district elected to ignore the message of reform, failing to provide the vision and leadership necessary for a district-wide reconceptualization, as they focused their resources and efforts on the accountability movement (a first order change) (Goldhaber & Hannaway, 2004; Johnson 2007a; Southerland et al., 2007; ). Accountability is indeed a large part of the reform movement in science education. However, it should not be the end-of-all-ends in terms of reform.

The district’s disregard of their science plan for what they believed to be a more effective way to meet state standards is similar to the findings reported by Smith and
Southerland (2007) for elementary teachers. These researchers examine how the “tools of reform” change, reconfigure, or reinforce the instructional practices of two elementary teachers. They find that “teachers may understand the messages of reform, but elect to disregard the proposed changes in terms of their own practice” (p. 415). Similar to the elementary teachers in the aforementioned study, the district understood that scientific literacy for all students was the underlying premise of reform, developing a plan to achieve this goal. But the approach that was second order in nature was abandoned for a “quick fix” and short-term, temporary gains.

Therefore, in this case, examining how Dr. Carsona’s instructional leadership influenced the science program requires a broader more expanded lens in which one has to look at how the district greatly affected Dr. Carsona’s actions and behaviors. The following summarizes what may be conceived of as a “breach” in organizational integrity:

- The district provided the overarching “actual” vision for elementary science (student achievement on state assessment).
- This vision differed from the “public” vision in the School-to Careers Science Plan. District-wide professional development opportunities, instructional “suggestions,” and internal correspondence advanced the “actual” vision.
- Ill-equipped to achieve the “actual” vision through reform-oriented means, Dr. Carsona embraced the recommended assessment-driven approach to change implementing first order structural changes (e.g., departmentalization, science laboratory). These changes didn’t require a different portrait of elementary science teaching or learning.
- Accountability was the most resounding and powerful message teachers and principals “heard” from the district. Achievement on assessments therefore became the criterion for measuring school success.
- Because of the supportive school culture nurtured through Dr. Carsona’s “effective” leadership, science teachers were eager to do what was necessary to see that the school’s vision of accountability gains were achieved.

The district’s actions (or lack thereof), undermined their own attempt to make second order changes. The “snubbing” of the science plan they created in favor of what
they believed would “really” increase student performance on the FCAT typifies their beliefs about science education reform; they did not believe reform would help students excel on the state assessment. Therefore, the district provided the vision, suggesting changes that would unify schools in the district towards a common goal. But the district was emphasizing first order changes—difficult changes, but first order none-the-less.

Indeed not all change is “good” change. Some change, as seen here, reinforces the status quo perpetuating the sentiment change without difference (Goodman, 1995; Woodbury & Gess-Newsome, 2002). And changes are costly in terms of funding and energy. The efforts these first order changes required left schools unable or unwilling to consider second order changes. Unfortunately, “there are few schools and districts that have provided their science teachers [or principals] an opportunity to improve their teaching effectiveness through professional development experiences. This is a problem that must be addressed for change to take place” (Johnson, 2007a, p. 134).

Sustainable reform must address the cultural tendencies and institutional norms from which beliefs about teaching and learning germinate. Suggesting that schools employ a departmentalization model such that students receive science on a consistent basis does not ensure that quality of teaching will happen. Politicians, school leaders, and site-based practitioners must begin to conceptualize science differently, recognizing that instruction that prepares students to be scientifically literate consumers of information will indeed prepare them to be successful on state assessment tests. It is at this point that stakeholders will truly understand the endless possibilities afforded by making structural modifications.

**Teachers Respond to Dr. Carsona’s Instructional Leadership: Trust as a Mediating Factor**

As instructional leaders, one of the things principals are charged with is creating a supportive school climate where teachers work collectively to help students excel academically (Habegger, 2008; Khourey-Bowers et al., 2005; Stolp, 1994). Creating such a learning environment was at the core of Dr. Carsona’s leadership style. Dr. Carsona nurtured a culture of care such that there was mutual respect throughout the school community, she supported teachers’ professional decisions, and she expressed
genuine concern for teachers’ well-being. This allowed for the development of a healthy school culture in which camaraderie, an individual’s sense of purpose, and solidarity were integral to the school’s core values. The strong communal networks (both personal and professional relationships) not only influenced collegial relationships amongst the staff, but greatly influenced the vision for teaching and learning of science.

How then does the cultivation of a cohesive professional community influence the vision for teaching and learning of science? The instructional leadership indicator that can be identified as having the greatest impact on the instructional focus within the science program at Simmons is Providing a Supportive Environment (see Figure 1). As described by the teachers of science (and others on staff), this supportive environment could be characterized by high levels of teacher/principal trust.

Trust is said to emanate from different areas such as work performance, whether the leader is perceived as competent, and the level of effectiveness (Smylie & Hart, 1999). Defined as “…a general confidence and overall optimism in occurring events; it is believing in others in the absence of compelling reasons to disbelieve” (Tschannen-Moran & Hoy, 1998, p. 342), trust is identified as an important and necessary element of leadership within an organization or school community (Collinson & Cook, 2007; Giancola & Hutchison, 2005; Short & Greer, 1997). More important, the degree to which reform is successfully implemented is linked to the level of trust within the organization.

Overall, the members of this school community operated out of a sense of trust and good faith on a daily basis. In science this sense of trust in Dr. Carson’s leadership can not be overstated. The overall vision for elementary science was defined by the district in terms of accountability and championed and supported by Dr. Carson.

In talking with Dr. Carson over the duration of this investigation, she attempted to convince me that she did not have the authority to make modifications to the district’s vision for elementary science or reject a curriculum suggestion; this was not the case. As discussed, Dr. Carson did not have the tools to make informed decisions in science. Notwithstanding, the science teachers embraced the vision for science she put forward, despite the fact it did not facilitate the implementation of effective elementary science practices as outlined in the district’s “public” science plan. In essence, the underlying rationale for science teachers’ unwavering support of the vision espoused by Dr. Carson...
was their trust in her leadership ability as evidenced by her efforts in other content areas and the leadership displayed during general school operations. Although the instructional practices of the teachers in third and fourth grade were not reflective of the school’s vision (several of these teacher indicated that they desired professional development to improve their science instruction while others admitted that they did not like teaching science), they all referenced trust in Dr. Carson’s leadership as the basis for their support. Too, the science laboratory teacher who spoke candidly about the countless number of disagreements she and Dr. Carson had over the years, nevertheless cited trust and “faith” in Dr Carson’s leadership as the basis for her support (Jlab-ID-021507). Leadership that creates strong levels of institutional trust can shape the beliefs and actions of the staff (Hoy & Clover, 2007; Stolp, 1994; Vodicka, 2006). Therefore, teachers did not support the school’s attempt at making changes in science on the grounds of instructional effectiveness, but rather on the premise of relational trust and confidence in the leader.

In an analysis of case study data of more than 400 Chicago elementary schools over a six-year period, Byrk and Schneider (2003) document how trust is a fundamental resource in the implementation of reform. For example, many aspects of school improvement (e.g., collective decision-making) require “teacher buy-in, a crucial ingredient for reform...[Incorporating novel, reform-minded ideals] occurs more readily in schools with strong relational trust” (p. 42-43). Therefore, schools benefit and school improvement efforts are bolstered amidst trusting school environments (Kochanek, 2005; Vodicka, 2006). Too, in learning environments where science teachers feel safe and trust that their principal supports them, they take risks, allowing themselves to be vulnerable, and make more earnest attempts at incorporating reform in ways that align with the schools’ vision (Banilower et al., 2007; Dickinson et al., 1997; Kelly & Staver, 2005; Spillane et al., 2001). However, because national reform initiatives were not the focus of Simmons’s (or the districts) efforts, many of the science teachers made changes to their practice to emphasize teaching that was antithetical to the reforms.

As a result, these data corroborate the finding of Banilower et al., (2007), Barish, 2007, Hanegan (2001), and Saka et al., (in press), who indicate that when principals cultivate a supportive, trusting school environment, science teachers are much more
likely to “go the extra mile” or work to their fullest potential. Although helping principals to cultivate communities of trust may be beyond our scope as science educators, research in this area and the findings of this investigation identify trusting relationships as the catalyst and intermediary agent of change. In this case however, trust between teachers/principal allowed for the advancement of changes that misaligned with national efforts.

Clearly, principals must have the knowledge and understanding of reform such that they are able to make informed decisions. It seems reasonable to assume that if change is facilitated by the relationships that elementary teachers have with their principals, it behooves us as science educators to consider a whole-school approach (principals and teachers) to the reformation of science as we continue to impress upon political and state officials.

The Benefit of Insight

Reflecting on the TCSR Model

This work was a purposeful attempt at examining with specificity how principals within the school’s context influence elementary science teachers’ classroom practices. The findings support the assertion that principals have an indirect affect on elementary teachers’ instructional practice (Hallinger & Heck, 1996; Pitner, 1988). This indirect influence was greatly facilitated by collegial relationships that were nurtured through high levels of trust. As a result, the school’s vision for science, instructional expectations, budgetary allocations, and degree to which teachers used innovative science practices, were indirectly facilitated by the principal, but had direct effects on instructional innovation as well as the value teachers placed on science.

Anderson and Helms (2001) assert that in order to understand that which influences the implementation of the NSES, it is imperative that research be conducted from multiple perspectives including among other things, an organizational perspective. This is because, as the TCSR model affirms, if we are to truly understand why desired change, particularly second order change, is slow-moving or not achieved, research must begin to examine those contextual factors that influence teacher practice (Woodbury & Gess-Newsome, 2002).
**Principal Influence on Teacher Thinking.** The TCSR model represents an interrelated portrait of those factors affecting education reform. This investigation was conducted from the *Teachers’ Thinking/Teacher Practice* and *Principal* perspective within the school’s content and sought to understand how this relationship influenced the enactment of science education reform. The results indicated that Dr. Carsona’s instructional leadership greatly influenced science teachers’ thinking within the science program. The TCSR model indicates that principals can influence teacher thinking about: 1) their knowledge and beliefs about change 2) the content that is taught 3) student learning 4) teaching and teacher efficacy, and 5) school goals and schooling (Woodbury & Gess-Newsome, 2002). Dr. Carsona had the greatest influence on *teachers’ knowledge and beliefs about change*, which in turn indirectly influenced other areas of *Teachers’ Thinking* (i.e., content being taught and student learning).

Dr. Carsona defined the parameters for change in the science program, articulating the science program’s structure (departmentalization), identified the areas that would receive instructional resources (fifth grade/science laboratory), and determined the grade level that would be prioritized in the school’s change agenda (fifth grade). Too, she articulated a vision for science, FCAT improvement, in which all teachers supported and worked towards either actively (e.g., Ms. Jenson) or passively (e.g., Ms. Smith). Dr. Carsona’s instructional leadership affected teachers’ dispositions and responses to the change efforts proposed and subsequently enacted by the teachers.

**Contextual Factors: Why They Didn’t Negatively Influence Teacher Practice.** This investigation also sought to understand how Dr. Carsona ameliorated those conditions that negatively affected science teachers’ instructional practices. However, as reported in the previous chapter (see Table 22), this research did not support the findings of other researchers who conclude that contextual factors such as the pressure of accountability, limited opportunities for professional development, and lack of resources negatively influences teacher classroom practices (Appleton & Kindt, 2002; Banilower et al., 2007; Griffith & Scharmann, 2008; Loucks-Horsley et al., 2003; Lee et al., 2004). Contextual factors that teachers in other investigations find to be inhibiting and constraining to their classroom practices were not perceived as such by the teachers in this investigation. Researchers find that the pressures of accountability, limited
professional development opportunities, and lack of resources are perceived by teachers as contextual barriers to science instruction (Appleton & Kindt, 2002; Banilower et al., 2007; Griffith & Scharmann, 2008; Kelly & Staver, 2004; Yore et al, 2008). Teachers are particularly skeptical and disapproving of mandated changes, such as those stipulated by NCLB legislation, “strongly resist[ing] reforms imposed on them by an external force, especially if it directly influences what occurs in their classrooms” (Griffith & Scharmann, 2008, p. 36). However, the teachers in this investigation did not conceptualize the FCAT or other contextual factors as negative and constraining, but rather embracing them as expected occurrence and minimizing any ill-effects.

It was quite unforeseeable and unexpected that factors science teachers in other research investigations find to be barriers (Appleton & Kindt, 2002; Griffith & Scharmann, 2008; Johnson, 2007b; Kelly & Staver, 2004) and described above, were justified and rationalized by the teachers in this investigation as “typical” or “expected” occurrences. By the teachers’ estimation, these contextual factors, which reflect each context on the TCSR model, were not perceived as barriers to their science instruction. But other researchers have reported that the contextual factors identified disable and stultify the most skilled science educator (Roehrig, Kruse, & Kern, 2007; Shaver, Cuevas, Lee, & Avalos, 2007).

A factor that may have contributed to the contradictory results of this work when contrasted with other work on contextual barriers is the positive school culture. Teachers expressed a sense of contentment, happiness, and delight working at Simmons. This appeared to counter any ill or disapproving feelings science teachers in other research investigations reported harboring about the aforementioned contextual factors. According to researchers, in a positive school culture teachers have high staff morale, find value in collaborative relationships, trust others on the team, work to enhance instruction, promote school success, hold a shared sense of purpose, and more readily embrace change (Bryk & Schneider, 2003; Fullan 2001, 2007; Lumsden, 1998; Kochanek, 2005; Peterson, 2002). Teachers in this study found the school environment to be positive and supportive. As such, the environment may have diminished any negative feeling teachers may have had or prompted them to view barriers in a positive light. I would also venture to say that Dr. Carsona’s leadership was instrumental in
settling teacher anxiety and neutralizing any negative feelings that may have developed (Hurren, 2006). I would therefore assert that schools can benefit greatly from “good” or “effective” leadership.

**Modification to the Instructional Leadership Model**

The intent of this investigation was not to development an instructional leadership model to help researchers identify the actions/behaviors that principals employ to support the enactment of science education reform. Nonetheless, this investigation provided great insight into those actions/behaviors that were found to be important in promoting science and cultivating an atmosphere where reform is probable. The instructional leadership model used in this investigation (see Table 11) helped me to understand those things Dr. Carsona did on a day-to-day basis to contribute to her school’s “success.” But through my observation of teacher/principal interactions, prolonged immersion in the setting, and with the aid of the Instructional Leadership Action/Behavior Questionnaire (see Appendix B), I have revised the instructional leadership model so it may be of use to science education and educational leadership researchers. Three key themes drive the modifications to the Elementary Principal Instructional Leadership Model for Science (Table 23): 1) science education reform must be a pronounced thread throughout 2) the school culture must be ready to embrace changes and principals are instrumental in these efforts, and 3) principals must have a clear understanding of what science education reform is and how to make adjustment in the curriculum to achieve the ideals therein.

Although no guiding themes were incorporated or removed from the original model (see Table 11), two indicators were removed: 1) promote teacher reflection and 2) model instructional practices. While reflection is a strategy that allows teachers to find practical solutions to complex often obscure and puzzling problems, teachers must do the “problem setting.” As professionals, teachers must “define the decision to be made, the ends to be achieved, [and] the means which may be chosen” (Schön, 1983, p. 40). Indeed principals can be influential by encouraging teachers to be reflective practitioners, but teachers may be better suited to determine when and what situations need to be reflected upon.
Table 23 Elementary Principal Instructional Leadership Model for Science

<table>
<thead>
<tr>
<th>PRINCIPAL INSTRUCTIONAL LEADERSHIP MODEL FOR SCIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>THEME: Engage in and Promote Professional Growth/Development</td>
</tr>
<tr>
<td>1. Praise teacher for employing reformed-oriented instruction</td>
</tr>
<tr>
<td>2. Foster collaborative relationships (mentor/coaching)</td>
</tr>
<tr>
<td>3. Promote teacher professional development</td>
</tr>
<tr>
<td>4. Supervise teachers’ performance/give feedback</td>
</tr>
<tr>
<td>5. Lead learning through principal professional development</td>
</tr>
<tr>
<td>6. Look for effective teaching that aligns with reform (during classroom visits)</td>
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<tr>
<td>7. Organize/suggest professional growth activities that emphasize effective practices</td>
</tr>
<tr>
<td>THEME: Monitor Student Progress</td>
</tr>
<tr>
<td>8. Monitor student learning</td>
</tr>
<tr>
<td>9. Ensure that the learning environment is orderly</td>
</tr>
<tr>
<td>10. Make instructional modifications/enhancements that prioritize the needs of students</td>
</tr>
<tr>
<td>11. Set high standards for science teaching and learning</td>
</tr>
<tr>
<td>12. Promote student learning</td>
</tr>
<tr>
<td>13. Data-driven decision-making</td>
</tr>
<tr>
<td>THEME: Make Available the Necessary Resources for Instruction</td>
</tr>
<tr>
<td>14. Allocate resources for instruction</td>
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<tr>
<td>15. Equitably distribute resources according to grade-level requisites and/or student needs</td>
</tr>
<tr>
<td>THEME: Prepare the Culture for Change</td>
</tr>
<tr>
<td>16. Articulate a vision for science that embraces scientific literacy for all students</td>
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<tr>
<td>17. Define science values in terms of national efforts</td>
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<tr>
<td>18. Provide a supportive environment</td>
</tr>
<tr>
<td>19. Establish trusting relationships</td>
</tr>
<tr>
<td>20. Develop a school-wide reform toward science improvement</td>
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<tr>
<td>THEME: Develop Teacher Leadership</td>
</tr>
<tr>
<td>21. Develop leadership capacity in teachers</td>
</tr>
<tr>
<td>22. Teachers participate in decisions made in science program</td>
</tr>
<tr>
<td>THEME: Use Leadership Skills to Promote Science Education</td>
</tr>
<tr>
<td>23. Positive/informal leadership</td>
</tr>
<tr>
<td>24. Human relations skills/expertise to promote science</td>
</tr>
<tr>
<td>25. Participate in the decision that are made in science</td>
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<tr>
<td>26. Solicit parental/community support in science activities</td>
</tr>
<tr>
<td>27. Ensure that science leadership is consistent across grade levels</td>
</tr>
<tr>
<td>28. Values ascribed to science are manifested school-wide</td>
</tr>
</tbody>
</table>

Bold – Highlights changes made to the Instructional Leadership Action/Behaviors Model (Table 11)
The educational leadership community also maintains that as instructional leaders, elementary principals should model effective instructional practices. While ideal, modeling science practices is something science teachers and principals in this study found to be impractical. Of the data examined on the necessity for principals to model effective science practices, there were two clear lines of thinking: 1) teachers were to be the “experts” of instruction, with principals assuming an auxiliary role and 2) the principalship today is too demanding for administrators (principals or assistant principals) to have command of the most effective instructional strategies in every content area. In tandem, I believe that with the demands placed on principals to lead and manage the daily operation of schools effectively, having the ability to model the array of science strategies available to classroom teachers is beyond the scope of their responsibility. I do argue that principals should be familiar with a range of strategies that are available to science teachers, but it should not be expected that they model them.

**Implications of this Research for Practice**

There are a number of implications that can be derived from this research for site-based practitioners, district leaders, science education researchers, educational leadership researchers, policy developers, educational reformers, and educational researchers.

- Elementary principals, as site-based leaders, are charged with making decisions that promote student success in science (Lewthwaite, 2004; Mechling & Oliver, 1983, 1988). Reform documents define this success in terms of scientific literacy (AAAS, 1990; NRC, 1996). In order for elementary schools to develop and implement science programs that parallel and reverberate the messages of reform, principals are integral. Elementary principals, perceived as effective instructional leaders, are more apt to be supported by teachers who in turn are more apt to support the decisions that principals make. In cases such as this, principals need to have at best a minimal if not robust understanding of science education reform and the goals espoused. In this way, elementary principals, in conjunction with science teachers, will be able to make school-wide decisions that promote the vision of reform. While the principal was not found to directly influence teacher practice, her instructional leadership defined school values and the pathway to
change. An informed site-based leader coupled with bottom up change has great potential when the forces operating in the larger context (national, state, or district) fail schools (and deceive stakeholders) in such a blatant manner.

- Understanding the nature of reform is contingent upon a basic understanding of the nature of science and scientific literacy (AAAS, 1983; Holbrook & Rannikmae, 2007; NRC, 1996). District leaders, principals, and teachers must understand and appreciate that science is not a list of facts to be memorized for a test or words to be copied from a wordwall. Instead, science is the process of making meaning of the natural world, and understanding science explains a large variety of different, yet related phenomena. Possessing an understanding of science allows these future societal leaders to intellectually debate topics of scientific importance and acquire skills such as reasoning, decision making, thinking critically, etc. that are essential in today’s global job market (AAAS, 1990, 1993; NRC, 1996). It is this view of science that underlies the Standards, and without this view of science, how can one be expected to promote the methods advocated in the Standards?

- Within the school district, there was a “public” science plan and an “actual” science plan. The “public” School-to-Careers Science Plan promoted a progressive, reform-minded approach to teaching and the championing of scientific literacy as the primary goal of science instruction. The “public” curriculum was research-based and available to those employed by the district and concerned stakeholders. The “actual” curriculum (the science plan that was enacted) on the other hand was not written in any formal document, but was advocated through emails, phone calls, available resources, and in-person conversations. The “actual” curriculum, which was promoted at the district level, was propelled by the needs of accountability and the goal of exceeding the minimum threshold on the FCAT. This dualistic view, which pit second order change against FCAT success (first order change), undermined the veracity and legitimacy that reform will indeed prepare students to successful meet the demands of accountability.
As science educators, we must make a more concerted effort to inform school administrators of the goals and vision embodied in reform. As revealed in this investigation, these teachers were more apt to follow the directives of the principal when perceived as a strong instructional leader. Indeed there are many elementary schools that are led by strong instructional leaders who mobilize teachers towards a common goal (Daugs et al., 1988; Mechling & Oliver, 1983; Spillane et al., 2000). The extent to which teachers trust their leadership can be the guiding factor in change efforts that are proposed, supported, and enacted. The principal and the leadership influence that they wield within the context, should be conceived of as a resource that can potentially be utilized to alter traditional patterns of reform.

The inclusion of science in NCLB legislation has placed a great deal of pressure on states and school districts to make adequate progress in science (Johnson, 2007a). In light of the pressure, in this district, the “actual” curriculum appeared to be a more lucrative and feasible path to tread. In Florida in general, the pressure can be so strong that even when principals recognize the narrowness of test-driven, accountability thresholds, they encourage deliberate methods of instruction to achieve the desired outcome (George, 2001; Goldhaber & Hannaway, 2004). In essence, decisions are made purely on the basis of what subjects and/or grades are tested and what is necessary to assure steady gains in student achievement (Atkins & Black, 2003; Linn 2000; Linn, Baker, & Betebenner, 2002). I am by no means unmindful that “[t]he law pose[s] substantial challenges for schools, districts, and states” (Linn et al., 2002, p. 15). However, science education reformers must continue to appeal to federal, state, and political entities because, “[i]f the practice of science education is to undergo radical improvement, policies must support the vision contained in the Standards” (NRC, 1996, p. 230).

Principals are in a unique position to influence curriculum decisions and guide the instructional choices individual teachers make during reform (Mechling & Oliver, 1983; Spillane et al., 2001; Woodbury & Gess-Newsome, 2002). I found this to be particularly true for the teachers in this elementary setting. In school
environments where teachers feel supported, they are more inclined to teach using reform-based practices, venturing beyond their comfort zone (Dickinson et al., 1997; McGinnis et al., 2004). As seen here, this may cause some science teachers to repress or abandon their own beliefs, following the guidance and direction of their principal. Thus, as elementary principals come to understand reform, particularly in settings with high levels of trust, etching the messages of reform into the school’s fabric will become less difficult and energetically expensive.

- A goal of science educators is a collaborative approach to reform; one in which all vested stakeholders work collectively towards second order change. The Snella County School District, aware of reform initiatives in science developed the School-to-Careers Science Plan. The plan suggested that in order to improve the current state of science, a district-wide effort was necessary. However, district leaders articulated a very different message to school-based leaders. Although able to adapt “suggestions” made by district leaders in reading to accommodate the Simmons school community, Dr. Carsons was unable to do this in science. She adopted in its entirety the district’s “actual” vision, as Simmons’s vision. Therefore it is important for principals to understand reform so that they can meet the demands of the district (in this case accountability) as well as make modifications to their science program such that it embodies the vision espoused in national reform documents; that is when or if principals and teachers recognize that district messages and efforts are obstructive, stifle “reform,” and are baneful. Reform in general and science education reform specifically is not antithetical to successful accountability (Sunal & Wright, 2006); however, this district saw the two as such. Although creating discord between the district and principals is not the intent, principals like teachers must have at minimal a basic understanding of science education reform and what is mean to enact second order changes. Therefore the science education community must help teachers as well as site-based leaders recognize that reform and accountability are complementary and not diametrically at odds.
This Research and its Fit with Current Research on Principals in Science Education

It has not been until recently that science educators have begun to report on principals’ influence within school science programs. Therefore, much of the work examines principals in science from a unique perspective, illuminating often novel results that inform, while at the same time petitioning for additional research to continue to expand our understanding. In its infancy, very few studies that I have found explicitly examine principals in science. Much of our insight to date has come as a result of research that did not set out to assess the principal’s role in science. From this research, two schools of thought have emerged: 1) principal support is important when teachers are implementing reform or endeavoring to change their practice and 2) the principal is recognized as important, but not sufficient to ensure implementation of reform.

Studies that Explicitly Examine Principals in Science Education

Specific studies on principals within the context of science are few and far between (Barish, 2007; Hanegan, 2001; Shaw et al., 1994). In one of the earlier studies, Shaw and his colleagues (1994) examine, among other things, whether elementary and middle school teachers and principals have similar views regarding the importance of teaching science. Shaw et al. (1994) report that the majority of teachers and principals surveyed recognize that teaching science is indeed important. Similarly, the teachers and administrators in this investigation indicate that teaching science is indeed important to students’ overall development. However, research must begin to help teachers as well as principals understand and design programs that provide students with the types of science experiences that are most beneficial to challenge students’ thinking and nurture their development beyond preparing for standardized assessments.

In another study, Hanegan (2001) sought to identify whether a principal who shows support for reform will affect the likelihood that teachers will implement curricular changes in their classroom. She discovers that principal support is linked to teacher implementation of reform. Hanegan (2001) also reports that principal support must be action-oriented (e.g., providing resources, promoting teacher leadership, etc) as to encourage teachers to try their hand at novel instructional approaches. These findings are similar to the findings of this dissertation research. Because teachers felt that they were
supported by Dr. Carsona as professionals, this dictated their level of support for the changes she proposed. Although the changes proposed did not align with reform, both studies underscore that support for change must not be devoid of action. Rather, teachers must be able to “see” principal support through their actions and institutional adjustments.

In a more recent analysis, Barish (2007) probes, through qualitative and quantitative means, the degree to which being a science trained principal (principals who have a degree in a science discipline) or nonscience trained principal, influences their leadership in high school science. Science teachers report that they have a greater level of satisfaction with principals who are trained in science. These science teachers also indicate that science trained principals encourage them to engage in professional development, are more involved in the hiring of science teachers, and take a keener interest in what constitutes quality instruction. While science trained principals utilize their knowledge of subject to guide their leadership practices, the data did not support the assertion that principals whose academic strength is science will provide greater support to teachers. Although indirectly related to the findings of this investigation, Barish’s study informs that principals who are more knowledgeable about science or understand what is deemed as quality instruction, take a more deliberate role in advancing quality instruction. As confirmed by the finding of this investigation, lack of knowledge and understanding can reinforce the status quo or cause one to champion change that is far from transformational.

Studies that Cite the Importance of Principal Support in Science Education

There is a more expansive body of research that underscores the importance of principal support in science, albeit in an indirect fashion. In an investigation of those behaviors that Lead Master Teachers (LMTs) perceive to be inhibiting and encouraging factors to reform implementation, Harwell (2000) establishes that when principals understand and are involved in the change process, implementation is more likely and less distressing. On the contrary, LMTs consider uninformed and uninvolved principals to be a constraining factor. On the one hand these findings support the conclusions in my research. With Dr. Carsona’s championing of first order reform, all of the science
teachers understood why change was needed and embraced and supported her approach. Her involvement in fifth grade science (in which she encouraged innovation) and lack of involvement in the other grades (which was disregarded, allowing mediocrity to persist), in no way discounts the fact that Dr. Carmana was involved but uninformed, a combination that proved ill-fated.

The findings of Vesilind and Jones (1998) echo the results of Harwell’s (2000) investigation. They analyze school cultures to determine how these environments contribute to or impede teacher leader effectiveness. Vesilind and Jones (1998) reveal that principals who are supportive show this support through symbolic gestures: defining science values, helping teacher leaders “corral the troops” (e.g., parents, teachers, etc.), and making resources available. These findings stress the importance of principals as unifying agents, something that Dr. Carmana was able to accomplish. She “corralled the troops” so to speak, but did not look beyond the district and the internal network of resources to shape teachers’ (and her) understanding of ways to achieve success per accountability and fundamentally reform the science program. My research confirmed that because teachers saw Dr. Carmana as supportive and a visionary, this prompted teachers to support her vision for change. But Dr. Carmana’s lack of involvement as well as some of the teachers’ lack of interest, limited pedagogical knowledge, or utter ineptness, allowed overly traditional science practices to dominate (McGinnis et al., 2004).

Professional development workshops and inservices have long been the settings used to help teachers redefine their beliefs about the teaching and learning of science and align their practice with reform. When attempting alignment of instructional practices with the vision espoused in reform documents through professional development, Banilow and his co-authors (2007) indicate that “teachers more frequently use the designated instructional materials when they feel supported by their principal to implement science education reform” (p. 386). Again, principals who are supportive increase the likelihood that teachers will consider being innovation or taking risks (Harwell, 2000). Many of the teachers in grades one through four did not venture beyond their comfort zone and Dr. Carmana’s leadership did not encourage change in these classrooms. The fifth grade science teacher described Dr. Carmana’s support as
invigorating, driving her to try different approaches. The science laboratory teacher, despite being unaware of innovative approaches to teaching science, saw Dr. Carona’s support and instructional leadership as the impetus for venturing into new realms with her teaching (although grossly off the mark to be defined as reform). The results of an investigation of Supovitz and Turner (2000) contradict the findings of Banilower et al., (2007) and my findings. Supovitz and Turner (2000) report that the school socioeconomic level (more affluent vs. poverty stricken communities) more than administrative support, has the greatest impact on teacher practices. The results of my investigation may contradict those of Supovitz and Turner’s (2000) because, despite the students’ economic circumstances, Dr. Carona had high expectation for all of the students.

Saka and his co-authors (in press) report similar results regarding administrator support of novice teachers when taking a closer look at school culture as a unit. They report that the interpersonal and professional relationship two novice teachers have with administrators greatly influence the extent to which they become a vested part of the schools’ cultures and employ instructional practices that align with their beliefs about how science should be taught (reform-minded). In the setting where there is strong communal support and cohesiveness, the teacher views administrators as instrumental to his sense of belonging, a value to staff and students, and enthusiasm for teaching in ways that align with his beliefs. On the other hand, when the science teacher is implanted in the school setting where he is uncomfortable and feels undervalued, he abandons his core values in an effort to “survive” in a hostile, unreceptive environment. These findings complement the findings of my work, highlighting that context and teachers’ sense of purpose and worth are strongly connected to how much effort they put forth, how they teach, and the perception they develop about school leaders.

**Studies that Cite Principal Instructional Leadership is Necessary but Insufficient**

Kelly and Staver (2005) examine a school district’s attempt to change the K– 6 science curriculum through a hands-on, kit-based program. Despite having the necessary resources (e.g., materials, text, etc.) to teach in reform-minded ways, teachers remained apprehensive about teaching science. Many teachers continued to teach through
traditional means or reverted back to conventional (comfortable) approaches, despite support from district leaders and principals. While necessary, the support was not enough to ensure implementation. Dr. Carsona was too of this mindset. For example, she supported Ms. Jenson, the fifth grade teacher, as she was asked to teach differently (e.g., diverse instructional practices, hands-on, science exclusively, etc.). Ms. Jenson, because of her beliefs about how science should best be taught, used the materials in ways that advanced reform efforts. On the other hand, resources were also provided to the science laboratory teacher with an array of materials to engage students in hands-on science. Despite this support (although much less than in fifth grade), and with materials to teach science in reform-minded ways, the science laboratory teacher did not know how to use the resources effectively (Elmore, 1995; Gess-Newsome, et al., 2003). Where grades one through four are concerned, it would have been interesting to see whether these teachers would have taught differently had the level of support and science resources provided been greater, something Kelly and Staver (2005) report did not change teachers’ level of self-efficacy, values that were at the core of their belief construct, what was in teachers’ pedagogical toolbox, or to put it frankly their ability to teach science.

In another science reform endeavor, Spillane and his colleagues (2001) examine how one school mobilizes resources toward improvements in an urban setting. Faced with inequitable distribution of resources across subjects in the district, a principal brings (albeit limited) resources together to minimize structural obstacles and lead change by mobilizing human, physical, and social capital. While the principal is recognized as a catalyst for change and critical to the success of reform, the authors explain that leadership must come from many entities (e.g., a distributive leadership perspective) in order to profoundly alter instructional patterns. Like my result and those of Kelly and Staver (2005), principal leadership is considered important, but insufficient to completely restructure the teaching landscape.

**Other Research that Speaks to Principals in Science Education**

In spite of a fervent push for shared-leadership, many would argue that with the title “principal,” comes authority and power to make decisions that others in the school
simply cannot make (AAAS, 1989; Mechling & Oliver, 1983). Thus, there are also those
documents that note indeed that principals have decision-making ability (or veto power)
simply because of their formal position. Having the authority to make budgetary,
building, cultural, or curricular decisions, principals can enact structural modification that
support or inhibit the opportunities teachers have to dialogue with colleagues, determine
who will participate in workshops and inservices during the school day, lay the
foundation for the school cultural as a whole to coalesce bringing about change, and
shape the values teachers ascribe to the latest change effort (Dickinson et al., 1997;
principals do not stand behind reform (Berns & Swanson, 2000) or make decisions that
inhibit efforts as was the case in this investigation and supported by Levy and Century’s
(2001) findings, change is improbable. As Levy and Century describe, principals may
very well see the value in teaching science, but forfeit teaching it for what is deemed
more important (in their case additional time to teach reading and mathematics).
Principals who have “only a cursory knowledge of the science program, [make]
infrequent observations of their staff’s science instruction, and [make] little or no
attempt…to encourage reluctant teachers to use the science kits” (p. 6), giving voice to
their beliefs about science as an enterprise and to the quality of science programs in their
schools.

Levy and Century (2001) also provide some insight into central office
administrators’ (district office as I refer to it) dualistic approaches to science.
Administrators affirm science is important, but “exercised little oversight of building
principals to see whether or not they were supervising their staff’s science teaching” (p.7-
8). Like Levy and Century, district leaders alluded that teaching science in reform-
minded ways was indeed important with the offering of the School-to-Careers Science
Plan. The plan, however, did not direct or guide the district’s actions. Different from my
investigation, however, was the fact that the district was not particularly interested in
change that would have profound effects on science teaching and learning, but rather test
scores. Levy and Century’s work and this research helps us understand that decision-
making, choices, commitment, and leadership (or non-leadership) from the district
provides a compelling reason why science education researchers must utilize a much
wider lens to truly understand why change is sluggish at best and ambitious at worst (Anderson & Helms, 2000; Woodbury & Gess-Newsome, 2002).

Because research on principals’ leadership within the context of science is in its infantile stage, much of the research to date offers new and novel insights. Although the findings of this research support and contradict research to date, it nonetheless furthers our understanding of teachers and principals (as well as the district) change efforts in science. The ultimate objective is scientific literacy for all students, and both teachers and principals must acquire new professional competencies in order to understand, embrace, and enact reform that melds with the national landscape. This certainly can be bolstered and strengthened when district leaders (and policy makers) promote a collective and unified passageway to reform. Future research must continue to add to the budding conversation, helping us to understand this phenomenon from a multitude of perspectives.

**Recommendations for Future Research**

Anderson and Helm (2000) inform that educational research, holistically speaking, has focused primarily on the psychological aspect of practitioners, as researchers look to understand the mental processes that guide instructional decisions. Studying this dimension has been very informative and contributed greatly to our understanding of science teaching and learning. “But to say that particular research is being pursued from a psychological perspective does not tell the whole story” (p. 4). Research conducted in science education must begin to examine the many intersecting factors that influence the enactment of reform. With this investigation, I hope to contribute to an evolving body of research that seeks to understand the principal’s influence in science education.

This investigation provides a detailed description of a principal’s instructional leadership in the science program and the response of teachers to this instructional leadership. This study, in many ways, supports the overarching finding that principals are important within the school’s context. But because examining principal leadership within the context of science education is an emerging field of study, this investigation reveals areas where additional research may contribute to our understanding.
• The district’s influence was found to be a key factor in shaping the principal’s instructional leadership. The district offered “suggestions” for curriculum inclusions that were communicated to school administrators, who in turn relayed those messages to teachers. Although external to the school and the classroom, the district’s rhetoric was integral to what became the enacted vision for change that was indeed contradictory to national efforts. Therefore, research must examine the district/elementary principals’ relationship and how it shapes and/or inhibits the enactment of reform.

• Research investigations that explicitly examine elementary principal’s instructional leadership within the content of science must continue. In so doing, we as science educators can begin to understand how to better advance the vision for reform through site-based administrators.

• Spillane (2005) and Burch and Spillane (2005) urge that principal leadership is different depending on the subject in which it is executed. As these findings suggest, the principal did not have the knowledge and understanding of reform to incorporate the elements that reformers suggest will promote scientific literacy. Therefore, research that examines principal instructional leadership in the area of science will help us as science educators to identify those actions/behaviors that support the enactment of science education reform.

• On a more basic level, research must attempt to understand beliefs that elementary principals have regarding the teaching and learning of science. As seen here, a principal perceived of as an effective leader influenced many aspects of the science program from the school’s instructional focus to the programs that were embraced. If we begin to understand elementary principals’ beliefs about science, we can continue to understand how science programs are affected by their leadership.

Concluding Thoughts…

Most elementary principals desire to implement programs that are in the best interest of the students they serve. However, because school districts may not be making an earnest effort to prepare teachers and principals to transform the culture, encourage the
use of reformed practices, and/or provide professional development opportunities to support the implementation of reform, as science educators we must continue to vigorously work to make the vision of science education reform a reality in every classroom in America. This effort must target policy makers peering down from the “top” as well as those individuals at the school level who give science education reform a face.

In education in general and science education in particular, the thrust has been change that allows teachers to think differently about their practice (Anderson & Helms, 2000; Woodbury & Gess-Newsome, 2002); professionally science teachers must rethink their beliefs about teaching and learning, develop a concrete understanding of what science education reform is and is not, and build up an experiential base from which to teach in reform-oriented ways. But the culture of schools is not shaped solely by teachers. Culture is influenced by internal as well as external entities by way of legislation, policy, regulations, and as determined from this investigation, contextual relationships. The national, state, and district contexts identify what is “worth” valuing. Unfortunately these values are sometimes incongruous with those of the science education community. But, within the elementary school’s context (that indeed has some degree of autonomy), both principals and teachers redefine external values in light of shared values and the communities they serve. Our goal then as science educators must be to help to reshape school cultures that provide science instruction to America’s children. Therefore, the efforts of science educators must be expansive (all stakeholders), inclusive (whole-school), and multidirectional (top down and bottom up) if we hope to prepare students to be informed, scientifically literate citizen, in the world that awaits.
APPENDIX A

INITIAL INTERVIEW PROTOCOLS
Principal and Assistant Principal Interview Protocol

- How many years have you been a principal/assistant principal?
  - At this school?
- What position(s) did you hold prior to your first appointment as principal?
- How long did you teach? What subjects have you taught?
- Describe your experiences with learning science in subsequent years?
- Describe the way(s) your teachers taught science.
  - Do you remember your feelings toward learning science?
- What is the district’s vision for science teaching and learning?
- What is the vision for science at the school?
- How is this vision communicated to staff and community?
- What school-wide activities do you have to engage student in science?
- What do you look for when observing teachers during science instruction?
- Does the school provide opportunities for teachers to engage in inservice/professional development activities aimed at reformed science practices?
- How are teachers selected?
- Can you identify any barriers that impede the teaching and learning of science?
- How much time does the average teacher have for science instruction?
- What funds are available for science resources and professional growth activities?
- When observing science instruction, what does this instruction look like?
  - Is this acceptable to you?
- What instructional strategies, techniques, and materials are used?
- What textbook is used for science instruction?
• What do you envision the environment would be like in an ideal science classroom?

• What is science?

• What are the goals for science stipulated in the School Improvement Plan?

• Do you think that it is important for students to learn science?

• Do you feel that there is a best way to teach science?
  - What is it?
  - How did you come to embrace this as a best practice?

• How would you categorize the type of science instruction utilized by teachers?

• What is scientific literacy?
  - What science experiences do students need to become scientifically literate?

• What professional development opportunities are available to help you develop your understanding of science teaching and learning?
  - Develop a successful program?

• Florida has developed the Sunshine State Standards. How are they utilized?

• Are you familiar with the National Science Education Standards?
  - Do they/did they play a role in the development of the science program?

• Does the district provide guidance/direction with regards to the science program?

• Students are now taking the FCAT in science. How have the results been used?

• How would you describe your school’s progress in moving toward excellence in science teaching and learning?

• As a whole, do you think that teachers enjoy teaching science?

• Are you satisfied with the science program that has been developed?
Science Teacher Interview Protocol

• How long have you been a teacher?

• What grade levels have you taught?
  - Subjects?

• What was your major in college?

• What were your early experiences like in science?
  - In elementary school?
  - In middle and high school?
  - In college?
  - In your preservice experiences?
  - In your family?

• Are there any memories that stick in your mind about science?

• When you learned science, what type of instruction do you most remember your teachers using?

• Did anyone in your immediate family attend college?

• Is education considered important in your family?

• How would you describe your family in terms of social economic status?

• What prompted you to accept the position of science teacher?
  - What were your initial thoughts about becoming a science teacher?
  - How has the year been going so far?

• What vision is promoted for science at Simmons?

• Do you feel that teaching science is important to the administrative team?

• Have you been observed teaching science?
  - Is there a particular type of instruction that is prioritized?
  - What type of feedback are you provided?

• How often do you receive science resources?

• Do you feel that the administrative team supports you in science?
• What does Dr. Carosa or Ms. Perez do to let you know you are doing a “great” job?

• In general, describe Dr. Carosa’s instructional leadership (in other subject areas)?

• What is the district’s vision for science teaching and learning?

• Describe what you would consider to be a “good” science lesson.

• Would you consider Dr. Carosa to be a positive instructional leader for science?
  - Describe how she is/is not a positive instructional leader?

• What types of school-wide activities do you have at the school for science?

• Do you feel that there is a best way to teach science?
  - What is it?
  - How did you come to embrace this as a best practice?

• Are there professional develop opportunities available for teachers of science?
  - How does one get to participate?
  - Who initiates this involvement?
  - Are these experiences offered by the district/school?

• Does the principal encourage and provide opportunities for collaboration between teachers in science?

• With regard to science, what do you think is most important to the district?
  - To the school?

• Describe what you would consider to be a “good” science lesson.

• What is scientific literacy?

• Can you identify any barriers that impede the teaching and learning of science?

• As a science teacher, what are your goals for your students?

• What is your comfort level with teaching science?
Science Laboratory Teacher Interview Protocol

- How long have you been a teacher?
- What grade levels have you taught?
  - Subjects?
- What was your major in college?
- What were your early experiences like in science?
  - In elementary school?
  - In middle and high school?
  - In college?
  - In your preservice experiences?
  - In your family?
- Is education considered important in your family?
- What prompted you to accept the position of science teacher?
  - What were your initial thoughts about becoming a science teacher?
  - How has the year been going so far?
- What vision is promoted for science at Simmons?
- Do you feel that teaching science is important to the administrative team?
- What is your role as the science laboratory teacher?
- Have you been observed teaching science?
  - Is there a particular type of instruction that is prioritized?
  - What type of feedback are you provided?
- Do you feel that the administrative team supports you in science?
- What does Dr. Carsona or Ms. Perez do to let you know you are doing a “great” job?
- In general, describe Dr. Carsona’s instructional leadership (in other subject areas)?
- What is the district’s vision for science teaching and learning?
- Describe what you would consider to be a “good” science lesson.
• Would you consider Dr. Carson to be a positive instructional leader for science?
  - Describe how she is/is not a positive instructional leader?

• Is science instructional time used for the purpose it is intended?

• What types of school-wide activities do you have at the school for science?

• Do you feel that there is a best way to teach science?
  - What is it?
  - How did you come to embrace this as a best practice?

• What are your feelings about teaching science?

• Do you think that it is important to teach science?

• How often are you observed teaching science?
  - Is there a particular type of instruction that is prioritized?

• Do you feel that teaching science is important to the administrative staff?

• Does the principal encourage and provide opportunities for collaboration between members of your grade level or across grade levels in science?

• Do you feel that there is a best way to teach science? What is it?
  - How did you come to embrace this as a best practice?

• Would you consider this science lesson to be reflective of what you consider to be the best way to teach science? How?

• How has the principal shaped how you teach science in your classroom?

• Do you think that your principal would consider this to be an effective science lesson?
  - Why?

• Is science instructional time used for the purpose it is intended?

• Does Dr. Carson meet with you on a regular basis concerning science?

• Are there professional development opportunities available for teachers of science?
- How does one get to participate?
- Who initiates this involvement?
- Is there district/external support for teaching science?

• Do you feel that your principal supports you in science?

• Would you consider the principal to be a positive instructional leader for science?
  - Can you describe those things that you consider to be positive?
  - Can you describe those things that you consider to be negative?

• Can you identify any barriers that impede the teaching and learning of science?

• Do you think that the science program needs to be improved?
  - Why/Why not?
  - How?
APPENDIX B

INSTRUCTIONAL LEADERSHIP ACTION/BEHAVIOR QUESTIONNAIRE
### INSTRUCTIONAL LEADERSHIP INDICATORS

<table>
<thead>
<tr>
<th></th>
<th>Y / N Does the principal praise you for a job well done in science? In what ways?</th>
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<tbody>
<tr>
<td>1</td>
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<table>
<thead>
<tr>
<th></th>
<th>Y / N Does the principal help to create a supportive environment for teachers of science? How?</th>
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<tbody>
<tr>
<td>2</td>
<td>*</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>Y / N Does the principal encourage collaborative relationships among science teachers? How?</th>
</tr>
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<tbody>
<tr>
<td>3</td>
<td>*</td>
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<table>
<thead>
<tr>
<th></th>
<th>Y / N Does the principal encourage the participation in science professional development?</th>
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<td>4</td>
<td>*</td>
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<table>
<thead>
<tr>
<th></th>
<th>Y / N The principal observes my science instruction and provides feedback on how to improve? What type?</th>
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<tr>
<td>5</td>
<td>*</td>
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</table>

**Directions:** This questionnaire is designed to help to ascertain what instructional leadership actions/behaviors are utilized by the principal to promote science. Please identify whether the action/behavior is being utilized by circling a Y (YES) or N (NO) next to each phrase. If the action/behavior is performed, briefly describe in what ways the action/behaviors is displayed. Additional space has been provided to identify actions/behaviors that are performed but are not listed.
<table>
<thead>
<tr>
<th></th>
<th>Y / N</th>
<th>Question</th>
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<tbody>
<tr>
<td>6</td>
<td></td>
<td>The principal promotes and encourages teacher reflection in science? How?</td>
<td></td>
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<td>7</td>
<td></td>
<td>The principal is the leader for learning in science? How?</td>
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<td>8</td>
<td></td>
<td>When observing, the principal looks for reform-minded science practices? What are they?</td>
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<td>9</td>
<td></td>
<td>The principal models effective instructional practices in your science classroom?</td>
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<tr>
<td>10</td>
<td></td>
<td>Does the principal monitor student progress in science?</td>
<td></td>
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<tr>
<td>11</td>
<td></td>
<td>The principal has helped to organize my classrooms for science instruction? In what ways?</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>The principal promotes an orderly environment where science teaching and learning can occur? How?</td>
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</tr>
<tr>
<td></td>
<td>Y / N The principal considered how students best learn science and developed the science program based on the needs of the student population? How?</td>
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<thead>
<tr>
<th></th>
<th>Y / N The principal has set high standards for science? What are they?</th>
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<tbody>
<tr>
<td>14</td>
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<table>
<thead>
<tr>
<th></th>
<th>Y / N The principal promotes student learning in science?</th>
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<td>15</td>
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<tr>
<th></th>
<th>Y / N The principal provides resources for science instruction? What resources have been provided to you?</th>
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<tbody>
<tr>
<td>16</td>
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<table>
<thead>
<tr>
<th></th>
<th>Y / N The principal has articulated a school vision for science? What is it?</th>
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<tbody>
<tr>
<td>17</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>Y / N The principal has defined what is important for student success in the science program? What?</th>
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</thead>
<tbody>
<tr>
<td>18</td>
<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
<td>Y / N The principal has encouraged you to be a leader in science? In what ways?</td>
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<td>---</td>
<td>--------------------------------------------------------------------------------</td>
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<tr>
<td></td>
<td>Y / N The principal has involved you/other teachers in decision made regarding science? What decisions?</td>
</tr>
<tr>
<td></td>
<td>Y / N Does the principal use human relations skills/expertise to advocate for science? In what ways?</td>
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<td></td>
<td>Y / N Has the principal solicited parental support in science? How?</td>
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</table>
APPENDIX C

CODE START LIST
# Code Start List

<table>
<thead>
<tr>
<th>CODE</th>
<th>CODE DESCRIPTION</th>
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<tbody>
<tr>
<td>AP IL S</td>
<td>Assistant Principal IL in science</td>
</tr>
<tr>
<td>Barriers</td>
<td>Barriers to teaching science</td>
</tr>
<tr>
<td>District</td>
<td>District influence in science</td>
</tr>
<tr>
<td>Ext pres P</td>
<td>External pressures on principal</td>
</tr>
<tr>
<td>FCAT</td>
<td>Florida Comprehensive Assessment Test</td>
</tr>
<tr>
<td>IL Acad</td>
<td>Instructional Leadership in other areas of academic program</td>
</tr>
<tr>
<td>Import</td>
<td>Importance of science</td>
</tr>
<tr>
<td>IS</td>
<td>Instructional Strategies</td>
</tr>
<tr>
<td>NSES</td>
<td>National Science Education Standards</td>
</tr>
<tr>
<td>P/OA Per Sci</td>
<td>Principal’s/other administrators perception of science instruction</td>
</tr>
<tr>
<td>Prin supp</td>
<td>Principal support in science</td>
</tr>
<tr>
<td>PD</td>
<td>Professional development</td>
</tr>
<tr>
<td>P pedago</td>
<td>Principal pedagogical understanding of science</td>
</tr>
<tr>
<td>P resp TL</td>
<td>Principal response to teacher leadership</td>
</tr>
<tr>
<td>PL</td>
<td>Principal Leadership</td>
</tr>
<tr>
<td>Prin IL S</td>
<td>Principal instructional leadership in science</td>
</tr>
<tr>
<td>Rel T/T</td>
<td>Relationship teacher/teacher</td>
</tr>
<tr>
<td>Rel T/P</td>
<td>Relationship teacher/principal</td>
</tr>
<tr>
<td>Rel P/S</td>
<td>Relationship principal/student</td>
</tr>
<tr>
<td>Rel O/T</td>
<td>Relationship other/teacher</td>
</tr>
<tr>
<td>SSS/NSES</td>
<td>SSS/NSES</td>
</tr>
<tr>
<td>Sci E</td>
<td>Science events/activities</td>
</tr>
<tr>
<td>Sci Adv</td>
<td>Science advocacy</td>
</tr>
<tr>
<td>Stu in sci</td>
<td>Student engagement in science</td>
</tr>
<tr>
<td>Sci Res</td>
<td>Science resources</td>
</tr>
<tr>
<td>T COLL</td>
<td>Teacher collaboration</td>
</tr>
<tr>
<td>TS</td>
<td>Teacher supervision</td>
</tr>
<tr>
<td>TL</td>
<td>Teacher Leadership</td>
</tr>
<tr>
<td>T Per P IL</td>
<td>Teacher perception of principal IL</td>
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<tr>
<td>T Per Sci</td>
<td>Teachers’ perception of science instruction</td>
</tr>
<tr>
<td>V</td>
<td>Vision/Goals for science</td>
</tr>
<tr>
<td>1st order</td>
<td>First order change efforts</td>
</tr>
<tr>
<td>2nd order</td>
<td>Second order change efforts/School-to-Careers Science Plan</td>
</tr>
</tbody>
</table>
APPENDIX D

CONTEXTUAL FACTORS MATRIX
## Contextual Factors Matrix

### Context: National State & District

<table>
<thead>
<tr>
<th>Professional organizations, national &amp; local policies, &amp; funding initiatives</th>
<th>Audit location</th>
<th>How is context mediated?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Standards, core curricula, &amp; tests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Teacher development &amp; evaluation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Textbooks &amp; teaching materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Structures pattern of interaction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Demographics &amp; Expectation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cultural norms of interaction &amp; behavior</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Context: School

<table>
<thead>
<tr>
<th>Type &amp; site of school &amp; grade levels</th>
<th>Audit location</th>
<th>How is context mediated?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Student, staff, &amp; community demographics &amp; expectations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Budget choices</td>
<td></td>
<td></td>
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<tr>
<td>• Organization of physical space</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Daily, weekly, &amp; yearly schedules</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Technology availability &amp; use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Principal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cultural norms of interaction &amp; behavior</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context: Department/Subject Area</td>
<td>Audit location</td>
<td>How is context mediated?</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>----------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>• Subject area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Teacher &amp; department demographics &amp; expectations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Budget choices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Physical location &amp; organization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Teachers’ class load, daily &amp; weekly schedule</td>
<td></td>
<td></td>
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<tr>
<td>• Department chair</td>
<td></td>
<td></td>
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<tr>
<td>• Subject area specialist</td>
<td></td>
<td></td>
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<tr>
<td>• Cultural norms of interaction &amp; behavior</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Context: Classroom</th>
<th>Audit location</th>
<th>How is context mediated?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Subject area and type of class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Student demographics, abilities, &amp; expectations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Budget choices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Physical organization of the room</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Class size, duration, &amp; time of day</td>
<td></td>
<td></td>
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<tr>
<td>• Textbooks, materials, &amp; assessments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Technology availability and use</td>
<td></td>
<td></td>
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<tr>
<td>• Cultural norms of interaction &amp; behavior</td>
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</table>
APPENDIX E

CLASSROOM OBSERVATION PROTOCOL
Classroom Observation Protocol

**PART I: BACKGROUND INFORMATION**

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<thead>
<tr>
<th>Name of Teacher</th>
<th>Years of Teaching</th>
<th>Room #</th>
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<tr>
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<table>
<thead>
<tr>
<th>Subject Observed</th>
<th>Grade Level</th>
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<table>
<thead>
<tr>
<th>Observer(s)</th>
<th>Date of Observation</th>
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<tr>
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<table>
<thead>
<tr>
<th>Start time</th>
<th>End time</th>
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<table>
<thead>
<tr>
<th>Lesson Being Observed</th>
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<table>
<thead>
<tr>
<th>Number of Students</th>
<th>Gender</th>
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<table>
<thead>
<tr>
<th>Ethnic composition</th>
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</table>

In the space provided below, provide a diagram of the classroom setting in which the lesson took place (space, seating arrangements, etc.)

* Adapted from the Teacher Observation Protocol developed by The University of Maine
  [http://www.umaine.edu/center/MST/MSTProgram.html](http://www.umaine.edu/center/MST/MSTProgram.html)
# PART II: DESCRIPTION OF CLASSROOM ACTIVITY

<table>
<thead>
<tr>
<th>Time</th>
<th>Type of Instruction</th>
<th>Student</th>
<th>Cognitive</th>
<th>Type of Instruction:</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td></td>
<td></td>
<td></td>
<td>L lecture/presentation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SP student presentation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>LWD lecture with discussion</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>w/ student</td>
</tr>
<tr>
<td>5-10</td>
<td></td>
<td></td>
<td></td>
<td>UT utilizing digital educational</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>WW writing work</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>RSW reading seat work</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HOA hands-on activity/materials</td>
</tr>
<tr>
<td>10-15</td>
<td></td>
<td></td>
<td></td>
<td>SGD small group discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CL cooperative learning groups</td>
</tr>
<tr>
<td>15-20</td>
<td></td>
<td></td>
<td></td>
<td>LC learning center/station</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TFI teacher/faculty interacting</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>D demonstration media and/or technology</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CD class discussion</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>OOC out-of-class experience</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>A assessment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>OTH Other</td>
</tr>
<tr>
<td>20-25</td>
<td></td>
<td></td>
<td></td>
<td>HE high engagement, 80% or more of the students engaged</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ME mixed engagement</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>LE low engagement, 80% or more of the students off-task</td>
</tr>
<tr>
<td>25-30</td>
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<td></td>
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<tr>
<td>30-35</td>
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</tr>
<tr>
<td>40-45</td>
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<tr>
<td>50-55</td>
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<tr>
<td>60+</td>
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</tbody>
</table>

**Student Engagement:**

- **HE** high engagement, 80% or more of the students engaged
- **ME** mixed engagement
- **LE** low engagement, 80% or more of the students off-task

**Cognitive Activity:**

1. **Receipt of Knowledge – ROK** (lectures, worksheets, questions, observing, homework)
2. **Application of Procedural Knowledge – APK** (skill building, performance)
3. **Knowledge Representation – KP** (organizing, describing, categorizing)
4. **Knowledge Construction – KC** (higher order thinking, generating, inventing, solving problems, revising, etc.)
0. **Other** (e.g., test prep, lab setup, classroom disruption)
## PART III: CONTENT AND CLASSROOM CULTURE

### LESSON DESIGN AND IMPLEMENTATION

<table>
<thead>
<tr>
<th>Occurred Never</th>
<th>Descriptive Very</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) The instructional strategies/activities respected students’ prior knowledge and the preconceptions inherent therein.</td>
<td>0 1 2 3 4</td>
</tr>
<tr>
<td>2) The lesson was designed to engage students as members of a learning community.</td>
<td>0 1 2 3 4</td>
</tr>
<tr>
<td>3) Student exploration preceded formal presentation.</td>
<td>0 1 2 3 4</td>
</tr>
<tr>
<td>4) This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.</td>
<td>0 1 2 3 4</td>
</tr>
<tr>
<td>5) The focus and direction of the lesson was often determined by ideas originating with students.</td>
<td>0 1 2 3 4</td>
</tr>
</tbody>
</table>

### CONTENT

#### Propositional Knowledge

<table>
<thead>
<tr>
<th>Occurred Never</th>
<th>Descriptive Very</th>
</tr>
</thead>
<tbody>
<tr>
<td>6) The lesson involved fundamental concepts of the subject.</td>
<td>0 1 2 3 4</td>
</tr>
<tr>
<td>7) The lesson promoted strongly coherent conceptual understanding.</td>
<td>0 1 2 3 4</td>
</tr>
<tr>
<td>8) The teacher had a solid grasp of the subject matter content inherent in the lesson.</td>
<td>0 1 2 3 4</td>
</tr>
<tr>
<td>9) Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when needed.</td>
<td>0 1 2 3 4</td>
</tr>
<tr>
<td>10) Connections with other content disciplines and/or real world phenomena were explored and valued.</td>
<td>0 1 2 3 4</td>
</tr>
</tbody>
</table>

#### Procedural Knowledge

<table>
<thead>
<tr>
<th>Occurred Never</th>
<th>Descriptive Very</th>
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</thead>
<tbody>
<tr>
<td>11) Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.,) to represent phenomena.</td>
<td>0 1 2 3 4</td>
</tr>
<tr>
<td>12) Students made predictions, estimations and/or hypotheses and devised means for testing them.</td>
<td>0 1 2 3 4</td>
</tr>
<tr>
<td>13) Students were actively engaged in thought-provoking activity that often involved the critical assessment of procedures.</td>
<td>0 1 2 3 4</td>
</tr>
<tr>
<td>14) Students were reflective about their learning.</td>
<td>0 1 2 3 4</td>
</tr>
</tbody>
</table>
15) Intellectual rigor, constructive criticism, and the challenging of ideas were valued.

<table>
<thead>
<tr>
<th>CLASSROOM CULTURE</th>
<th>Occurred</th>
<th>Descriptive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicative Interactions</td>
<td>0 1 2 3 4</td>
<td></td>
</tr>
</tbody>
</table>

16) Students were involved in the communication of their ideas to others using a variety of means and media.

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<thead>
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</table>

17) The teacher’s questions triggered divergent modes of thinking.

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18) There was a high proportion of student talk and a significant amount of it occurred.

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</table>

19) Student questions and comments often determined the focus and direction of classroom discourse.

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20) There was a climate of respect for what others had to say.

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<th>4</th>
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<table>
<thead>
<tr>
<th>CLASSROOM CULTURE</th>
<th>Occurred</th>
<th>Descriptive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student/Teacher Relationship</td>
<td>0 1 2 3 4</td>
<td></td>
</tr>
</tbody>
</table>

21) Active participation of students was encouraged/valued.

<table>
<thead>
<tr>
<th>0</th>
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<th>4</th>
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</table>

22) Students were encouraged to generate conjectures, alternative solutions and ways of interpreting evidence.

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<thead>
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</table>

23) In general the teacher was patient with students.

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</table>

24) The teacher acted as a resource person, working to support and enhance student investigations.

<table>
<thead>
<tr>
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<th>4</th>
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</table>

25) The metaphor “teacher as listener” was very characteristic of this classroom.

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<th>3</th>
<th>4</th>
</tr>
</thead>
</table>
PART IV: RATE THE OVERALL QUALITY OF LESSON

_______  Level 1: Ineffective Instruction
        _______  Passive Learning
        _______  Activity for Activity’s Sake

_______  Level 2: Elements of Effective Instruction

_______  Level 3: Beginning stages of Effective Instruction
         (Select one below.)
        _______  Low  _______  Medium  _______  High

_______  Level 4: Accomplished, Effective Instruction

_______  Level 5: Exemplary Instruction

Principal’s/Teacher’s commentary/reactions:
APPENDIX F

HUMAN SUBJECTS APPROVAL
Human Subjects Approval

Office of the Vice President For Research
Human Subjects Committee
Tallahassee, Florida 32306-2763
(850) 644-8673 · FAX (850) 644-4392

APPROVAL MEMORANDUM

Date: 5/29/2005

To: Kimberly Lanier
156-07 Ellis
Tallahassee, FL 32310-5819

Dept.: MIDDLE AND SECONDARY EDUCATION

From: Thomas L. Jacobson, Chair

Re: Use of Human Subjects in Research
A principal's instructional leadership: How does it influence elementary science amidst reform.

The forms that you submitted to this office in regard to the use of human subjects in the proposal referenced above have been reviewed by the Secretary, the Chair, and two members of the Human Subjects Committee. Your project is determined to be Exempt per 45 CFR § 46.101(b) 2 and has been approved by an accelerated review process.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals, which may be required.

If the project has not been completed by 5/24/2006 you must request renewed approval for continuation of the project.

You are advised that any change in protocol in this project must be approved by resubmission of the project to the Committee for approval. Also, the principal investigator must promptly report, in writing, any unexpected problems causing risks to research subjects or others.

By copy of this memorandum, the chairman of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols of such investigations as often as needed to ensure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Protection from Research Risks. The Assurance Number is IRB00000446.

Cc: Sherry Southerland
HSC No. 2006.221
APPENDIX G

INFORMED CONSENT
Informed Consent

Human Subjects Committee Letter of Consent for Adults
(Does not exceed minimal risk/application for exempted status)

Dissertation Title: A Principal’s Instructional Leadership: How Does It Influence Elementary Science Amidst Reform?

Kimberly S. Lanier

Email: LFB403@gmail.com
350-87 Ellis Drive
Tallahassee, Florida 32310-1679
Home Phone: 850-594-9616

209 Wilemon Carrell Hall, The Florida State University, Tallahassee, Florida 32306-4400
Office Phone: 850-644-3408
Office Fax: 850-644-7806

March 20, 2005

Dear Participant:

I am a graduate student under the direction of Dr. Alejandro Gallard and Dr. Sherry Southerland in the Department of Middle and Secondary Education of the College of Education at The Florida State University. I am requesting your participation in my dissertation research, A Principal’s Instructional Leadership: How Does It Influence Elementary Science Amidst Reform? It is my goal to better understand how a principal’s instructional leadership in terms of science instruction is enacted in an elementary school. To better understand this phenomenon, this research investigation requires that I engage persons at all levels of the organization, including administrators, teachers, informal school leaders, district personnel assigned to this school, and others participants who may inform this investigation; hence your participation is requested.

There are no foreseeable risks or discomforts for participating in this investigation. The benefit of the research is that it looks at science reform as an interplay between the school principal, teacher, and context, an interplay that is often not explored. Further, it provides an opportunity for the school principal and teachers to see how each influence the teaching and learning of science.

Your participation in this investigation is expected to last for a period of four months, which will include nine one-day visits for audiotaped interviews, observations, and analysis of documentation. After the initial data collection period I do require that you participate in a member check session to review data that are collected and interpretations that are made. All tapes and other documents gathered for this investigation will be destroyed by March 15, 2012.

The results of the research investigation may be published; however, all information obtained during the course of the investigation will remain confidential, to the extent allowed by law, and your identity will not be disclosed, as pseudonyms for the participants and location will be used.

Your participation in this investigation is completely voluntary and if at any time you choose to withdraw, there will be no penalty or repercussion. If you have any questions, please call me at home, 850-594-9616, or contact me via e-mail, LFB403@gmail.com. You may also contact my major professors via e-mail, agallard@fsu.edu or southerland@fsu.edu. Thanking you in advance for your participation.

Sincerely,

Kimberly S. Lanier
I, ____________________________________________, give my consent to participate in the above investigation. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Committee, Institutional Review Board, through the Vice President for the Office of Research at (850) 644-8033.

__________________________________________ (signature)  ____________________________ (date)

[Stamp: Florida State University Institutional Review Board]
REFERENCES


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BIOGRAPHICAL SKETCH

Kimberly S. Lanier was born in Miami Beach, Florida. She is the baby and only girl of five siblings born to Robert and Mae Lanier. Kimberly earned a bachelor’s degree in Elementary Education from Florida Memorial College; a Master’s Degree in Elementary Education with Certification in Educational Leadership from Nova Southeastern University, and; the degree of Specialist in Education (Science Education) from Florida State University. From 1994 to 2000 she taught elementary school; one of those years she served as the school’s Reading Leader supervising the reading program. In 2000 Kimberly accepted a position as a school administrator at a small private school in Tampa, Florida, at which time she was offered a scholarship to pursue her doctoral studies. During her graduate studies, Kimberly worked as a graduate and research assistant in the Science Education Program and the Education Learning Community for undergraduate education majors. She also worked as a Science Consultant for Elementary Programs in the Gadsden County and Taylor County School Districts. As an instructor, she taught *Teaching Science in the Elementary School* and *Classroom Management, Legal Issues, Professional Ethics, and School Safety*. Additionally, she supervised education interns; facilitated professional development for science, and; developed curriculum ensuring that it was multidisciplinary, addressed current issues in science teaching and learning, and aligned with national and state standards.

Kimberly is a member of many national, regional, and local professional organizations such as, American Educational Research Association (AERA), Leon Association of Science Teaching (LAST), National Science Teachers Association (NSTA), National Association of Research in Science Teaching (NARST), and Southeastern Association for the Education of Teachers in Science (SAETS). Her professional memberships have afforded her the opportunity to present at education conferences nationally and abroad. Kimberly’s research interests include principal leadership and how it influences in science, teacher professional development, and the development of preservice teacher educators.
Kimberly is currently a curriculum developer and professional development facilitator. She works collaboratively with a team in the development of novel and innovative curricula and technology programs that are multidisciplinary, address current issues in science teaching and learning, and align with national and state standards. When Kimberly completes her doctorate, she plans to continue developing science education curriculum and facilitating professional development workshops for educators and community agents all over the country.