THE RELATIONSHIP BETWEEN VERTICAL TEAMING IN SCIENCE AND STUDENT ACHIEVEMENT AS REPORTED IN THE ACADEMIC EXCELLENCE INDICATOR SYSTEM (AEIS) AT SELECTED PUBLIC SCHOOLS IN BEXAR COUNTY, TEXAS

A Dissertation

by

VERONICA HERNANDEZ ARTEAGA

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2008

Major Subject: Educational Administration

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Approved by:

Co-Chairs of Committee, Virginia Collier
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ABSTRACT

The Relationship Between Vertical Teaming in Science and Student Achievement as Reported in the Academic Excellence Indicator System (AEIS) at Selected Public Schools in Bexar County, Texas. (August 2008)

Veronica Hernandez Arteaga, B.A., St. Mary's University;

M.A., St. Mary's University

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The purpose of this study was to examine the relationship between vertical teaming in science and student achievement. This study compared student achievement of campuses implementing vertical teaming with schools that do not practice vertical teaming. In addition, this study explored the relationship between selected demographic variables and vertical teaming using Grade 5 Science TAKS results in the Academic Excellence Indicator System (AEIS). Campus demographic variables such as economically disadvantaged, minority students, English language learners, student mobility, and experienced teachers were researched. A call-out yielded 168 responses. With the exclusion of the 12 campuses, a total of 156 participating campuses from 18 traditional school districts remained.

Campuses employing vertical teaming were self-identified on the basis of having implemented the process for two or more years. The gain in percent mastered for Science TAKS scores from 2004 to 2007 was used as the Science TAKS score variable.

Results indicated that there was no significant difference in student achievement in science for campuses practicing vertical teaming and campuses that did not. The two-way ANOVA was used to measure the relationship between the independent variables (vertical teaming and campus demographic variables) on the dependent variable (student achievement on Science TAKS). The results suggested that campuses having low percentages of economically disadvantaged students statistically gained more on the Science TAKS than campuses that have high percentages of economically disadvantaged students irrespective of vertical teaming practices. In addition, campuses that have low percentages of minority students statistically gained more on the Science TAKS than campuses that have high percentages of minority students despite vertical teaming participation.

Recommendations include districts, state, and federal agencies providing campuses with a high percent of economically disadvantaged students with more resources and more flexibility in using those resources. Recommendations for further study included a replication of the study that takes into account the degree of implementation of vertical teaming.

DEDICATION

This dissertation is dedicated to my parents, Manuel S. Arteaga and Estella H. Arteaga. They have shown me what is important in life through their wisdom and example. I would like to thank them for instilling in me the value of family, religion, and education. It is through their diligent work ethic, support, and encouragement that I have finished this task.

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CHAPTER I

INTRODUCTION

Just as change is ubiquitous in a successful business in order to meet customer demands, educators find the need to adjust their practices due to increasing demands from government mandates and changing demographics in school communities. As time becomes scarce in education, it is necessary to avoid duplicating unnecessary lessons and at the same time identify areas that need more emphasis in order for students to succeed. In vertical teaming, teachers from different grade levels articulate curriculum in a subject in order to think globally about the needs of all students and identify gaps or overlaps in the curriculum design in a discipline. The infrastructure that vertical teaming has provides a synergistic system that allows educators and students to build upon previous material and navigate efficiently through the curriculum (College Board, 2004; Kowal, 2002). This study was designed to examine vertical teaming within the context of science.

In our ever-evolving world, science has consistently emerged as a topic that shapes our society. Political discussions often address among other issues new diseases, the potential of alternative fuels, and space discovery. This focus on scientific topics has led to improving science education, becoming increasingly vital to preparing a scientifically literate citizenry (DeBoer, 2000).

The style for this dissertation follows that of *The Journal of Educational Research*.

Standard-based reforms that have been constructed to improve science education have not been successful. Even with these reforms, the United States has yet to reach the goal of its students becoming world leaders in science, and gaps in student achievement are still seen in major racial and ethnic groups along with the economically disadvantaged (National Research Council, 2007; Texas Education Agency, 2007b). Many researchers believe that changes are needed throughout the education system to address the issue (DeBoer, 2000; Grigg, Lauko, & Brockway, 2006; Lynch, 2001; National Research Council, 2007).

This study investigated if an alternative collaboration practice through vertical teaming would help support educators and societal goals by making an impact on student achievement in science. Vertical teaming brings teachers from different grade levels together in the spirit of cooperation in order to raise the academic standards of a school by vertically aligning curriculum. Through the creation and use of vertically aligned curriculum, more students are encouraged to apply previously gained skills and knowledge to new and more challenging material (College Board, 2004).

Although teaming is arranged vertically in order to support the process of cooperation within the structure, there is a parallel leadership distribution. Due to the 1983 report *A Nation at Risk: The Imperative for Educational Reform*, by the National Commission on Excellence in Education, the American public became increasingly more demanding on the school system to improve students' academic performance (DeBoer, 2000). School reform and accountability movements placed pressure on school principals to increase student achievement. A new style of leadership emerged to answer the demands from this era of school accountability and school restructuring. This new style, transformational leadership, became the dominant model of education administration (Leithwood, 1992; Stewart, 2006). According to Leithwood (1992), "transformational school leaders are in continuous pursuit of three fundamental goals: 1) helping staff members develop and maintain a collaborative, professional school culture; 2) fostering teacher development; and 3) helping them solve problems together more effectively" (pp. 9-10). In this construct, teacher isolation is replaced with cooperative interdependence.

The shift from individual worker to teamwork materialized in the business arena before the collegial culture of schools changed (Wheelan & Kesselring, 2005). Wheelan and Kesselring (2005) assert that in industry "the trend was fueled by the need for businesses to find new methods to compete in a global economy and address the fact that the complexity of work at this point in history requires collaboration" (p. 323). Godard (2001) found that in examining moderate levels of alternative work practices, which include work teams, employees had an increased sense of "belongingness," empowerment, task involvement as well as commitment. The findings of the attributes in work groups suggest a link with the goals of transformational leadership.

Educational reforms that include team empowerment, shared leadership, and organizational learning move education toward a more collaborative, synergistic structure (Stewart, 2006) resembling the vision of transformational leadership. The types of teams that function in the majority of U.S. schools include (a) faculty groups as a whole, (b) grade-level teams, (c) vertical teams, (d) school leadership teams, and (e) site-based management teams (Wheelan & Kesselring, 2005). The practice of vertical teaming encourages team empowerment and teacher work groups (Kowal, 2002). Kowal (2002) suggests that “A vertical team is a group of educators (teachers, counselors, administrators) from different grade levels who work together to develop a curriculum that provides a seamless transition from grade to grade” (Kowal, 2002, p. 1). Team empowerment and teacher work groups authorize a sense of collective autonomy (Pounder, 1999) and encourage participative decision-making (Crow & Pounder 2000). By utilizing vertical teaming, campuses have the capability to cooperatively dissect state standards in order to meet federal testing requirements (Kowal, 2002).

Through collaboration, teachers can feel empowered in addressing their additional tasks (Wheelan & Kesselring, 2005). With the passing of No Child Left Behind Act of 2001 (NCLB), educators are faced with more responsibilities and added pressure to ensure success in student performance. NCLB under State Plans section 1111, subsection (c) requires states to implement at a minimum the following annual assessments (U.S. Department of Education, 2007a):

> (v)(I) except as otherwise provided for grades 3 through 8 under clause vii, measure the proficiency of students in, at a minimum, mathematics and reading or language arts, be administered not less than once during—
> (aa) grades 3 through 5;
> (bb) grades 6 through 9; and
> (cc) grades 10 through 12. (para. 3)

In an effort to move toward underserved children in our nation’s public schools, NCLB placed more challenges on educators by emphasizing the disaggregation of assessment data by student groups. States are required to address the achievement gaps by analyzing information on major racial and ethnic groups, economically disadvantaged students, students with disabilities, and English language learners. NCLB, under Improving Academic Achievement of the Disadvantaged section 101 numbers (2) and (3), called for states to provide fair, equal, and opportunities for high-quality education through the following expectations (U.S. Department of Education, 2007a):

> (2) meeting the educational needs of low-achieving children in our Nation's highest-poverty schools, limited English proficient children, migratory children, children with disabilities, Indian children, neglected or delinquent children, and young children in need of reading assistance;
>
> (3) closing the achievement gap between high- and low-performing children, especially the achievement gaps between minority and nonminority students, and between disadvantaged children and their more advantaged peers; (para. 2-3)

A subject that has not received an equal role compared to math and reading in education assessment is science. State and federal education agencies have recently required science assessments in comparison to the other core subjects such as reading and math. While reading and math have been assessed annually with NCLB since the 2004-2005 school year, the assessment for science as a content area was not required until 2007-2008 school year. States are required to administer the subject not less than one time during grades 3-5; grades 6 through 9; and grades 10 through 12 (U.S. Department of Education, 2007a). The state assessment of Texas, Texas Assessment of Knowledge and Skills (TAKS), has included science testing once at the 5th grade and 10th grade levels since 2003. Only one grade level, 8th grade, included science assessment in Texas from 1995 until 2002 (Texas Education Agency, 2007b).

With federal requirements and state ratings based on student achievement, the demands of the public placed a spotlight on educators. An area that has consistently received critical attention is the subject least tested, science. The Third International Mathematics and Science Study (TIMSS) reported that U.S. students are far from achieving the goal to be first in the world in science and mathematics (Schmidt & Valverde, 1998). Currently at the state level, science is what keeps most campuses recognized instead of exemplary in Texas accountability ratings (Education Service Center [ESC] Region 20, 2007). Researchers suggested that the curriculum and professional development in science needed to be more cohesive (National Research Council, 2007; Schmidt & Valverde, 1998; Settlage & Meadows, 2002). Similarly, the National Research Council (2007) recommended, "Extensive rethinking of how teachers are prepared before they begin teaching and as they continue teaching – and as science changes – is critical to improving K-8th science education in the United States" (National Research Council, 2007, p. 1).

Schools and other establishments charged with nurturing and supporting children must find ways to collaborate and use their resources more efficiently and effectively (White & Wehlage, 1995). State agencies place educators responsible for ensuring that learning is connected throughout the grade levels and for providing a variety of opportunities for student learning. The Science Texas Essential Knowledge and Skills (TEKS) in science resulted in a grade-appropriate progression being developed. This interdependency between grade levels should assist in reinforcing and unifying themes or strands of learning in science. Through Science Texas Essential Knowledge and Skills

(TEKS) grade-appropriate progression is developed (Texas Education Agency, 2004). With an emphasis on connected learning throughout all grade levels in science, the advantages of vertical curriculum alignment moved beyond concrete curriculum concerns. Newmann and Wehlage (1995) proposed that vertical (teaming) alignment encouraged educators to work together to achieve school goals.

Science assessments are the tool for determining whether students are mastering the science knowledge and skills needed in order to be scientifically literate. With the pressure to improve test scores tunneling teachers' decisions making and reducing their creativity (Settlage & Meadows, 2002), it is critical that educators feel a sense of empowerment and support from their cohorts. Staff members in collaborative school cultures often talk, observe, evaluate, and plan together (Leithwood, 1992). Reeves (2002) suggests that in order to add value to state standards, leaders and educators need to have conversations to prioritize standards. While the issue of teaming is a positive development in school reform, surprisingly little research has been conducted on the relationship between vertical teaming and student achievement (Wheelan & Kesselring, 2005). This study sought to quantitatively explore campuses that practice vertical teaming with their science curriculum.

Statement of the Problem

Embedded in the problem are three dimensions: (a) teacher collaboration through vertical teaming, (b) national focus on science, and (c) educational reform through student assessment. This study recognizes that as mandates for standards-based testing from both the state and national levels increased when more attention was placed on quality of academics of all children. As a result, there is a needed focus toward the subject of science where there are low performances as documented by student assessment (Schmidt & Valverde, 1998). Educators are faced with decisions on how to best address the educational issues. In science education, addressing the need for improvement in student achievement in science would involve a dialogue that includes contributions from the experiences of teachers at each level in the subject of science (ESC Region 20, 2007). In addition, educators are urged to address how to teach science to diverse student populations (Lynch, 2001; National Research Council, 2007). Studies that examine teacher work groups have suggested that work teams specifically vertical teams have had positive results (Conley, Fauske, & Pounder, 2004; Crow & Pounder 2000), yet few researchers have critically examined how vertical teaming and standard-based assessments interact with student achievement (Wheelan & Kesselring, 2005).

The No Child Left Behind Act of 2001 (NCLB) was created to set demanding accountability standards, increase achievement, and change the culture of public schools (U.S. Department of Education, 2007a). Currently under No Child Left Behind (NCLB), states must measure every student's progress in reading and math in each of grades 3 through 5. By the 2007-2008 school year, the federal government added a science assessment to take place at least once for children in 3rd through 5th grade (U.S. Department of Education, 2007a). DeBoer (2000) points out that both state and federal agencies have developed and identified content standards in order to define science programs. With strong encouragement from the U.S. Government on down to its citizens, there is an expectation that all American students become "scientifically literate" (DeBoer, 2000).

When examining the passing rates of Texas elementary students at the state level, science mastery is not competitive when compared to math; and from 2003 to 2007, Science TAKS scores were 5 to 12 percentage points below both math and reading at the 5th grade level. In addition, there is a steady discrepancy of at least 20 percentage points between White and Hispanic subgroups as well as the White and African American subgroups in science from 2003 through 2007 (Texas Education Agency, 2007b).

Both nationally and internationally, United States elementary students scored satisfactory in science. At the international level, according to TIMSS, the 4th grade students performed well; they were outperformed by only one country (National Research Council, 2007). Nationwide, 4th grade students' science scores were higher than in previous assessment years, with lower-income students making significant gains. From 2000-2005, African Americans and Hispanic students' science scores improved, and the gaps between White and African Americans and White and Hispanic students narrowed. In comparison to other states, Texas students were parallel in science at all achievement levels: (a) basic, (b) proficient, and (c) advanced (Grigg, Lauko, & Brockway, 2006).

Despite state and national efforts to close the achievement gaps among all students, science test scores do not indicate progression toward that goal at the secondary level. When examining the 11th grade Science TAKS results from 2003-2007, all subject areas were similar in range with the exception of social studies, which steadily runs at a higher passing rate than English language arts, math, and science. In inspecting the science scores more closely, again a gap of a minimum of 20 percentage points exists between White and Hispanic subgroups as well as the White and African American subgroups in science from 2003 through 2007 (Texas Education Agency, 2007b). In the state of Texas, science will be the subject that keeps most schools from earning honors in statewide ratings (ESC Region 20, 2007). In examining demographic characteristics, districts have recognized gaps in passing rates in accountability subsets. Districts find it necessary to target African Americans, Hispanics, and economically disadvantaged as areas of improvement (Northside Curriculum & Instruction Department, 2006). Nationally, the overall performance of our nation's 12th graders has declined since 1996. Furthermore, the score gap between White and African Americans and White and Hispanics did not narrow between 1996 and 2005 (Grigg et al., 2006).

Although districts and campuses have identified their concerns with the achievement gap in science and recognized a need to work together to overcome the obstacle, teachers in urban schools report having less power over curriculum (Settlage & Meadows, 2002). According to Godard (2001), teams who work together have a greater sense of belonging and identification with the group objectives, which helps foster performance. However, Elmore (2002) contends that teacher team meetings at the elementary levels in science have for the most part utilized grade level teaming. He continues to argue that in the current structure, grade level team meetings do not engage teachers in dialogic conversations that link their instructional practice in a way that transfers to their students' learning. An integral part of this problem is that educators have generally not sought to connect what occurs in their own grade level with the different grade levels within their school (Elmore, 2002).

The 5th grade Science TAKS assess 5th grade standards as well as standards in previous grade levels (Texas Education Agency, 2004), thus making the need for vertical teaming a critical issue. There are opportunities for the 5th grade Science TAKS to assess a 3rd grade standard from the Texas Essential Knowledge and Skills (TEKS). A standard such as 3.11C that states “identify the planets in our solar system and their position in relation to the Sun” has been assessed at the 5th grade level both in 2003 and 2005 (Texas Education Agency, 2007c). As educators and students address standards that are not stated at their grade level, collaborating with other faculty members to share gaps or repetitions in the curriculum appears warranted (ESC Region 20, 2007).

Collaboration and teaming are required for both federal and state funding. An example at the federal level occurs through the use of Title I funding that expects the role of the teacher is expected to serve in a collaborative capacity among faculty and staff (Virginia Department of Education, 2007). At the state level, criteria I for the Texas Educator Excellence Award requires that teachers demonstrate excellence in improving student achievement in collaborating with other teachers on the campus (Texas Education Agency, 2006b). In addition, the second required criterion for the Educator Excellence Award involves teacher behavior, which includes team teaching and other activities related to collaboration with teachers. These are examples of the expectation in education that teachers document collaboration with faculty and staff that contributes to improving overall campus student achievement. Minimal research demonstrates that vertical teaming has an impact in science curriculum in the state of Texas or across the country.

Purpose of Study

As our nation moves into more specialized assessments at the elementary levels and the expectation that our students become leaders in the world on tests of scientific literacy (DeBoer, 2000; National Research Council, 2007), school systems are encouraged to provide a strong infrastructure that may prove to positively influence student learning outcomes in these areas. The purpose of this study was to examine the relationship between vertical teaming in science and student achievement. This study sought to compare student achievement of campuses implementing vertical teaming with the student achievement of schools that do not use vertical teaming. In addition, this study attempted to ascertain the degree to which vertical teaming impacted selected demographic variables as reported by Science TAKS results in AEIS.

Research Questions

The study was guided by the following research questions:

1. Is there a difference in student achievement as reported in AEIS between elementary campuses practicing vertical teaming in science and elementary campuses that do not utilize vertical teaming in science?
2. Is there a relationship between school variables (i.e., percent economically disadvantaged, percent English language learners, percent minority, percent mobility, and percent of experienced teachers) and student achievement on Science TAKS controlling for demographic variables?

Operational Definitions

The findings of this study were reviewed within the context of the following definitions of operational terminology:

Academic Excellence Indicator System (AEIS): AEIS is a statewide system that compiles an array of information on the performance of students and school finance in every school and district in Texas each year. The system involves district and state-level reports on finance, population and staffing (Texas Education Agency, 2007a).

Bexar County, Texas: Bexar County is a county located in the state of Texas. As of 2005, population is 1,518,370. Its county seat is San Antonio (U.S. Census Bureau, 2006).

Database: Academic Excellence Indicator System (AEIS) is a database.

Public School: A public school is an elementary or secondary school in the United States supported by public funds and providing free education for children of a community or district (Pickett, 2000).

Percent of Economically Disadvantaged: A variable in the study that represents the campus percentage of economically disadvantaged students enrolled for 2006-2007 is the percent of economically disadvantaged. The percent of economically disadvantaged students is calculated as the sum of the students coded as eligible for free or reduced-price lunch or eligible for other public assistance, divided by the total number of students (Texas Education Agency, 2007d).

Percent of English Language Learners: A variable in the study that represents the campus percentage of limited English proficient (LEP) students enrolled for 2006-2007 is the percent of English language learners. LEP students are identified by the Language Proficiency Assessment Committee (LPAC) according to criteria established in the Texas Administrative Code. Not all pupils identified as LEP receive bilingual or English as a second language instruction, although most do. The percent of LEP students is calculated by dividing the number of LEP pupils by the total number of students in the school (Texas Education Agency, 2007d).

Percent of Experienced Teachers: A variable in the study that represents the campus percentage of teachers with six or more years of teaching experience from 2006-2007 is the percent of experienced teachers.

Percent of Minority Students: Students are reported in AEIS as White, African American, Hispanic, Asian/Pacific Islander, and Native American (Texas Education Agency, 2007d). Percent of minority students is a variable in the study that represents the campus percentage of African American students, Hispanic students, Asian/Pacific Islander students, and Native American students enrolled for 2006-2007.

Percent of Mobile Students: A variable in the study that represents the campus percentage of mobile students on a campus is the percent of mobile students. A student is considered to be mobile if he or she has been in membership at the school for less tan 83% of the school year (Texas Education Agency, 2007d).

Student Achievement: The gain in the percentage of students passing Science TAKS in 2004 and 2007 is student achievement.

Texas Assessment of Knowledge and Skills (TAKS): The Texas Assessment of Knowledge and Skills (TAKS) is a comprehensive testing program of public school students in grades 3-11. The TAKS is designed to measure to what extent a student has learned, understood, and is able to apply the important concepts and skills expected at each tested grade level (Texas Education Agency, 2007d).

Variables: Variables studied consist of demographic characteristics of campuses: percent of economically disadvantaged students, percent of English language learner students, percent of minority students, percent of mobile students, and percent of experienced teachers.

Vertical Teaming: A vertical team is a group of educators (teachers, counselors, administrators) from different grade levels who work together to develop a curriculum that provides a seamless transition from grade-to-grade (Kowal, 2002, p. 1).

Assumptions

The findings of this study were preceded by the following assumptions:

1. The researcher was impartial in collecting and analyzing the data.
2. The interpretation of the data accurately reflects the results of the study.
3. The teachers on campuses with vertical teaming were adequately trained in the teaming process.

4. The teachers on campuses with vertical teaming were implementing the teaming practices.
5. The methodology proposed and described here offers the most logical and appropriate design for this particular research project.
6. Grade level meetings are conducted on elementary campuses.

Limitations

1. The study was limited to the selected number of elementary public schools within Bexar County, Texas elementary schools.
2. The study was limited to the information acquired from the literature review and database.
3. Findings were generalized only to public school districts within Bexar County, Texas.
4. The study cannot be considered a cause and effect study due to the many variables that contribute to community challenges.
5. Implementation of teaming concept was not to the same degree for campuses.
6. The study used 2006-2007 demographic information.
7. The percentage of students meeting standards in spring 2004 was set for one standard error of measurement.
8. The percentage of students meeting standards in spring 2007 was set for panel's recommendation.

Significance of the Study

With the shift in transformational leadership, education has moved toward teacher empowerment. Similarly, vertical teaming is one way to promote teacher empowerment. In fact, through vertical teaming, teachers feel that they are able to make a positive contribution rather than in a structure that is solely top down vertical directive. Thus, the vertical teaming approach creates collaboration that has been lacking for years (Senge et al., 2000). Still, educators argue that teachers are in an autonomous activity (Darling-Hammond & McLaughlin, 1995; Settlage & Meadows, 2002). Vertical teaming has the opportunity to be the response to autonomy. Indeed, there are challenges in vertical teaming that include similar planning times (Flowers, Mertens, & Mulhall, 1999) and curriculum conversations comprised of superficial understanding (Routman, 2002). Because of the challenges in planning and curriculum instruction, this study has leadership implications. Without the visional leadership and jurisdiction over master schedules to support this structure, vertical teaming would not be implemented.

According to the 2004-2005 Academic Excellence Indicator System (AEIS), the passing rate of Texas 5th grade students in science was 64% (Texas Education Agency, 2006a). The Science Texas Assessment of Knowledge and Skills (TAKS) evaluates the Science Texas Essential Knowledge and Skills (TEKS) from kindergarten to grade 5. With information on how grade levels from kinder to 5th grade are interdependent in developing and implementing an aligned curriculum (English & Steffy, 2001; Reeves, 2002), learning gaps and surpluses in curriculum may be identified in order to increase student achievement. Vertical alignment occurs when the objectives to be mastered at one grade level are fundamental for comprehension at the next level (Reeves, 2002). This type of vertical alignment can be processed through vertical teaming. Through vertical teaming, there is a discourse among educators on the topic of science curriculum. Science test scores indicate that the subject consistently falls behind other disciplines at the elementary level (Texas Education Agency, 2007b). As a result, U.S. education is failing to accomplish its goal set forth by the national science education standards that all students, regardless of age, gender, or ethnic background, should have the opportunity to attain high levels of scientific literacy (American Association for the Advancement of Science [AAAS], 1989).

In reviewing literature on team-related outcomes, there have been a number of studies that focus on teacher and student outcomes due to interdisciplinary teaming efforts, yet a clear link between the effectiveness of teacher teams and specific student outcomes has not been established (Conley et al., 2004; Crow & Pounder, 2000). The majority of teacher teaming focuses on work group concepts rather than departmental disciplines. In addition, the majority of students targeted in these studies are at the secondary level (Flowers et al., 1999; Janz, Colquitt, & Noe, 1997; Pounder, 1999; Somech, 2005), less is known about elementary levels and student learning outcomes. There are limited studies addressing the process of vertical teaming specifically in elementary settings with a focus on a subject such as science. This empirical study attempts to address vertical teaming with the focus on the discipline of science and student achievement at the elementary level.

Organization of the Study

This dissertation is divided into five major chapters. Chapter I contains an introduction, a statement of the problem, purpose of the study, research questions, operational definitions, assumptions, limitations, and a research significance statement. Chapter II provides the reader with a review of the literature. The research methodology and procedures implemented in the data collection for this quantitative study are found in Chapter III. Chapter IV reports the analysis and comparisons of the data collected in the study. Chapter V, the final chapter, presents the author's summary, conclusions, and implications in addition to recommendations for further research.

CHAPTER II

REVIEW OF LITERATURE

Introduction

The purpose of this study was to explore the relationship between vertical teaming in science and student achievement within the context of elementary campuses. Chapter II provides the review of relevant literature for this study. This chapter is organized into three major sections. Literature used in this review will address student assessments, scientific literacy, and teacher collaboration. In order to set the context for the discussion of my findings, the history of testing is initially presented, specifically focusing on national mandates, state accountability, and student achievement gaps that have influenced school restructuring and education reform. Next, because this study focused on the subject of science, the literature chronicles scientific literacy, as well as examined minorities in science and science curriculum that exposes the need to explore strategies to improve all student performance in science. The last section reviews the major findings from teacher collaboration that investigates vertical teaming in science, the establishment of vertical teaming through transformational leadership, and teacher involvement in site-based management.

Educational Reform Through Student Assessment

History of Testing

Because many decisions made in pubic education are based on public school law, it is necessary to review the politics surrounding the history of testing in our nation. Legislative decisions made through public influence have directly shaped public education. Through national mandates, most recently No Child Left Behind Act of 2001 (NCLB), politicians were able to show their constituents that they were making a good faith effort in improving education standards through student assessment.

Prior to 2001, standardized tests in the United States were criterion-referenced tests of demonstrated skills in spelling, writing, and arithmetic. The College Board administered the first Scholastic Aptitude Test (SAT) in 1926 for college admissions (Frederiksen, 1984). In the 1950's and early 1960's, testing had little impact on instruction and was primarily used to identify ability groups. Tests were largely unaligned to instruction until the passing of the Elementary and Secondary Education Act (ESEA) in 1965. Following the passage of the ESEA, testing provided an avenue of evaluating federally funded programs. In the 1970's, data revealed a decline in student attainment of knowledge and skills; as a result, testing increased and more attention was drawn to student improvement (Frederiksen, 1984; Linn, 2000).

As a result of initiatives that focused on school reform, raising standards through new courses and standardized tests were widespread in public schools during the 1980's. As large school reform movements emerged, new tests or expanded use of an existing test developed (Newmann, King, & Rigdon, 1997). The landmark publication of *A Nation at Risk* in 1983, led a modern accountability standards movement that challenged our nation's schools to focus on student achievement and rigorous curricula. This open letter to the American people has been at the forefront of public education policy until the latest national reforming effort called the No Child Left Behind Act of 2001 (U.S. Department of Education, 2007b). Increasing focus on student outputs rather than inputs became a national trend. Through NCLB, sanctions and rewards were spelled out. These mechanisms to ensure implementation were absent from *A Nation at Risk*.

National Mandates: No Child Left Behind

No Child Left Behind is based on four principles: (a) accountability, (b) practices based on scientific research, (c) parental choice, and (d) increased local control and flexibility (U.S. Department of Education, 2007a). The No Child left Behind Act mandates that school improvement plans must incorporate strategies based on scientifically based research: corrective action must include professional development based on scientifically based research; and Title III grantees must use English language acquisition approaches based on scientifically based research. The following are some of the goals established through NCLB:

- By the 2013-2014 school year, all students will be proficient in reading and math;
- Starting in the 2013-2014 school year, all 3rd graders will be proficient in reading at the end of the year;
- All English language learners will be proficient in English;
- By the 2005-2006 school year, all teachers will be highly qualified;
- All learning environments will be safe, drug free, and conducive to learning; and
- There will be 100% graduation rate of all high schools (U.S. Department of Education, 2007a)

Under basic program requirements, NCLB required each state to implement a single, statewide accountability plan to ensure all public schools from kindergarten through 12th grade achieve adequate yearly progress as defined by each state (U.S. Department of Education, 2007a). In addition, NCLB requires each state to include the following: (a) the plan must be based on state-adopted academic standards and assessments, (b) the plan must be used in all public kindergarten through 12th grade schools, and (c) the plan must include sanctions and rewards that will be used to hold all public kindergarten-through 12th grade schools accountable for all students' achievement and adequate yearly progress (U.S. Department of Education, 2007a).

No Child Left Behind assessment guidelines requires states to assess reading at the elementary levels grades 3-5, middle school 6-8, and high school levels 9-12 in reading and math. The following NCLB mandate addresses academic assessments in general (sec.1111, State Plans):

> Each state plan shall demonstrate that the state educational agency, in consultation with local educational agencies, has implemented a set of high-quality, yearly student academic assessments that include, at a minimum, academic assessments in mathematics, reading or language arts, and science that will be used as the primary means of determining the yearly performance of the state and of each local educational agency and school in the state in enabling all children to meet the state's challenging student academic achievement standards, except that no state shall be required to meet the requirements of this part relating to science assessments until the beginning of the 2007-2008 school year (U.S. Department of Education, 2007a).

In addition, the No Child Left Behind Act requires schools to close the gap in achievement between 12 identified subgroups of students, to demonstrate steady gains in achievement for all students, and to provide a highly-qualified teacher for all students. A school must demonstrate students' achievement through annual assessment and accountability measures as detailed by a NCLB adequate yearly progress objective. Public schools are to test their students yearly in grades 3 through 8 in reading and math and show steady improvement in each grade in each subgroup (U.S. Department of Education, 2007a; Orlich, 2004).

The NCLB Act also requires each school to be judged on the achievement level of each subgroup with a minimum number of students determined by the states. If a school fails to make adequate yearly progress (AYP) in any subgroup, it is deemed "in need of improvement" and interventions must begin. If a school fails to make adequate yearly progress for two years in a row, students may move to another school in the system at the system's expense. If a school fails to make AYP for three years, the system must provide supplemental educational services such as tutoring from the school or private firms. After failing to make AYP for four years, the school must write a school improvement plan and after the 5th year, the school is to be reconstituted (Finn & Hess, 2004; U.S. Department of Education, 2007a).

High Stakes Testing

Assessment with important consequences for educators and students is known as high stakes assessment (Gunzenhauser, 2003; Marchant, 2004). According to Marchant (2004), "High-stakes tests are usually national or state-wide standardized achievement tests" (Marchant, 2004, p. 2). The American account of high stakes assessment is more challenging in comparison to other industrialized countries (Hess & Brigham, 2000). In setting high standards, some students will not be able to meet them and, therefore, will be denied diplomas. Heavier penalties are associated with testing such as evaluations of school personnel, student promotions, and limited local decision making with state funding. Yet, the U.S. debate assumes that all students will meet uniform standards (Hess & Brigham, 2000). According to Hess and Brigham (2000), the French and Japanese governments use their evaluations to sort students into vocational tracks. This translation of testing presupposes that not all students will achieve at a high level on the assessment (Hess & Brigham, 2000).

National or statewide standardized achievement tests are considered standardized if they have a set of policies for administering the assessment. All students taking the test follow the same directions and guidelines of testing time limits and resources. The tests target a specific grade level and are designed to allow for a distribution of scores (Marchant, 2004). With the process of taking a large standardized achievement test, there is no feedback on responses, which has limited potential for learning and pushes for a demonstration of students' knowledge and skill. Some educators argue that assessments should not be a one-time appraisal of student's performance. Instead, it should be a juncture to educate and improve student performance (Ruiz-Primo, Shavelson, Hamilton, & Klein, 2002).

Ruiz-Primo et al. (2002) proposed that in evaluating education reform on student achievement, assessment should include multiple levels and be multifaceted. It should move outward from what is central to the concepts being taught. Various tests should be used to measure all angles of knowledge such as declarative, procedural, and strategic knowledge (Ruiz-Primo et al., 2002).

With the current trend of testing, some researchers have found evidence that high-stakes testing is leading schools into a system where there is excessive importance placed on scores. Lowery (2000) suggests that these evaluation methods create false competitiveness and value comparisons by rank-ordering students according to their scores. In addition, the assessments lose their credibility as useful monitors when high stakes are attached (Gunzenhauser, 2003; Linn, 2000; Lowery, 2000).

Originally, standardized achievement tests were used to provide information for diagnostic and prescriptive teaching methods for individual students' ability level. With a push from policymakers to hold school systems more accountable for student performance, test scores were used to assign students to schools, special programs, and classes. Moreover, education agencies set standards for performance and distribute incentives and sanctions. While rules provided for rewards and recognitions for schools or education systems with high performance, the rules are also mandated interventions or even take over the administration of a school when student performance was considered to be below state standards (Marchant, 2004; Newmann et al., 1997).

Accountability

The majority of states indicate the purpose of state testing was to sustain the accountability. Accountability refers to the belief that schools and teachers should answer to the public regarding the academic achievement of students. Standardized accountability systems are predicated on the assumption that all students will learn a predetermined body of knowledge to a particular level of accomplishment (Frederiksen, 1984; Hess & Brigham, 2000).

Districts, states, and other agents external to schools, especially businesses and organizations of citizens and parents, have become increasingly concerned about establishing policies that will improve student performance. In this accountability system of feedback loops, schools provide information to these stakeholders. If the stakeholders have sufficient political or persuasive power, their reactions could alter school practices (Frederiksen, 1984; Hess & Brigham, 2000; Sutton, 2004).

Standards-based reform established state and local content as well as student achievement standards. As the standards were identified or adopted by a school or system, curriculum was developed to align with the standards and teachers were prepared and supported in order that they might provide a high level of instruction. Students' progress was determined through the use of state and district assessments using standards as the measurement criteria (Wehmeyer et al., 2004). With this arrangement, standards-based reform could contribute to student performance. Through curriculum alignment, students would have instructional programs aligned to the assessment (Thurlow, 2002).

State Mandates

With the passage of House Bill 72 by the Texas Legislature in 1984, a new beginning in the Texas public school accountability system was created. For the first time, the Texas legislation ordered a system of accountability primarily based on student performance. Student achievement became the basis for accountability in Texas rather than the processes of schools (Texas Education Agency, 1987). In 1993, the Texas Legislature enacted statutes that authorized the creation of the Texas public school accountability system to rate school districts and evaluate campuses. At the time, Texas already had the necessary supporting infrastructure in place to develop a practical and effective accountability system. This infrastructure included the Texas Assessment of Academic Skills (TAAS), a student-level data-collection system; a state-mandated curriculum; and a statewide assessment tied to the curriculum (Texas Education Agency, 2007e).

In 2001, No Child Left Behind was signed into law requiring all states to have standards in place by 2014. States were allowed to set and deign their own proficiency level for adequate yearly progress with 100% proficiency by 2014 (Orlich, 2004). The system that was generated with the 1993 Texas legislative session remained in effect through the 2001-2002 school year, but in 2003, a new assessment, the Texas Assessment of Knowledge and Skills (TAKS), was administered in Texas (Texas Education Agency, 2007e).

The TAKS assessed more subjects and grades and had increased difficulty compared to the previous statewide assessment. TAKS was designed to measure higher-order thinking skills and problem-solving ability. The Texas Assessment of Knowledge and Skills (TAKS) was first administered in the 2002-2003 school year. The TAKS measures the statewide curriculum in reading at grades 3-9; in writing at grades 4 and 7; in English Language Arts at grades 10 and 11; in mathematics at grades 3-11; in science at grades 5, 10, and 11; and social studies at grades 8, 10, and 11. The Spanish TAKS is administered at grades 3 through 6. Satisfactory performance on the TAKS at grade 11 is prerequisite to a high school diploma (Texas Education Agency, 2007e).

Ratings established using the newly designed TAKS system were first issued in the fall of 2004. Texas public school accountability ratings are primarily based on the percent of student passing rates on TAKS in reading, mathematics, and writing; the dropout rate; and the attendance rate. In examining schools' and districts' progress in meeting performance standards on TAKS and dropout rates, the state education agency considered all students and subpopulations, which included African American, Hispanic, White, and the economically disadvantaged. Districts and schools could receive any one of four classifications based on the Academic Excellence Indicator System (AEIS) report card (Texas Education Agency, 2007e). Those classifications are comprised of low-performing, acceptable, recognized, and exemplary. The TAKS standards for school accountability rating in 2007 as reported by the Texas Education Agency (TEA) were:

Exemplary – 90-100% passing for every subject

Recognized – 75-89.9% passing for every subject

Acceptable – 40%-74.9% passing varies by subject:

Reading/ELA, Writing, and Social Studies – At least 65% of the tested students pass the test

Mathematics – At least 45% of the tested students pass the test

Science- At least 40% of the tested students pass the test (Texas Education Agency, 2007e).

Every Texas public school receives a “report card” each year that identifies the campus rating, student performance on TAKS, and several other indicators of school improvement. Schools are largely rated on the results of the TAKS. Each year, schools are required to release and distribute the campus AEIS report to parents of students in the school (Texas Education Agency, 2007e). Students who attend schools rated as low-performing are able to request transfers to other schools and other school districts. In some situations, schools can be taken over by the state if low test scores put them on the unacceptable list. Both students and schools are held accountable for test results (Linn, Baker, & Betebenner, 2002; Orlich, 2004; Texas Education Agency, 2007e; U.S. Department of Education, 2007a).

High-stakes tests with consequences can motivate educational improvements, but it also puts the state in a position to classify students as “failures” (Hess & Brigham, 2000). Minority students, students who are considered to be economically disadvantaged, and children with disabilities have lower test scores than their counterparts (Eisner, 2001; Heck, 2006; Sanchez, Kellow, & Ye, 2000). In comparing schools at both the state and national levels, many argue that there is not an equal playing field (Acker-Hocevar & Touchton, 2002; Coley, 2001; Sanchez et al., 2000). Acker-Hocevar and Touchton (2002) wrote that many principals believed that schools should be compared only with schools sharing the same demographics and resources. In Texas, the Texas Education Agency (TEA) has established a cluster of campuses with similar demographics called the Campus Group. According to the Texas Education Agency (2007d),

> Each campus is in a unique comparison group of 40 other public schools (from anywhere in the state), that closely matches that campus on six characteristics. Comparison groups are provided so that schools can compare their performance to that of other schools with whom they are demographically similar. Comparison groups are also used for determining the Comparable Improvement Gold Performance Acknowledgments. (p. 5)

The Texas Legislature has been adamant on knowing whether students were achieving. Financial incentive systems for educators have been set up to reward schools with increased levels of academic performance. The Governor's Educator Excellence Award Program, also known as the Texas Educator Excellence Grant (TEEG) awards qualifying campuses a non-competitive grant. Schools are eligible for the grant through the criteria of percentage of educationally disadvantaged students and high levels of achievement or growth in student achievement. Based on the results of the spring 2006 administration of TAKS, 1,119 Texas elementary and secondary public schools received cash awards ranging from $40,000 to $300,000 (Texas Education Agency, 2006b).

Achievement Gaps

Through the Texas Educator Excellence Grant, there is a focus on the state's most economically disadvantaged campuses. Economically disadvantaged students, minority students, and low-performing students have been identified through NCLB as high priority in the efforts to close achievement gaps between non-minority, high performing, and advantaged students (U.S. Department of Education, 2007a). The notion that schools were failing to provide at-risk, disadvantaged, or poor students with the knowledge and skills to be successful catapulted our nation into standards-based reform

(Kersaint, Borman, Lee, & Boydston, 2001). With the passage of NCLB, came the national conception that the standards-based reform would leave no child left behind.

Standards reform ostensibly attempted to level the socioeconomic playing field so that all would have an equal opportunity for learning. These standards-based assessments stated what students needed to know, comprehend, understand, and be able to perform at each grade level regardless of demographics, background, or other personal characteristics. With standards-based reform, stakeholders expected improved student performance and instructional programs due to the fact that educators knew what curriculum needed to be taught and what tests revealed that students had previously learned (Thurlow, 2002). Hess and Brigham (2000) emphasized that "Statewide assessments have the potential to increase the equality of educational opportunities for students across school districts. Standardized assessments will dramatically reduce the inequities from different curricula being offered in different schools or even within different classes in the same school" (Hess & Brigham, 2000, p. 4). Standards-based assessment set the expectation that there is no excuse for lower expectations for certain groups of children. At the same time, NCLB stressed the expectation of high standards for all children (Thurlow, 2002).

NCLB increased categories of accountability that identified 12 subgroups that included (a) low-income students, (b) Whites, (c) Blacks, (d) Native Americans, (e) Hispanics, (f) Asians, (g) multiethnic students, (h) special education students, (i) English language learners, (j) migrants, (k) all students, and (l) all students except special education students (Orlich, 2004). According to Schwartz (2000), the achievement gap encompassed all levels between minority students and White students. Schwartz (2000) found that the maximum achievement gap between Hispanic and African American students and their White and Asian peers existed at the high achievement levels. Coley (2001) reported that Whites are far more likely than racial minority students to take college preparatory courses in high school and to complete college. The ERIC Digest (2000) reported that racial minority students are up to three times more likely to drop out of high school than their White peers. Olson (2002) emphasizes that “while researchers have proposed a variety of causes for the achievement gaps between minority and nonminority students and between rich and poor families, we need to understand the academic, social, and psychological consequences of dramatic gaps in opportunity structures” (Olson, 2002, p. 9).

Eisner (2001) explored urban student achievement using the Stanford Achievement Test Series, 9^{th} Edition, form T (SAT-9) assessment, the most commonly used standardized assessment among the major cities of the United States. This study investigated the achievement of 760,000 urban students in grades 2 to 11 in reading language, mathematics, problem solving, and science. Six out of ten urban students were African American or Hispanic, while in the national sample, six out of ten were in the White subgroup. Furthermore, two-thirds of the urban students were eligible for free lunch, in contrast to one-third nationally. Urban White students outperformed all other urban test-takers. Achievement gaps between White and non-White urban students were significant. In addition, this study found the greater the concentration of poverty in the school district, the lower the student achievement (Eisner, 2001). This study reiterated that troublesome gaps continue for English learner, Hispanics, and African Americans in our school system, and students from low income families continued to fall further behind their classmates.

Another study by Herman, Brown, and Baker (2000) found that in California after the first year of administering the SAT-9 assessment, overall student performance was low, especially for socioeconomically disadvantaged students. Sanchez, Kellow, and Ye (2000) compared SAT-9 subtest scores of students' grade, gender, and ethnicity across different educational programs such as special education and Title I. The study sample consisted of 144,700 students in grades 1 through 11 from public schools in a large city in the Southwest United States. Data analysis suggest that there were significant differences between scores by ethnicity and gender in all grades. Learning gaps were found among ethnic groups across both genders. White and Asian students had higher scores than Africa American and Hispanic students. Female students scored significantly lower than male students in reading, language, spelling, and math until 9^{th} grade. In science, male students generally scored higher than the female students (Sanchez et al., 2000).

High poverty, high-performing schools have demonstrated that the learning gap can be closed. Hilliard (2000) contends that teacher efficacy plays a vital role in school success. Teachers can spearhead powerful changes in raising the academic performance regardless of student race or economic background. Every individual in the school is aware of the school's mission. Each stakeholder works with each other to attain high performance levels (Hilliard, 2000).

In another study of high poverty, high-performing school districts, Skrla and Scheurich (2001) investigated four large and medium-size Texas school districts that ranged from 8,000 to 50,000 student population and demonstrated significant improvement on Texas state achievement tests for children of color and children from low-income homes. The districts included in the study were (a) Aldine, (b) Brazosport, (c) San Benito, and (d) Wichita Falls. Through their investigation, Skrla and Scheurich (2001) determined that high poverty high-performing schools have high expectations and are grounded in the belief that all students can learn and excel. These districts had closed achievement gaps between the performance of these children and that of White, middle-class students. In addition, the districts studied were selected on improvements in academic performance for all student groups. All districts selected with the exception of one Exemplary district, achieved a rating of Recognized. Skrla and Scheurich (2001) found that the accountability factor helped move these districts in a more successful position by (a) making “educational inequity visible” (p. 243); (b) reducing the “risks for superintendents” (p. 247); (c) forcing “superintendents to seek exemplars” (p. 249) and become the instructional leader; (d) developing “antideficit leadership orientations” (p. 251); and (e) driving “successively higher expectations” (p. 254).

In order to close the achievement gap, schools must be ready for the cultural diversity and learning challenges that non-English speaking students present. According to Downey et al. (2002), “Even after adoption and implementation of programs, too seldom does the educational institution conduct its own research to determine if the program is meeting the need it was designated to address” (p. 86). Using good research for program selections is one strategy to assist school administrators in preventing unsuitable selections of program alternatives. In regard to English language learners, Downey et al. (2002) asserted that it is imperative that learning institutions use effective programs and strategies for working with students whose primary language is not English to focus on vocabulary development and reading comprehension. Several recommendations were emphasized to decrease the achievement gaps. The recommendations included (a) increase teacher training, (b) increase the number of students who accept and are eager to help ELL (English language learners) students, (c) improve parent outreach, and (d) increase the understanding among staff that a limited ability to speak and write in English does not reflect a student's intelligence.

Science Literacy

Minorities in Science

As America confronts the achievement gap that is one of the most intractable problems facing our public schools and our society, math and science consistently prove to be areas of concern for minorities. According to Barton (2003), just 20% of White 12th graders and only 4% of Hispanic 12th graders reach the "proficient" level (as defined by the National Assessment of Educational Progress) in mathematics; students below this level are not likely candidates for science and engineering. Barton (2003) continued to stress that there is an interconnectedness in meeting the need for better science and mathematics instruction and for more equality in the preparation and representation of minority populations in these professionals (Barton, 2003).

In Texas, evidence of this inequality in science achievement begins at the elementary level where there has been disparity between student achievement among ethnic groups in science. In reviewing the 5th grade Science TAKS scores as compared to against math and reading scores, math scores have been steadily higher than both reading and science. When compared with reading, science scores consistently fell anywhere from 5 percentage points lower in 2003 to 14 percentage points lower in 2006. In 2007, the passing rate for reading was 89% passing for 5th grade students, Math had a passing rate of 90%, while science again ranked last with a 77% passing rate. In reviewing the ethnic groups, the White population had the greatest passing rate in all subjects compared to the other subgroups. In math, the White population had a passing rate of 96%, followed by Hispanics with an 89% passing rate, a difference of 7 percentage points, African Americans were the lowest with a passing rate of 83%, a difference of 13 points. Both Hispanics and African Americans scored 11 points lower in math than the White students. In Science, which has the largest discrepancies of all subjects, White students scored at a 90% passing rate, Hispanics were 20 points behind with a 70% passing rate, while African Americans fell even further by 26 points with a 64% passing rate (Texas Education Agency, 2007a). Table 1 displays the results of all students who met TAKS standards from 2003 to 2007 in the subjects of math, reading, and science in Texas.

Table 1. Results of the Percentages of All Students Who Met TAKS Standards From 2003 to 2007 in Math, Reading, and Science in Texas

		Percentages				
Subject	Students	2003	2004	2005	2006	2007
Math	All	86	82	79	90	90
	White	93	90	89	96	96
	Hispanic	82	76	74	87	89
	African American	74	69	64	80	83
Reading	All	79	79	75	88	89
	White	89	90	88	96	96
	Hispanic	73	71	66	83	85
	African American	69	70	64	80	85
Science	All	74	69	64	74	77
	White	87	84	79	88	90
	Hispanic	65	60	54	68	70
	African American	59	52	46	61	64

Starting early is society's best chance at increasing achievement in science. Barton (2003) points out that early childhood development and education will provide a more equal starting point, because disparities in racial-ethnic groups are already set before young children enter school. He states that the longer the delay in initiatives to reduce inequality of achievement in grade school and high school, the less effective the efforts will be and the smaller the gains. In addition, expenses go up the higher the grade level in which an initiative is begun. Early intervention is critical to all goals for educational achievement and for the economy and nation as a whole (Barton, 2003).

While the discrepancies in science achievement begin early, the inconsistency in scores between ethnic groups in science is not a new problem. Barton (2003) explains "The roots of unequal achievement are deep in the American economy and society" (p. 20). In 1990, the National Assessment for Educational Progress (NAEP) shared highlights of their Science Report Card. Alexander (1992) notes that in the NAEP assessments at grades 4, 8, and 12, large disparities in science proficiency existed between White and Asian/Pacific Islander students and their Black and Hispanic counterparts. These differences occurred in each of the four content areas covered by the NAEP science assessment – the life sciences, physical sciences, earth and space sciences, and the nature of science. In addition, NAEP found that schools did not place a special priority on science, especially in 4th grade. Fewer than half of the 4th graders attended elementary schools that placed a special priority on science and only half of the 4th graders reported having instruction in science almost every day, and fewer than one-third of 12th graders attended high schools that did so (Alexander, 1992).

Although nationally in 2005, science scores rose for all student groups at the elementary level, gaps continued to exist between ethnic groups (Grigg et al., 2006). The gaps between 4th grade White and Black students have decreased since 1996 and 2000 from the 2005 science scores. The 2005 science scores also revealed gaps between 4th grade White and Hispanic students since 2000. According to Grigg et al. (2006), 35 out of the 37 states that participated in their study between 2000 and 2005 had a score gap between White and Black students that remained unaltered. While the national results showed an increase in the average science scores from 1996 to 2000 at grade 4, there was no significant change at the 8th grade level, and a decline at 12th grade (Grigg et al., 2006).

Minorities continue to struggle in science testing and Planty, Provasnik, and Daniel (2007) found that had fallen behind in completing advanced science courses as well. With requirements for earning a high school diploma becoming more rigorous with the articulation of *A Nation at Risk*, there was an increase in the rates at which students accrue course credits. The New Basics recommendations called for all high school students to complete four years of English; three years each of mathematics, science, and social studies; and a half-year of computer science. Planty et al. (2007) point out that in 2007, 23 states required three or more years of science resulting in more students taking advanced courses in science, specifically chemistry and physics. Asian/Pacific Islander graduates were more likely in 2004 to complete advanced courses in science than any other race/ethnicity. Following Asians/Pacific Islanders, Whites were more likely than Blacks, Hispanics, and American Indians to have completed advanced science and mathematics courses in 1998, 2000, and 2004 (Planty et al., 2007; Texas Education Agency, 2007b).

Although Advanced Placement Programs in science at the secondary level have been recognized nationally as a method of promoting educational excellence and limited to secondary instruction, U.S. elementary students performed better in comparison to their international peers than U.S. secondary students (College Board, 2004; National Research Council, 2007). Both national and international elementary students in the United States scored satisfactory in science, while secondary students continue to need improvement. At the international level, according to the Third International Mathematics and Science Study (TIMSS), the 4th grade students performed well and were outperformed by only one country (National Research Council, 2007). Nationwide, 4th grade students' science scores have increased in previous assessment years. From 2000-2005, African Americans and Hispanic students' science scores progressed, and the gaps between White and African Americans and White and Hispanic students decreased. In comparison to other states, Texas students were parallel at all achievement levels: (a) basic, (b) proficient and (c) advanced (Grigg et al., 2006). Conversely, the overall performance of our nation's 12th graders has declined since 1996. Furthermore, the score gap between White and African Americans and White and Hispanics did not narrow between 1996 and 2005 (Grigg et al., 2006).

Frequency of Science Testing

Although achievement gaps have created a sense of urgency to focus on science, standard-based reforms, arising from national and state mandates, which have been constructed to improve science education have not been successful. The No Child Left behind Act of 2001 was created to set demanding accountability standards to challenge failing schools (U.S. Department of Education, 2007a). Under No Child Left Behind, schools are required to: (a) use research-based instructional and assessment methods; (b) to form partnerships with universities, colleges, community organizations, businesses, museums, and science centers; (c) to fill classrooms with highly qualified teachers; and (d) to measure the progress of students each year in grades 3 through 5 at the elementary level (Linn et al., 2002; U.S. Department of Education, 2007a). Although the state of

Texas has had science assessment in place for 5th grade students since 2003 through the Texas Assessment in Knowledge and Skills, the federal government will include a science assessment for the first time in the 2007-2008 school year in order to determine a campus' Adequate Yearly Progress (Texas Education Agency, 2007b; U.S. Department of Education, 2007a). According to DeBoer (2000), state and federal agencies have created and identified content standards in order to define science programs.

As a whole, because of the infrequency in science testing in comparison to math and reading, science both at the state and national levels has not been a main concern for students or educators. Texas did not include the subject of science at the elementary levels in state assessments until 2003. In 2007 and 2008 for the subject of science, Texas accountability standards required that all students and groups have a 40% passing rate in 2007 and 45% passing rate in 2008 in order to be an academically acceptable campus, 75% passing rate in order to be a recognized campus, and 90% for an Exemplary rating. Under NCLB, the adequate yearly progress (AYP) performance standards for all students and groups did not include science in order to meet AYP. Reading/English language arts and math are the only subjects that AYP addressed for AYP performance standards.

In addition, policies have been enacted requiring promotion based on student test performance. In an effort to end social promotion, Texas Education Code § 28.0211 requires that every 5th grader must demonstrate proficiency in the subjects of reading and mathematics test in order to be promoted to the 6th grade. Also, every 3rd grade student must demonstrate proficiency in reading in order to advance to the 4th grade level (Texas Education Code, 2007). Children at these grade levels have three attempts to be successful. This law is called the Student Success Initiative and originated with the 76th Legislature in the Texas Reading Initiative. TEA explains that the purpose of this law is to make sure students in these grade levels have the reading and mathematic skills necessary to be successful in school (Texas Education Agency, 2007f). Science is tested once at the elementary level in 5th grade. Proficiency on the Science TAKS is not required for promotion in 5th grade (Texas Education Agency, 2007e).

According to Frederiksen (1984), the behavior of students and teachers can be influenced by any subject tested when known beforehand, because students want to earn acceptable grades and teachers want their students to do well. Tests tend to increase the time and effort spent in learning and teaching what the tests measure and decrease efforts to learn and teach skills not measured by the test (Frederiksen, 1984). Throughout educational history, science has not been a consistent focus in comparison to core academics such as reading, writing, and arithmetic (DeBoer, 2000).

DeBoer (2000) suggests that although the subject has been recognized as one that would provide intellectual training at the highest level through the inductive process of observation and drawing conclusions, public attitude toward science has fluctuated historically. He points out that in the 1930's, educators recognized that science affected nature and personal lives. After World War II, DeBoer (2000) asserted that public attitudes shifted with the realization that scientific developments had the potential to devastate society and be the end of the "human enterprise." From the launch of Sputnik in 1957, science education was viewed as a necessary course for national security. United States citizens were concerned that America would become a second-rate power.

The urgency for scientific literacy increased with the report, *A Nation at Risk: The Imperative for Educational Reform* in 1983. According to DeBoer (2000):

> The report argued that academic standards had fallen in the U.S. as evidenced by the embarrassingly low test scores of American youth, especially in math and science and that this poor academic performance was the cause of our declining economic position in the world. (p. 589)

In 1990, President Bush released The National Education Goals in the State of the Union address. He presented Goal 4: “By the year 2000, U.S. students will be first in the world in science and mathematics achievement” (National Research Council, 2007, p. 129).

Success in other countries has prompted the U.S. government offices to support the standards movement as a means of school reform, yet science standards continue to be neglected. Instructional time for science in grades kindergarten through eight is losing out to basic subjects such as math, reading, and writing and to time spent teaching test-taking skills. With teachers feeling obligated to teach-to-the test, there is little reason to believe that science instructional time will increase when it is added as a subject in many standardized testing situations (Amrein & Berliner, 2003; Marchant, 2004).

National Focus on Science for a Scientific Literate Society

The NCLB was created to address challenges felt by American citizens that schools were failing and to produce the type of science-educated citizens that America needed for leadership in the economic global community and for the security of the country. Government officials at the national, state, and local levels responded to pressure from their constituency (DeBoer, 2000). The emerging mandates of measuring students' progress in science under No Child Left Behind Act makes the topic of reforming science education even more pressing. DeBoer (2000) wrote that science education should be applicable to contemporary life and that all members of society should understand the world around them so that each individual could contribute to society. He emphasized that not only should the individual, positive, reform, and societal building components of science be understood but that the public needed the skills and understanding to make judgments about the risks associated with science. In an effort to increase the public's understanding of science, the American Association for the Advancement of Science (1989) instigated Project 2061 with the goal to develop for all American citizens a high level of scientific literacy. The Association writes "Scientific literacy – which embraces science, mathematics, and technology – has emerged as a central goal of education" (AAAS, 1989, p. 3). Project 2061 involved a three-phase plan of focused collaborative action that would contribute to the reform of education in science by developing curriculum models for the use of school districts and states and focusing on the substance of scientific literacy (AAAS, 1989).

The goal of a scientifically literate society influences policies and curricular changes in science. The National Science Education Standards stated that students were scientifically literate when they were able to use their knowledge and understanding of the concepts and processes relevant to science to make personal decisions, participate in civic and cultural affairs, and be economically productive (National Research Council, 1997). The American Association for the Advancement of Science (1989) argued the need for scientific literacy as follows:

1. Science is able to provide humanity with the knowledge of the biophysical environment and of social behavior that it needs to develop effective solutions to its global and local problems: without that knowledge, progress toward a safe world will be unnecessarily handicapped.

2. By emphasizing and explaining the dependency of living things on each other and on the physical environment, science fosters the kind of intelligent respect for nature that should inform decisions on the uses of technology; without that respect, we are in danger of recklessly destroying our life-supported system.

3. Although many pressing global and local problems have technological origins, technology provides the tools for dealing with such problems, and the instruments for generating, through science, crucial new knowledge; without the continuous development and creative use of new technologies, society will limit its capacity for survival and for working toward a world in which the human species is at peace with itself and its environment. (pp. 12-13)

Science Curriculum and How It Is Taught

DeBoer (2000) believes the best route to scientific literacy relies heavily on educators and involves community. He suggested that educators should provide guidance, offer suggestions about curriculum and pedagogy, and prepare instructional resources that can be used to address the various goals of science teaching. DeBoer (2000) continued to explain that teachers should act according to the highest standards of their profession. They should utilize established principles of student learning and dialogue honestly among the science education community in order to identify appropriate curriculum. Through honest discourse, intelligent choices are made based on obtaining rich resources for the curriculum not based on the goal of high test scores.

The American Association for the Advancement of Science and the National Research Council of the National Academy of Sciences has set out Science content standards. These standards have been replicated and adapted by many individual states and school districts (Schmidt & Valverde, 1998).

Settlage and Meadows (2002), however, explained that standards-based educational reform has had several negative effects from standardized testing. One effect they illustrated is the lack of power educators have over the curriculum. Teachers find themselves in a disparate instruction based on predicted individual test performance, limited resources, and time. This can lead to a triage mentality where instructors sort students into categories: (a) likely to pass the tests with no intervention; (b) unlikely to pass the tests regardless of intervention; and (c) potentially able to pass the tests if intervention is applied (Settlage & Meadows, 2002). In reviewing systemic science education reform that was based upon an accountability system, concerns on standards-based educational reform and science included linguistics and cultural diversity (Lynch, 2001). A goal of science education reform has been to close achievement gaps among the underserved that included linguistically and culturally diverse students. Lynch (2001) argued that reform has not reduced achievement gaps overall in the U.S., and despite systemic science education interventions, overall achievement in science has remained flat.

Even though they can be problematic, assessments in science education are essential in properly evaluating students and curriculum. According to Lowery (2000), assessment of students at the elementary levels should be established around the following five principles: (a) its purpose should be to direct a data driven curriculum based on clearly stated measurements and outcomes; (b) its results should be compared to standard of "opportunity to learn" and should reflect students' knowledge, skills and knowledge of the teachers, the school's program and policies, and equipment and community involvement; (c) its data should be valid, reliable, and authentic; (d) it should accommodate diversity of students and be free of stereotypes and bias; and (e) it should be used to make decisions about programs, courses, and students while teachers keep in mind the inaccuracies, weaknesses, assumptions, and strengths of all assessment practices.

Levitt (2001) explains that learning science was more a process of adjusting one's prior conceptions rather than planting ones that did not previously exist. Students do not merely add to their knowledge in science; they also change what they already know. In addition, Levitt recognized that teachers believe that teaching and learning science should be student centered and that their beliefs moved education more toward science education reform. Educators are recognized as the central determining factor in successful implementation of reform in science education (Levitt, 2001).

Science methods used by educators are under scrutiny when evaluating implementation of reform. The National Research Council (2007) argued that the teaching approaches currently used are insufficient to introduce students on a path of participation in a society infused with job opportunities in scientific and technical fields. Science standards that have instigated reforms are broad. In order to be proficient in science, there should be an understanding of scientific ideas and students should demonstrate a firm grasp of scientific practices. The National Science Teacher Association (NSTA) recommended that the program of study emphasize student understanding through inquiry. Inquiry is the uniting strand that binds courses from elementary through high school together. It includes searching, organizing, experimenting, and communicating. Educators should give all students opportunities to engage in and reflect on natural phenomena through the process of inquiry. With the philosophy that every child has nonstop curiosity, it is the belief of NSTA that every child is born a scientist and the challenge science educators have is keeping that curiosity alive (NSTA, 2000).

In order to maintain and expand students' natural curiosity, the National Research Council (2007), stated that students should (a) know, use, and interpret scientific explanations of the natural world; (b) generate and evaluate scientific evidences and explanations; (c) understand the nature and development of scientific knowledge; and finally, (d) students' work should actively participate in scientific practices and discourse. It was further recommended that science instruction provide opportunities for students to interact in all four strands of science proficiency. Students should have an active role in building their own knowledge and understanding. The Texas Education Agency (2004) suggested that exploration, through concrete experiences at the elementary levels, would prepare students for the study of science concepts in greater depth at middle and high school. Therefore, it is necessary that policymakers, education leaders, and school administrators ensure adequate time and resources are provided for science instruction at all grade levels for all children. In addition, teachers should have opportunities to deepen their knowledge of the science content of the K-8 curriculum and be provided with adequate professional development (National Research Council, 2007; Texas Education Agency, 2004).

Recommendation 2 of *Taking Science to School: Learning and Teaching Science in Grades K-8,* a report from the National Research Council (2007), stresses that the next generation of standards and curricula both nationally and at state levels should be structured to identify a few core ideas in science and elaborate how those ideas can be cumulatively developed over grades K-8. The National Research Council reasons that core ideas should be both foundational in terms of connection to many related scientific concepts and have the potential for sustained exploration at increasingly sophisticated levels across grades K-8. This action will aim to eliminate ideas that are not central to the development of science understanding and will clearly identify the knowledge and practices that can be developed in science education at all grade levels (National Research Council, 2007).

According to Schoonmaker (1998), a teacher's personal understanding and beliefs of science are vital to the success of learning in the classroom. The teacher can be the change agent of learning through curriculum. Decisions science educators make in the classroom such as the lesson, the focus, and what is important or not, will be based on his or her personal and individual ideas related to what is worth knowing and how children learn. Schoonmaker further asserts that recognition of the power of personal knowledge is significant because all learning "passes through the individual's mental and emotional filters" (p. 585). This personal awareness can be used as a basis for comprehending how the individual teacher has constructed his or her understanding of science and science teaching.

In working on a campus, a teacher's personal understanding of science interacts with campus, student, and curriculum goals. As illustrated in *Pathways* from the National Science Teacher Association, the National Science Education Standards challenge school systems to design science programs with consistent goals for student-learning throughout the grade levels. One approach is to emphasize "real-world applications and societal implications to tie coursework together across the grades" (NSTA, 2000, p. 113).

Efforts from the Department of Education and National Science foundations in the development of the National Science Education Standards were published in December of 1995. The science standards provide a descriptive vision of science for all students in all grades. Standards for Professional Development for Teachers of Science Professional Development Standard D state that professional development programs for science educators must be coherent and integrated. According to Lowery (2000), quality preservice and inservice programs are characterized by

> (a) clear, shared goals based on a vision of science learning, teaching, and teacher development congruent with the National Science Education Standards;
>
> (b) integration and coordination of the program components so that understanding and ability can be built over time, reinforced continuously, and practiced in a variety of situations;
>
> (c) options that recognize the developmental nature of teacher professional growth and individual and group interests, as well as the needs of teachers who have varying degrees of experience, professional expertise, and proficiency;

> (d) collaboration among the people involved in programs, including teachers, teacher educators, teacher unions, scientists, administrators, policymakers, members of professional and scientific organizations, parents, and businesspeople, with clear respect for the perspectives and expertise of each;
>
> (e) recognition of the history, culture, and organization of the school environment; and (f) continuous program assessment that captures the perspectives of all those involved uses a variety of strategies, focuses on the process and effects of the program, and feeds directly into program improvement and evaluation. (p. 133)

Although standards for quality professional development include collaboration and coherence among science educators, this standard continues to be an area of weakness in education. A criticism in science education is that science education fails to link concepts within a single year and from grade-to-grade (NSTA, 2000). The image that TIMSS data draws is a nation that does not have a coherent, focused, and rigorous science curriculum that provides all students with a reasonable chance to learn to their potential (Schmidt & Valverde, 1998). In Texas, however, it is an expectation that

> All educators should work together to align the curriculum across all grade levels so that unifying themes (strands) of learning are reinforced. The Texas Essential Knowledge and Skills instruction throughout elementary and middle school will lay the foundation for biology, chemistry, physics, and earth science concepts taught in the high school. (Texas Education Agency, 2004, p. 5)

In reviewing standards globally, TIMSS discovered that in grades 1 through 3 in the United States they had nearly seven times the number of science topics as typically intended in the TIMSS countries that outperformed the U.S. (Schmidt & Valverde, 1998). Standards that transcended local boundaries were common in most TIMSS countries and were present in all countries outperforming the United States. Schmidt and Valverde (1998) emphasized that most countries have consensus on the question of basics grade-by-grade that results in producing a coherent vision to guide their systems. The overall structures included topic focus through the years with rigor built in incrementally and with the sequencing of the topics stemming from the coherence of the disciplines. In creating the coherence of that vision, educators expressed the need for priorities, sequences, and conceptual links among topics and experiences within disciplines. Perhaps more importantly, teachers observed a need for those items across the various science disciplines (Schmidt & Valverde, 1998).

Teacher Teaming

Teacher Collaboration

A strategy commonly used in countries that are successful in science is creating a clearly articulated vision in standards (Schmidt & Valverde, 1998). This coherent practice has been used in cooperation with collective leadership in science to ultimately effect student learning. In addition, the synergistic design of a teacher work group proposes collective dialoging among professionals in education specifically to achieve their goals (Hoy & Hannum, 1997). Through school restructuring initiatives in reaction to the 1983 report, *A Nation at Risk: The Imperative for Educational Reform* and currently No Child Left Behind Act (NCLB) of 2001, educators have been introduced to a new style of working (Newmann et al., 1997; Stewart, 2006). Teacher involvement strategies were among the most popular products of the reform (Crow & Pounder, 2000). These new strategies increased opportunities for teacher collaboration and team learning in elementary and middle schools. The formation of grade level teams of teachers was one of those strategies (Senge et al., 2000). According to Senge (1990), team learning is an alternative to traditional management that results in a learning organization. A learning organization is where “people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together” (Senge, 1990, p. 3).

Teacher work groups and teacher teams are learning organizations. Crow and Pounder (2000) explain that “Teacher work groups or teams are designed to create work interdependence and increased self-management, increasing members’ responsibility for the group’s performance and outcomes” (p. 217). Pounder (1999) declares that teaming also recognizes the complexity of the instructional process. There is an acknowledging that individual teachers and groups are interdependent in obtaining educational goals for students and creating a school community (Pounder, 1999). Somech (2005) found that teachers who work collaboratively in structured teams and develop a shared belief in team effectiveness have a greater sense of identification with the objectives of their school.

The development of effective teams is an evolutionary process. Hackmann et al. (2002) noted that some campuses attempted to “provide teachers of exploratory subjects with common planning time so they can interact as a team and enhance the curricular connections among their disciplines” (p. 39). In reviewing team planning, many researchers suggested that in order to promote effective school structures, team planning time was a non-negotiable. Flowers (2000) emphasized that research has demonstrated that teams with high levels of team and individual preparation time more frequently integrated classroom instruction across disciplines (Flowers, 2000) and experience the largest gains in student achievement scores (Flowers et al., 1999). In addition, teams that met at least two hours per week registered higher levels of job satisfaction than nonteaming teachers (Flowers et al., 1999). Fully practicing teaming that promotes student achievement is an extensive and time-intensive process (Hackman et al., 2002).

Effective teams traditionally have positive outcomes such as high team empowerment. Somech (2005) found that team empowerment is positively associated with performance and organizational commitment and has no significant link with professional commitment. Teachers working collaboratively with colleagues in structured teams that shared a belief that their team could be effective had a greater sense of belonging and identification with the objectives of their school (Somech, 2005). Conversely, Zigarelli (1996) found that achievement-oriented school cultures were positively correlated to student performance when there was no evidence found that teacher empowerment or teacher education level were related to student performance.

Collaboration and teaming also play an important role in school culture and at the state level, in the selection of recipients for the Governor’s Educator Excellence Award Program in Texas. This non-competitive grant known as the Texas Educator Excellence Grant provides a financial incentive system for educators for increased student academic achievement. Collaborating with other teachers on the campus to improve achievement is included in the criteria and is an objective for the grant. The teacher must have had a record of collaborating with faculty and staff that contributed to improving overall campus student achievement. Another criterion for the grant is teacher behavior through collaboration that included team teaching and other activities related to collaboration with teachers (Texas Education Agency, 2006b).

An internal accountability among collaborating educators can override external accountability. According to Newmann et al. (1997), not all school performance is linked to external accountability or agencies that are external to the school. On some campuses, Newmann et al. (1997) found that essential components of accountability were generated largely within the school staff. Staff identified clear standards for student performance, collected information to inform themselves about their levels of success, and exerted strong peer pressure within the faculty to meet goals. In some schools, strong internal accountability was accompanied by compatible external accountability; but in others, internal accountability existed without, or even in opposition to, external accountability requirements (Newmann et al., 1997). In their study, Newmann et al. (1997) observed that building a collective conscious must be associated with standards of internal accountability.

The efficacy of reform efforts largely rests with teachers; therefore, their voices need to be included in the design and implementation of the curriculum and curriculum alignment, which is the “congruence of all the elements of a school curriculum—the curriculum goals, the instructional program (what is taught and the materials used), and the tests used to judge outcomes” (Crowell & Tissot, 1986, p. 2). Teachers have identified curriculum, instruction, and assessment alignment as a major goal for vertical teaming initiative (Bertrand, Roberts, & Buchanan, 2006). There are so many components in the education system that it is easy for educators to feel powerless, yet teachers are encouraged to take a lesson from modern mathematical chaos theory. This theory states “when a single butterfly flaps its wings, air currents around the world are affected” (NSTA, 2000, pp. 120-121). In the same manner, each contribution no matter how small influences the whole.

Vertical Teaming

The system of school accountability is overly complex to be approached by individual teachers. It is through the vertical collaborative efforts of the educators that curriculum is linked and best practices are shared (Bertrand et al., 2006). Vertical teaming has been recognized as an approach used by educators to increase student achievement through discussion of the standards and how different teachers teach the standards at each grade level (Bertrand et al., 2006; Kowal, 2002; Wheelan & Kesselring, 2005).

Piland (1981) identified vertical teaming at the college level as a group of faculty members who teach a block of students in certain general courses. The faculty would plan their instructional activities together and build on the student learning experiences in each course. Through this process, the faculty members would demonstrate relationships and differences between disciplines (Piland, 1981).

Kowal (2002) defined a vertical team in association with K-12 curriculum as “a group of educators (teachers, counselors, administrators) from different grade levels who work together to develop a curriculum that provides a seamless transition from grade to grade” (Kowal, 2002, p. 1). According to Kowal (2002), vertical teams work in each subject area to articulate the curriculum. By consistently monitoring the articulation, teachers are able to make changes when they notice gaps or overlaps. Additionally, networking provides a support system that decreases teachers' feelings of isolation (Kowal, 2002).

Research on teaming at the elementary level indicated favorable outcomes for student performance. Wheelan and Kesselring (2005) explored the relationship between perceived effectiveness of elementary school faculty groups as a whole and student performances on standardized tests. Vertical teams were one of the types of teams that were included in the study. In their research, Wheelan and Kesselring (2005) examined the developmental levels of the work groups of 61 elementary schools with data regarding the passing rates of the Ohio Fourth Grade Proficiency Test. They found that through the collaboration of faculty members to become more trusting, cooperative and work oriented, student performance would be positively affected (Wheelan & Kesselring, 2005).

Research specifically addressing secondary vertical teams has implications for vertical team characteristics and outcomes. For example, Bertrand et al. (2006) researched a vertical team initiative and the impact the initiative had on school improvement efforts in a Southeast Missouri public school district. The population for the study consisted of 63 secondary teachers from grades 6 through grade 12. Through an open-ended survey, the teachers' perspectives were collected and analyzed. Bertrand et al. (2006) discovered five emerging themes relative to the impact of the vertical teaming initiative. The themes included: (a) collaborative teaming, (b) professional development/continuous learning, (c) data/results oriented, (d) alignment of curriculum and benchmark assessments, and (e) shared vision and beliefs.

The five themes that Bertrand et al. (2006) identified include the following descriptions. “The first theme, the idea of professional development, was perceived by the teachers as a means of continuous learning as they worked toward accomplishing their goals” (Bertrand et al., 2006, p. 4). Through the second theme, collaborative teaming, teachers were able to build on each other’s strengths as they shared ideas and strategies they were using in the classroom by meeting both in horizontal and vertical teams. The third theme, data/results oriented, allowed most of the educators to place a major focus on collecting and analyzing data. The fourth theme (curriculum, instruction, and assessment alignment) demonstrated that as the vertical teaming initiative was being implemented, the relationship between learning goals, instructional activities, and student assessment appeared to be emerging. Finally, in the last theme (shared vision and beliefs) teachers voiced their belief that high expectations of students led to increased student achievement. In addition, the educators explained that through vertical teaming, they had a shared vision that “stemmed from the collective understanding of both the purpose of the vertical team initiative and the benefits the practice has had on school improvement efforts” (Bertrand et al., 2006, p. 6).

Vertical teaming has surfaced in research attempting to seek solutions to close the achievement gap. Kremen and Kremen (2001) studied 118 schools within the eight counties that comprise California’s Central Valley. Those counties included (a) Kern, (b) Tulare, (c) Fresno, (d) Kings, (e) Madera, (f) Merced, (g) San Joaquin, and (h)

Stanislaus. The purpose of the study was to describe the many combinations of educational theory and application that were being implemented throughout the Central Valley of California to close the achievement gap by improving the achievement of students in the lowest quartile. The results of the phone surveys and reports from the site visits made up the majority of the report. Forty-two percent of the principals surveyed identified curriculum articulation as an area of focus. Their concerns included promoting better horizontal articulation, grade level meetings. Additionally, they spoke about vertical articulation, communication up and down the grade levels at their school. The principals expressed a sense of urgency for curriculum articulation. They believed that their schools' test scores could be greatly enhanced if they simply taught to the test/standards better (Kremen & Kremen, 2001).

Science Vertical Teaming

Coordinating teaching efforts through vertical cooperation of teachers working together contributed to the concept that science courses should not be isolated from an established curriculum. According to *The AP Vertical Teams Guide for Science*, an AP Vertical Team "is a groups of educators in a given discipline from different grade levels, including middle school teachers, who work cooperatively to develop a vertically aligned program that is anchored in the Advanced Placement Program" (College Board, 2004, p. 1). This idea illustrated that high-level science courses should not be isolated from an established curriculum. A carefully planned program, teaching skills, and concepts over many years, can prepare students for challenging science courses. It is the belief of the College Board (2004) that a planned program is best achieved by vertical cooperation of teachers working together to coordinate their teaching efforts. A goal of a successful vertical team in science is development of a continuum for skill building from one grade level to the next. The team communication leads to a better understanding of what has been taught in preceding years. This communication helps teachers organize strategies to reduce repetition and allows them to encourage students to apply past instruction to new and more challenging material (College Board, 2004).

Educators recognized the importance of previous instruction for the success of a student in science. The College Board (2004) asserts that in establishing a vertical team in science, attention must be given in structuring the dialogue among teachers into a series of useful meetings in order to plan curriculum that best addresses the needs of their students. Each teacher on the team should be able to attend to the science goals in an individual style with freedom to select specific materials and classroom methods. In order to share a common vision, the team should begin by meeting and identifying the standards and expectations. Team members select a vertical team leader who can be a grade level teacher, department chair, or an AP teacher (College Board, 2004).

According to the TIMSS, “U.S. science curricula lack focus and are poorly designed” (National Research Council, 2007, p. 16). Teachers repeated the same material year after year without exploring any topic in greater depth or detail when they were uncertain about what has been addressed in previous courses. Accordingly, students rarely explored any topic in a deep and challenging fashion (National Research Council, 2007). The College Board believes that vertical teams can help schools address these major issues in science education. By promoting vertical articulation of a curriculum linked to the standards and expectations associated with AP science courses, an AP vertical team in science gives coherence and direction to the overall science curriculum (College Board, 2004). The vertical teaming approach creates collaboration that has been lacking for years (Senge et al., 2000).

With the increased coordination that vertical teaming supplied, administrators, teachers, and students developed a clearer vision of how the curriculum unfolded, enhancing their ability to understand its objectives (Bertrand et al., 2006; College Board, 2004). By coordinating efforts, members of a vertical team in science could reinforce student understanding of principles by ensuring that content, issues, and topics were introduced in early grades and then revisited in greater depth in later grades. A well-designed vertical curriculum should carefully sequence and coordinate activities within and between courses (College Board, 2004; Downey et al., 2002; English & Steffy, 2001). Together they shape a “synergistic system (with mutual support between different aspects of instruction) for helping students learn higher-level thinking skills” (College Board, 2004, p. 17). In addition to introducing new material grade-by-grade and course-by-course, a vertical team builds upon previous material by repeating important ideas or illustrating different experiences or the same experience in a different context (Bertrand et al., 2006; College Board, 2004). Each teacher will choose to illustrate these themes with examples that are pertinent and familiar to students. The College Board (2004) pointed out that the process fosters the development of an educational community committed to the performance of all students.

By carefully planning the curriculum, members of the team can help close gaps in student understanding, provide frequent encouragement with difficult material, and better prepare all students (College Board, 2004; Downey et al., 2002; English & Steffy, 2001). Some of the advantages of vertical alignment include (a) empowering teachers who participate, (b) stimulating students, (c) increasing communication among teachers, and (d) decreasing the feelings of isolation some teachers experience (College Board, 2004). This practice serves as a reminder that everyone’s efforts play essential roles in students’ long-term success in science.

Downey et al. (2002) stressed that for campuses with low-performing scores on state assessments, “it is absolutely imperative that the school back-load from the external test deeply” (p. 17). Superficial alignment occurs when state test items are deconstructed and curriculum objectives are developed that mirror the content, context, and cognitive level of the test items. With superficial alignment, the teacher should know exactly what the assessment items look like. “The process for deep alignment involves broadening the content to a reasonable range of learning; using alternative ways of assessing the expanded content; and moving the cognitive level to higher levels” (Downey et al., 2002, p. 17). Downey et al. (2002) asserted that the greater degree that one or more of these areas are expanded, the deeper the alignment. In deep alignment, when educators teach the content, it is practiced in various contexts and at a variety of cognitive levels. Such practice increases the probability that students will be able to transfer the learning to multiple situations (Downey et al., 2002).

Many researchers acknowledged the benefits of teacher teaming and collaboration. Newmann and Wehlage (1995) proposed that vertical (teaming) alignment encourages educators working together to achieve school goals. Bertrand et al. (2006) emphasized by collaborating in horizontal and vertical teams, teachers were able to build on each others strengths, which helped meet the challenges of federal and state accountability measures. Reeves (2002) suggested that in order to add value to state standards, leaders and educators need to have conversations to prioritize standards. Leithwood (1992) suggested that staff members in collaborative school cultures often talk, observe, evaluate, and plan together. Ezell, Klein, and Lee (2006) found that collaboration and enhancing communication between teachers has also been a benefit of vertical teaming. According to a study on workplace conditions, Little (1982) observed that in successful schools more than unsuccessful ones, teachers valued and participated in norms of collegiality and continuous improvement; they practiced a greater range of professional interactions with fellow teachers or administrators that included talking about instruction, and shared planning or preparation. In vertical teaming, teachers shared the spotlight with administrators. In another study, Janz et al. (1997), found that "teams high in interdependence performed at a higher quality level" (p. 892). According to Conley et al. (2004), variables from interpersonal processes in teaming have an impact on the perceptions of improved teaching and learning.

Vertical Teaming Roles Require Transformational Leadership

Collaboration can occur through informal interpersonal interaction and through structured formal interactions. Fradd (1992) emphasized that collaboration across grade levels cannot occur without an organizational structure that promotes interaction and communication. As accountability is pushed on administrators; there is a calling for visionary leadership. Visionary leadership and the ability to foster positive change are necessary to produce the type of quality needed in order to meet the demands of the public. Hess and Brigham (2000) believe the accountability systems set in place “cannot easily coexist with the traditional administration and culture of schooling – one or the other has to give” (p. 2). School leaders must be aware of their critical role in promoting effective teaming practices. According to Ritchie, Mackay, and Rigano (2005), designated leaders of subject departments had little empirically based literature to inform their practice.

School reform and accountability movements have placed pressure on school administration to increase student achievement. A major focus during the era of school accountability and school restructuring is leadership. Restructuring the school by improving school conditions and linking the culture of the organization to the leader encompasses the transformational model of leadership (Stewart, 2006). Newmann and Wehlage (1995) suggested that there are limits to restructuring. Schools, where restructuring activities did not advance intellectual quality of learning, were seriously preoccupied with other tasks and goals for schooling. In this case, teachers, administrators, parents, and students spent time and energy attempting to maintain an orderly environment for learning and trying to achieve other legitimate goals of school (Newmann & Wehlage, 1995). The adoption of shared governance and team planning permitted the potential for interpersonal conflict and power struggles. In contrast, campuses where teacher teams were being used to emphasize student learning of high quality offered important support for their peers in creating more intellectually rigorous and engaging curriculum. Newmann and Wehlage (1995) concluded that in adopting new innovations, learning how to use new structures to enhance faculty and student concern for high quality learning is the challenge.

Marks and Printy (2003) investigated the conceptions of leadership and their relationship to school performance while examining 24 nationally selected restructured elementary, middle, and high schools. In this study, they found that transformational leadership is a necessary but insufficient condition for instructional leadership. When transformational and shared instructional leadership coexist in an integrated form of leadership, the influence on school performance, measured by the quality of its pedagogy and the achievement of its students, was substantial (Marks & Printy, 2003).

Transformational leaders attempt to shape a positive organizational culture and contribute to organizational effectiveness by fostering collaborations and initiating a process of continuous inquiry into teaching and learning (Fullan, 1991). In a four-year study, Leithwood (1994) assessed the effects of transformational leadership in schools responding to a variety of restructuring initiatives. In his conceptual framework, he asserted that transformational leadership in schools (a) directly affects school outcomes as teacher perceptions of student goal achievement and student grades and (b) indirectly affects these outcomes by influencing three psychological characteristics of staff which in turn affect the outcomes. Three characteristics are perceptions of school characteristics, teacher commitment to change, and organizational learning. Leithwood

(1994) concluded that transformational leadership has a significant value in restructuring schools.

Authority and influence connected with transformational leadership are not necessarily formal administrative positions. Power is attributed by organization members to whoever is able to inspire their commitments to collective aspirations. According to Leithwood and Jantzi (1999), this form of leadership can be described in relationship to six “leadership” and four “management” dimensions. Those dimensions include: “(a) building school vision and goals; (b) providing intellectual stimulation; (c) offering individualized support; (d) symbolizing professional practices and values; (e) demonstrating high performance expectations; and (f) developing structures to foster participation in school decisions” (Leithwood & Jantzi, 1999, p. 454). Transformational school leaders focus on the individual and collective understandings, skills, and commitments of teachers. Through dialoguing, they may challenge teachers to analyze their assumptions about their work and to rethink instructional processes; they may establish expectations for quality pedagogy and support teachers’ professional growth (Marks & Printy, 2003).

The process of learning to work cooperatively and collaboratively with other educators to address the needs of specific students is not easy. Transformational leaders encourage and influence a shared commitment that involves collaboration (Barnett & McCormick, 2004). Collaboration provides the means to meet the educational needs of many students in mainstream and special education settings (Fradd, 1992). In examining high-performing schools, it is important to increase awareness in understanding high stakes assessment and accountability. Deming (1986) discussed the concept of constancy of purpose and consistency. According to Deming, the concept of constancy of purpose illustrates how to create a high-performing school. A successful organization requires a clear sense of direction and a strategic focus that result in a purpose. The second element, consistency, is defined as staying power under duress (Deming, 1986). In light of consistency with purpose, Downey et al. (2002) illustrated six critical standards for high-achieving schools. The areas described included instruction of the curriculum, curriculum and assessment alignment, resource and curriculum alignment, mastery teaching, formative monitoring, and staff development. With these insights and with the knowledge of best educational practice for students, teachers are able to acquire strategies to improve schools and enhance student achievement.

Site-Based Management

Vertical teaming and school-based management are forms of school teaming. The development of school teaming is a positive achievement, yet an important issue is the relationship between school teaming and student achievement. In the search for strategies to improve student achievement, it is necessary to review the literature surrounding school-based management because of its involvement in teacher work group design.

Teacher involvement strategies are among the most popular education and restructuring initiatives introduced. Site-based management, participative decision making, and shared governance are some examples of these strategies (Crow & Pounder, 2000). Site-based management or school-based management (SBM) proposes to promote a way to empower local communities, improve administrative efficiency, increase parent involvement, and balance state authority. As evidenced by advisory councils and shared decision making, the movement for school-based management has emphasized giving school participants more influence to establish the program of their school. Although SBM includes healthy school climate practices such as transformational leadership and infusion of common values, existing literature reviews identify some of the problems with current SBM policy and research (Hess, 1994; Leithwood & Menzies, 1998; Wohlstetter & Odden, 1992).

School systems across the country are involved in site-based management, however, the school's decision-making responsibility is limited. Wohlstetter and Odden (1992) assert there is a wide variation across districts in types of decisions and the extent of authority on topics such as budget, personnel, and curriculum strategies. Issues that SBM focused on were peripheral issues such as school climate, campus beautification, career education, remedial education, parent involvement, scheduling, and safety. Persons serving on the site councils were typically unsatisfied because they were not empowered in dealing with real issues of budget, staff, and curriculum (Wohlstetter & Odden, 1992). In addition, there is a huge cost in principals' and teachers' time and effort required to make any form of SBM work well particularly in the first years of implementation (Leithwood & Menzies, 1998).

Another criticism of site-based management is that it has various forms and is not practiced through one model. The literature suggests that SBM comes in four specific designs: (a) community control (b) administrative decentralization, (c) principal control, and (d) balanced control (Leithwood & Menzies, 1998; Wohlstetter & Odden, 1992). The community control method transfers power from professional educators and the board of education to lay persons such as parent and community groups. The second design, administrative decentralization, arranges for teacher control by delegating decision making down the ranks of the professional hierarchy to building-level educators. While in the third model, principal control, principals are not required to establish site councils and may or may not have a site council. Finally, the last model, balanced control, consists of power that is exercised equally by school professionals and parent/community members (Leithwood & Menzies, 1998; Wohlstetter & Odden, 1992). Each form experiences different obstacles as well as measurements of success.

Researchers also identify a lack of clarity in goals and accountability as a concern for SBM. Hess (1994) suggests the purpose of SBM is to ease supervision and promote a downward-hierarchical form of management and from an organizational point of view, create teacher empowerment. SBM seldom includes specific learning goals for students or have accountability mechanisms that assess SBM with respect to those goals or organizational improvements (Hess, 1994). Another concern both educators and administrators have with SBM is that district-initiated SBM programs often are in conflict with state rules and regulations and that state-initiated SBM reforms also are in discord with district rules and regulations. School bureaucracy has made it difficult to transfer authority away from the central administration to individual schools. Consequently, site teachers and administrators get contradictory support of the policy system (Wohlstetter & Odden, 1992).

More recently, researchers recommend that SBM should advance in future policies to provide an effective system that decentralizes decision making to the school site, which leads to increased student learning. A recommendation of SBM includes being a part of a coordinated effort to improve school productivity by setting student outcome goals and including SBM policy with a content focus (Wohlstetter & Odden, 1992). While school structures may inhibit or generate opportunities for teacher learning, there are many structural alternatives to select from. There is little evidence of positive effects on students with the SBM model (Leithwood & Menzies, 1998). SBM's limited impact on student achievement places more focus toward vertical teaming as structural alternative.

Summary

This chapter reviewed literature relevant to the study. In this literature review, the history of testing was explored. Discourse on national mandates, high stakes testing, state accountability, state mandates, and student achievement gaps were disclosed. It is clear from this literature that legislature and state boards have been adamant on knowing whether students were achieving. In examining the experiences of the business world, politicians and policymakers assumed that the presence of a strong accountability system with high-stakes testing would drive schools to improve all student achievement. Although in analyzing student test results, there continues to be a noticeable discrepancy between the performance of minority students and their White counterparts.

Next, a review of the literature demonstrated that teachers, students, and schools are not meeting the goals set by federal expectations on closing the achievement gaps between ethnic groups and the goals of science literacy advocates. Although science has not received the attention as other subjects such as math and reading in education reform, it has been presented that the subject is a critical facet of the U.S. curriculum where teachers play a primary role as science advocates. The dilemma seems to be in how educators address the goals of science education.

The last section of the literature review emphasized that teachers' collaborations in vertical team meetings are a valuable resource for deepening educators' understanding of practice embedded in professional growth and links to state-mandated performance standards and social interaction. While there have been studies that examined the strategy of teacher collaboration, few studies have focused specifically on the relationship between vertical teaming in the subject of science and student achievement. Researchers have found that transformational leadership generates a positive climate for the teacher collaboration strategies. Transformational leaders support restructuring initiatives of teacher teaming that include vertical teaming and site-based management. Additionally, site-based management is among the most popular teacher involvement strategies that have been introduced through education reform and restructuring initiatives, yet scholars reveal that it has not proven to yield successful results.

Although there is a considerable body of literature on (a) teacher collaboration, (b) national focus on science and (c) educational reform through student assessment, this study will expand those topics in a different way. A number of studies have identified some teacher student outcomes due to interdisciplinary teaming efforts; however, most studies have not ascertained a clear link between the effectiveness of teacher teams and specific student outcomes. The majority of literature on the topic of interdisciplinary teams is prescriptive or normative rather than empirical. Most studies focused on middle schools with interdisciplinary teacher teams. A less studied approach to teacher involvement is teacher teaming in a subject. No one has explored a particular teaming process such as vertical teaming in the subject of science at the elementary level. This study seeks to examine vertical teaming at the elementary level in science 5th grade level in Texas. Although relationships between faculty collaboration, climate, and student achievement have been studied, the relationship between group effectiveness and student achievement has not received much attention. This study suggests that a better understanding of the relationship between vertical teaming in science will help teachers create vertical articulation that assists in supporting vertically aligned curriculum that positively affects all student achievement. In addition, because of the challenges in planning and curriculum instruction, this study has leadership implications. This chapter examined the phenomenon of vertical teaming as a resource for teaching within the framework of standards driven curricula in science.

In view of the literature, the purpose of this study was to examine the relationship between vertical teaming in science and student achievement. This study sought to compare student achievement of campuses implementing vertical teaming with the student achievement of schools that do not use vertical teaming. In addition, this study attempted to ascertain the relationship between selected demographic variables and student achievement on Science TAKS controlling for demographic variables.

CHAPTER III

METHODOLOGY

As our nation moves into more specialized assessments at the elementary levels and the expectation that our students lead the world in scientific literacy (DeBoer, 2000; National Research Council, 2007), school systems are encouraged to provide a strong infrastructure. With the increased coordination that vertical teaming supplied, administrators, teachers, and students developed a clearer vision of how the curriculum unfolded, enhancing their ability to understand its objectives (College Board, 2004). By coordinating efforts, members of a vertical team in science could reinforce student understanding of principles by ensuring that content, issues, and topics were introduced in early grades and then revisited in greater depth in later grades. A well-designed vertical curriculum should carefully sequence and coordinate activities within and between courses (College Board, 2004; Downey et al., 2002; English & Steffy, 2001). Together the coordination of vertical teaming and vertical curriculum provide the infrastructure that shapes a “synergistic system (with mutual support between different aspects of instruction) for helping students learn higher-level thinking skills” (College Board, 2004, p. 17).

The purpose of this study was to examine the relationship between vertical teaming in science and student achievement. This study sought to compare student achievement of campuses implementing vertical teaming with the student achievement of schools that do not use vertical teaming. In addition, this study also investigated the degree to which vertical teaming impacts selected demographic variables as reported by

Science TAKS results in the Academic Excellence Indicator System (AEIS). It was necessary to recognize that other school reforms have been implemented before and during the implementation of the vertical teaming in elementary campuses such as horizontal teaming, site-based management, school leadership teams, teacher empowerment initiatives, and professional learning communities (Pounder, 1999; Wheelan & Kesselring, 2005).

Chapter III is comprised of the research methods used to conduct this study. The chapter is arranged by the following categories: population, procedures, instrumentation, and data analysis.

Research Questions

Two main questions guided this study:

1. Is there a difference in student achievement as reported in AEIS between elementary campuses practicing vertical teaming in science and elementary campuses that do not utilize vertical teaming in science?
2. Is there a relationship between school variables (i.e., percent economically disadvantaged, percent English language learners, percent minority, percent mobility, and percent of experienced teachers) and student achievement on Science TAKS controlling for demographic variables?

Population

The population for this study consisted of a total of 156 public schools from traditional independent school districts within Bexar County, Texas, where enrollment includes kindergarten through 5^{th} grade students at the elementary level. Since the

Science TAKS is administered at the 5th grade level, it was important to identify campuses that included grade levels kinder through grade 5 or 1st through 5th grade. Intermediate campuses, which include grades 5 and 6, primary schools that catered to early childhood (pre-K up to 1st grade), and campuses only servicing kinder through 4th grade were excluded from the study. Charter and private schools in Bexar County, Texas, were also not considered for the purposes of this research study. Reasons for their exclusion from the study include the following: (a) private schools are not subject to the same standards and requirements as public schools (Texas Education Agency, 2006a), and (b) "charter schools are subject to fewer state laws than other public schools with the idea of ensuring fiscal and academic accountability without undue regulation of instructional methods or pedagogical innovation" (Texas Education Agency, 2007i, p. 1).

Bexar County was selected because of the diversity of schools along various demographic levels. In addition, there is a broad mixture in school sizes within the county. There are rural, suburban, and large urban school districts that encompass the area. Within all 18 traditional school districts in the county reside 241 elementary campuses. Table 2 shows the total student population count and percentage of demographic information in the traditional districts selected in Bexar County. With an average student count of 16,822, the student population demographic percentages included an average of 58.9% of Hispanic students, 29.9% of White students, and 9.2% of African American students. The economically disadvantaged population in traditional districts in Bexar County totaled an average of 57.5%. The limited English proficient student population calculated to an average of 9.24%.

Table 2. Student Population Counts and Percentages of Demographic Information for 2007 in the Traditional Districts Selected in Bexar County, Texas

District	Student Count	African Amer. %	Hispanic %	White %	Econ. Disad. %	LEP %
Alamo Heights	4,536	2.1	31.6	63.9	19.7	5.30
Comal	810	1.6	46.0	50.9	48.5	14.40
East Central	8,470	11.0	57.1	31.2	57.2	4.90
Edgewood	11,906	1.4	97.5	1.0	96.5	19.70
Fort Sam Houston	1,327	32.6	18.2	44.8	38.5	3.50
Harlandale	14,100	0.6	95.6	3.6	91.5	14.40
Judson	20,242	27.9	45.8	23.3	56.9	6.50
Lackland	872	20.8	19.5	55.4	38.6	2.40
Medina Valley	3,059	1.3	52.2	45.5	46.8	6.40
North East	61,003	9.5	45.5	41.1	39.0	6.80
Northside	81,861	8.0	62.3	26.2	46.3	6.70
Randolph Field	1,147	20.8	18.7	55.6	12.5	.03
San Antonio	55,322	8.1	88.5	3.0	91.5	16.80
Sctz-Cib-UnCty	9,470	12.0	29.0	55.8	24.1	2.80
Somerset	3,542	1.4	84.1	14.1	80.1	11.20
South San Antonio	9,786	1.5	95.8	2.4	90.9	16.80
Southside	4,899	1.6	84.2	13.5	76.5	12.70
Southwest	10,438	3.0	88.3	7.8	80.8	15.00
Average	16,822	9.2	58.9	29.9	57.5	9.24

Academic Excellence Indicator System (AEIS) provided information on the Science TAKS results. The AEIS served as a statewide system that compiles an array of information on the performance of students and school finance in every school and district in Texas each year. The system involved district- and state-level reports on finance, population, and staffing (Texas Education Agency, 2007a). Data were provided for a percentage of students passing the science tests and percentages for campus variables. There were 231 elementary campuses that qualified for the study. Table 3 shows the number of schools in Bexar County and traditional districts that met the criteria to participate in the study.

Table 3. List of Traditional Districts and Qualifying Elementary Schools in Bexar County, Texas

District	Elementary Campus	Did Not Qualify	Qualified
Alamo Heights	3	1	2
Comal	10	5	5
East Central	5	0	5
Edgewood	11	0	11
Fort Sam Houston	1	0	1
Harlandale	14	0	14
Judson	14	0	14
Lackland	1	0	1
Medina Valley	1	0	1
North East	42	0	42
Northside	59	4	55
Randolph Field	1	0	1
San Antonio	50	0	50
Sctz-Cib-UnCty	6	0	6
Somerset	1	0	1
South San Antonio	10	0	10
South Side	3	0	3
Southwest	9	0	9
Total			231

In identifying campus involvement with vertical teaming, years of implementation were the criteria. Campuses identified as utilizing vertical teaming had participated in the vertical teaming process for two or more years. Studies suggest that after one year or more of working together, teaming teachers have a greater knowledge of the curriculum and instructional matters beyond the limits of their own content area

(Erb, 1988; Wheelan & Kesselring, 2005). Thus, with two years of implementation, the researcher assumed the teaming process had been adequately established.

Procedures

The study was conducted in the fall of 2007. One hundred fifty-six participating campuses in public school districts within Bexar County, Texas, were identified using the Texas School Directory, found in the Texas Education Agency website. Campus administrators or campus instructional specialists, and in some cases, district curriculum directors, were contacted via telephone to ascertain whether or not the campus had practiced vertical teaming in the subject of science for the past two years (i.e., fall of 2005 to the spring of 2007). The campus representative self-determined if their campus was utilizing vertical teaming in science or not. Only two instances occurred where the respondent asked for clarification of the definition of vertical teaming. Consent to participate was assumed by phone response.

The call-out yielded 168 responses with 106 campuses (63%) stating that they practice vertical teaming and 62 (37%) claiming they did not practice vertical teaming in science. The total response rate for the study was 72.7%. During the months of November and December of 2007, data were compiled. The data were analyzed in December of 2007. Table 4 displays the districts in Bexar County, the number of elementary schools in Bexar County that qualified for the study, the number of schools that responded in the district, and their response to the call-out.

Table 4. Results of the Responses From Qualifying Elementary Schools in Bexar County, Texas

District	Qualified	Response	Y	N
Alamo Heights	2	2	2	0
Comal	5	3	2	1
East Central	5	3	3	0
Edgewood	11	5	2	3
Fort Sam Houston	1	0	0	0
Harlendale	14	10	6	4
Judson	14	3	2	1
Lackland	1	1	1	0
Medina Valley	1	1	1	0
North East	42	29	24	5
Northside	55	52	18	34
Randolph Field	1	1	1	0
San Antonio	50	38	32	6
Sctz-Cib-UnCty	6	4	1	3
Somerset	1	0	0	0
South San Antonio	10	6	4	2
South Side	3	3	3	0
Southwest	9	7	4	3
Total	231	168	106	62

Out of the 168 campuses that participated in the study, 12 were not included in the analysis due to several factors. Those factors include the following: (a) reorganization – for example, a campus which originally contained a population of kinder through 5th grade, may have been reorganized to a primary or intermediate campus; (b) the campus did not exist in the school year 2003-2004; or (c) the campus science score was not reported. With the exclusion of the 12 campuses, a total of 156 (67.53%) remained who participated in the study out of the 231 traditional campuses in Bexar County that qualified.

The population was entered in a Microsoft Excel file and the campuses were classified as nominal variables for sorting purposes. Each campus practicing vertical teaming was assigned #1, and each campus not practicing vertical teaming was assigned the number 0. The campuses were then combined and sorted alphabetically by the researcher. By assigning different numbers to each campus, the two groups were easily identified for sorting and analysis purposes.

The TAKS data were acquired for each campus from AEIS. Science TAKS scores were obtained for both groups, vertical teaming and non vertical teaming campuses, in the study. The two sets of scores included the 2004 Science TAKS results and 2007 Science TAKS results for 5th grade. In order to investigate student achievement (dependent variable), the researcher identified the percentage points gained in Science TAKS scores for each campus. The formula used for the dependent variable, student achievement on Science TAKS, was the difference of Science TAKS scores of 2004 from the Science TAKS scores of 2007 (Science TAKS 2007 – Science TAKS 2004). This was done so that a positive difference indicated a gain in the percent of students mastering the 5th grade science subtest. Population of economically disadvantaged, English language learner population, ethnic populations, student mobility rate, and teaching experience of science teachers for each campus were also collected from AEIS and treated as independent variables. This study tested the relationship between school variables and student achievement in science on TAKS controlling for demographic variables.

In order to ensure confidentiality or anonymity of responses of results, there was no direct link between data collected and the subjects. Campuses were not individually identified.

Instrumentation

By examining Science TAKS reports for the 2004 and 2007 years tested, the researcher collected TAKS science scores for 156 elementary campuses. Through a review of AEIS and Public Education Information Management System (PEIMS) data, data as percent English language learner, percent economically disadvantaged, percent minority, percent mobility, and percent of experienced teachers were determined for the campuses identified for the study.

The campuses were organized into two groups for sorting purposes. The groups were identified as vertical teaming campuses and non-vertical teaming campuses in science. Campuses that practiced vertical teaming were assigned #1, and the non-vertical teaming campuses were assigned number 0. Indicators were gathered in AEIS. The information on each campus was organized in a computer spreadsheet program, Microsoft Excel.

Vertical teaming was one independent variable for the study. The criterion group, campuses that practiced vertical teaming in science (code 1) was compared to the non-criterion group, the campuses that did not practice vertical teaming in science (code 0), on Science TAKS scores. For the purposes of this study, vertical teaming is referred to as a group of educators (teachers, counselors, administrators) from different grade levels who work together to develop a curriculum that provides a seamless transition from grade-to-grade (Kowal, 2002).

Other demographic independent variables were included to explore the possible effects of each on TAKS scores. The definitions for all school variables in the study were obtained through the *Glossary for the Academic Excellence Indicator System* published by the Texas Education Agency (2007d). These variables included percent economically disadvantaged, percent English language learners, percent minority, percent mobility, and percent of experienced teachers. For this study, percent of economically disadvantaged students was defined as the percent of students coded as eligible for free or reduced-price lunch or eligible for other public assistance (Texas Education Agency, 2007d). Percent of English language learners was described by the percent of pupils identified as limited English proficient (LEP) by the Language Proficiency Assessment Committee (LPAC) according to criteria established in the Texas Administrative Code (Texas Education Agency, 2007d, 2007h). Percent minority was identified by percent of African American students, Hispanic students, Asian/Pacific Islander students, and Native American students on a campus (Texas Education Agency, 2007d). Percent mobility was defined as percent of students who has been a member at a school for less than 83% of the school year (Texas Education Agency, 2007d). Percent of experienced teachers was considered to be the percent of teachers with six years' experience or above (Texas Education Agency, 2007d). Data for all school variables were provided by AEIS.

The campuses were regrouped into four categories for each school variable by (a) bottom quartile, (b) mid-low quartile, (c) mid-high quartile, and (d) top quartile. The quartiles were determined by the value of the boundary at the 25th, 50th, or 75th percentiles of a frequency distribution divided into four parts, each containing a quarter of the population (Pickett, 2000). Each school variable was classified as a nominal variable with the following distinctions: (a) bottom quartile (76-100), 1; (b) mid-low quartile (51-75), 2; (c) mid-high quartile (26-50), 3; and (d) top quartile (0-25), 4.

The dependent variable for this study was Science TAKS scores. TAKS scores were used as a measure of academic achievement for each campus. The scores used in the study included the school years of 2003-2004 and 2006-2007. For the purposes of the study, the gain in percent mastered for Science TAKS scores from 2004 to 2007 was used as the Science TAKS score variable that provided a better insight on student performance. This indicator focused on student achievement over time.

Since TAKS began testing the subject of Science in 2003, results of the percentage of students meeting standards for the spring of 2003 was set for 2 SEM (Standard error of measurement) below the Panel's Recommendation. In the spring of 2004, the percentage of students meeting standards was set for 1 SEM, while in the spring of 2005, schools were rated for the first time on percentage of students meeting standards at Panel's recommendation. The standard error of measurement was computed using the following formula (Texas Education Agency, 2007g):

$$SEM = \sigma_x \sqrt{(1-r)}$$

The second year scores, which were 2004 Science TAKS scores, were considered in the study allowing one year exposure to the science assessment and transition to TAKS format. Additionally, the 2007 scores were used since they represented the 2006-2007 school year that was viewed as the most recent scores with the implementation of vertical teaming.

Data Analysis

The results of the study were reported using appropriate quantitative techniques outlined by Gall, Borg, and Gall (2007) and Fields (2005). Several statistical procedures were used to answer research questions which included an independent samples t-test and a factorial analysis of variance. An alpha level of .05 was used to establish significance (Spatz, 2005).

The two-way ANOVA was chosen as the statistical method of design. Analysis of variance (ANOVA) is "an inferential statistics technique for comparing means, comparing variances, and assessing interactions" (Spatz, 2005, p. 225). The two-way ANOVA was selected because there were two important independent variables (vertical teaming and school variable) in the study, and the researcher wanted to know if these two independent variables changed the dependent variable (Science TAKS score). Vertical teaming was designated as the first level of analysis, while the five demographic variables were designated as level two. In addition, two-way ANOVA permits the study of interactions. Interactions indicate the joint influence of the two independent variables on the dependent variable (Spatz, 2005). The interactions between the two independent variables on Science TAKS score represented level three of analysis.

With the two-way ANOVA and t-test, the researcher examined the relationship between vertical teaming in science and student achievement. Two questions guided the research.

Research Question #1

Is there a difference in student achievement as reported in AEIS between elementary campuses practicing vertical teaming in science and elementary campuses that do not utilize vertical teaming in science?

The first research question examined the TAKS scores for two groups, Campuses with vertical teaming in science and campuses that did not practice vertical teaming in science. For the first question, the independent t-test was used because it is a parametric test to determine whether significant differences existed between the means of two independent samples. The purpose of the t-tests was to determine whether a significant difference in TAKS science scores existed between the two groups in the study. The two groups were comprised of campuses that did not practice vertical teaming in science and campuses that practiced vertical teaming in science. This procedure has been discussed in more detail in Chapter IV.

Research Question #2

Is there a relationship between school variables (i.e., percent economically disadvantaged, percent English language learners, percent minority, percent mobility, and percent of experienced teachers) and student achievement on Science TAKS controlling for demographic variables?

For the second research question, a two-way analysis of variance (ANOVA) was conducted to measure the effects of school variables on 5th grade TAKS science scores. A two-way ANOVA was used because it measures the effects of more than one independent variable on the dependent variable as well as the interaction effects of combinations of independent variables. Tests were run to determine if certain school characteristics created a more successful vertical teaming experience. If a statistical difference existed, a *Scheffé post hoc* analysis was run (Spatz, 2005). This procedure has been discussed in more detail in Chapter IV.

In summary, the population of this study was elementary campuses in selected public schools in Bexar County, Texas. Charter and private schools were not included for the purposes of this research study. There were 18 traditional school districts in the county that include 241 elementary campuses. Of the 241 potential participants, 231 qualified. A call-out to the 231 qualifying campuses yielded 168 responses (72.7%). A total of 106 (63%) campuses were identified as practicing vertical teaming in science, while 62 (37%) did not implement vertical teaming in science.

The Science Texas Assessment of Knowledge and Skills (TAKS) was the instrument used to measure student achievement in the study of the relationship of vertical teaming in science and student achievement at elementary campuses as reported by AEIS in Bexar County, Texas. The Science TAKS reports for 156 elementary campuses for the 2004 and 2007 were examined. The gain in percent mastered for Science TAKS scores from 2004 to 2007 was used as the Science TAKS score variable. Through AEIS, data concerning (a) percent English language learner, (b) percent economically disadvantaged, (c) percent minority, (d) percent mobility and (e) percent of experienced teachers were determined on the campuses identified for the study. These demographic independent variables were included to explore the possible effects of each on TAKS scores.

Analysis and interpretation of the data followed the principles prescribed by Gall et al. (2007), Spatz (2005), and Fields (2005). The data collected with AEIS were analyzed with statistical analysis software program, SPSS 13.0 for Windows. Several statistical procedures were used to answer research questions to include independent sample t-test and analysis of variance to test for significant differences between campuses. Data analysis included specific statistical procedures for use in answering each research question.

CHAPTER IV

ANALYSIS OF THE DATA

Introduction

Chapter IV contains an analysis of the data pertaining to the relationship between vertical teaming in science and student achievement as reported in the Academic Excellence Indicator System (AEIS) at selected public elementary schools in Bexar County, Texas. First, this study examined the student achievement between elementary campuses practicing and elementary campuses not utilizing vertical teaming in science as reported in AEIS. Secondly, the study investigated the relationship between school variables and student achievement on Science TAKS controlling for demographic variables. The chapter is divided into four sections: (a) introduction, (b) description of the population studied, (c) results of the research questions, and (d) summary.

Description of the Population

The population for this study consisted of a total of 168 public schools from traditional independent school districts within Bexar County, Texas, where enrollment includes kindergarten through 5th grade students at the elementary level. Since the Science TAKS is administered at the 5th grade level, it was important to identify campuses that included grade levels kinder through grade 5 or 1st through 5th grade. Traditional school districts in Bexar County had an average student count of 16,822; the ethnic population included an average of 58.9% of Hispanic students, 29.9% of White students, and 9.2% of African American students. The economically disadvantaged population in traditional districts in Bexar County had an average of 57.5%. The Limited English Proficient student population had an average of 9.24%.

Elementary campuses practicing vertical teaming in science and elementary campuses not practicing vertical teaming were included in the study. One hundred six campuses (63%) stated that they were practicing vertical teaming, while 62 (37%) stated otherwise. In identifying campus involvement with vertical teaming, years of implementation was the criteria. Campuses reported utilizing vertical teaming had participated in the vertical teaming process for two or more years. Schools that were not in existence prior to 2005 were eliminated from the study. After one year or more of working together, teaming teachers have a greater knowledge of the curriculum and instructional matters beyond the limits of their own content area (Erb, 1988; Wheelan & Kesselring, 2005). With two years of implementation on a campus, the vertical teaming process has been adequately established.

Out of the 168 campuses that participated in the study, 12 were not included in the analysis due to several factors. Those factors include the following: (a) reorganization – for example, a campus that originally contained a population of kinder through 5^{th} grade, may have been reorganized to a primary or intermediate campus; (b) the campus did not exist in the school year 2003-2004; or (c) the campus science score was not reported. With the exclusion of the 12 campuses, a total of 156 (67.53%) remained that participated in the study out of the 231 traditional campuses in Bexar County that qualified.

Results

Research Question #1: Is there a difference in student achievement as reported in AEIS between elementary campuses practicing vertical teaming in science and elementary campuses that do not utilize vertical teaming in science?

Related Null Hypothesis #1: There is no significant difference in student achievement between campuses practicing vertical teaming in science and campuses that do not practice vertical teaming in science.

Using results from AEIS, the 2004 and 2007 Science Texas Assessment of Knowledge and Skills (TAKS) scores from participating campuses were gathered. From these data, the researcher calculated the following statistics. The first research question determined if there was a significant difference in TAKS science scores between campuses practicing vertical teaming and campuses that did not practice vertical teaming. Student achievement was defined as the gain in percent mastered for Science TAKS scores from 2004 to 2007. The study consisted of two groups of campuses for comparison purposes. Campuses in Group 0 did not practice vertical teaming in science, and campuses in Group 1 did practice vertical teaming in science during the school years of 2005-2006 and 2006-2007.

An independent sample t-test was conducted to evaluate the null hypothesis that there was no difference in 5^{th} grade Science TAKS scores for campuses that practiced vertical teaming in science and campuses that did not practice vertical teaming in science. The independent t-test was used because it is a parametric test to determine whether significant differences existed between the means of two independent samples.

Table 5 shows that campuses that practiced vertical teaming (Group 1-yes) in science actually had lower gains in percent mastered than campuses that did not practice vertical teaming (Group 0-no) in science. The table identifies 98 campuses that participated in vertical teaming and 58 campuses that did not participate in vertical teaming. Campuses that did not practice vertical teaming had a mean of 28.33 with a standard deviation of 15.696. In addition, the table explains that the average gain in Science TAKS score for campuses that did practice vertical teaming was 24.45, with a standard deviation of 15.811. The t-test for independent samples did not yield a significant difference in mean scores, with *t*= 1.485, the two tailed value of *p*= .140. As a result, the null hypothesis was retained.

Table 5. Means and Standard Deviations for 2007 of the 5th Grade Science TAKS, Gain in Percent Mastered Scores from 2004-2007

Vertical Teaming	*n*	*M*	*SD*	*t*	*p*
Yes	98	24.45	15.811	1.485	.140*
No	58	28.33	15.696		

Note. Coding of vertical teaming: 0=no, 1=yes.
*p>.05, two-tailed.

Because this was a field study, the researcher explored school demographics to rule out the possibility that potential findings might be based on systematic demographic differences. The second question examined whether contextual variables explained

Science TAKS performance between schools using and not using vertical teaming to a greater degree. The researcher used statistical analyses to answer that question.

Research Question #2: Is there a relationship between school variables (i.e., percent economically disadvantaged, percent English language learners, percent minority, percent mobility, and percent of experienced teachers) and student achievement on Science TAKS controlling for demographic variables?

Related Null Hypothesis #2: There is no significant difference in school variables (i.e., percent economically disadvantaged, percent English language learners, percent minority, percent mobility, and percent of experienced teachers) and student achievement on Science TAKS controlling for demographic variables.

Similarly as in question #1, the researcher gathered the 2004 and 2007 Science TAKS scores from participating campuses. The second research question explored if there was a difference in student achievement on the Science TAKS controlling for demographic variables. Student achievement was defined as the gain in percent mastered for Science TAKS scores from 2004 to 2007. Using the two-way ANOVA, the study included two groups of campuses for comparison purposes. Campuses in Group 0 did not practice vertical teaming in science, and campuses in Group 1 did practice vertical teaming in science during the school years of 2005-2006 and 2006-2007. In addition, campuses were clustered in four groups for each school variable by (a) bottom quartile, (b) mid-low quartile, (c) mid-high quartile, and (d) top quartile. The quartiles were determined by the value of the boundary at the 25th, 50th or 75th percentiles of a frequency distribution divided into four parts, each containing a quarter of the population (Pickett, 2000).

Percent of Economically Disadvantaged

Research Question #2a: Is there a difference in scores between percent of economically disadvantaged and student achievement on Science TAKS controlling for the demographic variable?

Related Null Hypothesis #2a: There is no relationship between percent of economically disadvantaged and student achievement on Science TAKS controlling for the demographic variable.

The null hypothesis #2a was analyzed using a two-way ANOVA. The descriptive statistics used by this analysis are presented in the Table 6. It is followed by Table 7 that provides the two-way ANOVA results. Each set of tables (descriptive statistics and two-way ANOVA) addressed different campus variables: (a) Tables 6 and 7, percent economically disadvantaged; (b) Tables 8 and 9, percent minority; (c) Tables 10 and 11, percent English language learners; (d) Tables 12 and 13, percent mobility; and Tables 14 and 15, percent experienced teachers.

Descriptive statistics analysis were first conducted to achieve the following objectives: to provide a snapshot of the (a) mean, (b) standard deviation, (c) number of participating campuses in the study, (d) division of campuses participating in vertical teaming, and (c) quartiles for economically disadvantaged experience for this study. From the data, the researcher calculated the number, mean, and standard deviation of each quartile pertaining to student achievement on Science TAKS.

Table 6 lists quartiles of campuses that did not practice vertical teaming first. Next, the campuses that did participate in vertical teaming followed, and lastly, a total of all campuses that participated in the study. Of the 156 campuses that participated, 98 (63%) campuses practiced vertical teaming, while 58 (37%) did not practice vertical teaming. The mean value was the average gain in Science TAKS on the particular quartile or total. The standard deviation for each quartile and total section was listed. This table provides raw data used to calculate the sample statistics from which we then infer the population parameter (Gall et al., 2007). It supplies all the means critical for the investigation.

Table 6. Descriptive Statistics for 5th Grade Science, Gain in Percent Mastered Scores, by Vertical Teaming Participation, by Percent Economic Disadvantaged

Vertical Teaming	Percent Economic Disadvantaged	Mean	Standard Deviation	*N*
No	Bottom Quartile	21.46	18.773	13
	Mid-Low Quartile	26.17	17.711	18
	Mid-High Quartile	32.13	12.558	15
	Top Quartile	34.25	9.236	12
	Total	28.33	15.696	58
Yes	Bottom Quartile	16.48	8.882	23
	Mid-Low Quartile	23.67	18.765	21
	Mid-High Quartile	25.67	14.858	24
	Top Quartile	30.13	16.521	30
	Total	24.45	15.811	98
Total	Bottom Quartile	18.28	13.279	36
	Mid-Low Quartile	24.82	18.090	39
	Mid-High Quartile	28.15	14.208	40
	Top Quartile	31.31	14.815	42
	Total	25.89	17.830	156

Table 7 presents the three elements that are compared in the two-way ANOVA – the impact of vertical teaming, the impact of percent of economically disadvantaged, and the interaction of the two. Each of the three components was examined, in turn.

The p-value obtained from the procedure relating to vertical teaming was 0.079. It was consequently inferred that, in the population from which this sample was drawn, the means of the two groups were the same. That is, campuses that participated in vertical teaming and those who did not participate gained the same on the Grade 5 Science TAKS.

Table 7. Two-way ANOVA Results for 5th Grade Science, Gain in Percent Mastered Scores, by Vertical Teaming Participation, by Percent Economic Disadvantaged

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.
Corrected Model	4362.228(a)	7	623.175	2.675	.012
Intercept	98270.356	1	98270.356	421.823	.000
Verteam	727.641	1	727.641	3.123	.079
Ecdis	3298.943	3	1099.648	4.720	.004*
Verteam * Ecdis	77.664	3	25.888	.111	.953
Error	34478.920	148	232.966		
Total	143415.000	156			
Corrected Total	38841.147	155			

Note. Coding of vertical teaming: 0=no, 1=yes.
*p<.05, two-tailed.

The p-value obtained from the procedure regarding percent of economically disadvantaged was 0.004. At least one of the four group means was different from at least one other. To determine where the difference existed, a *post hoc* analysis was conducted. Significantly different means were located between the bottom quartile (18.28) and the mid-high quartile (28.15) with a percent mean difference of 9.87 as well as between the bottom quartile (18.28) and the top quartile (31.31) with a percent mean difference of 13.03. Campuses in the top quartile and mid-high quartile statistically gained more on the Grade 5 Science TAKS than campuses in the bottom quartile.

The researcher noted that there was no significant difference in the means of the four economic quartiles across the two teaming options. The procedure relating to the interaction between vertical teaming and percent of economically disadvantaged yielded a p-value of 0.953. The impact of percent of economically disadvantaged did not change between the two teaming options. In other words, the level of economic disadvantage impacted campuses the same irrespective of vertical teaming participation on the Grade 5 Science TAKS.

Percent of Minority Students

Research Question #2b: Is there a relationship between percent of minority students and student achievement on Science TAKS controlling for the demographic variable?

Related Null Hypothesis #2b: There is no relationship between percent of minority students and student achievement on Science TAKS controlling for the demographic variable.

The null hypothesis #2a was analyzed using a two-way ANOVA. The descriptive statistics used by this analysis are presented in the Table 8.

Table 8. Descriptive Statistics for 5th Grade Science, Gain in Percent Mastered Scores, by Vertical Teaming Participation, by Percent Minority (4 Groups)

Vertical Teaming	Percent Minority	Mean	Standard Deviation	*N*
No	Bottom Quartile	23.45	19.851	11
	Mid-Low Quartile	21.25	9.306	16
	Mid-High Quartile	32.86	16.325	22
	Top Quartile	35.78	12.204	9
	Total	28.33	15.696	58
Yes	Bottom Quartile	17.57	17.008	23
	Mid-Low Quartile	21.50	11.883	24
	Mid-High Quartile	29.14	15.539	22
	Top Quartile	28.79	16.079	29
	Total	24.45	15.811	98
Total	Bottom Quartile	19.47	17.891	34
	Mid-Low Quartile	21.40	10.798	40
	Mid-High Quartile	31.00	15.863	44
	Top Quartile	30.45	15.392	38
	Total	25.89	15.830	156

Table 9 introduces the three elements that are compared in the two-way ANOVA – the impact of vertical teaming, the impact of percent of minority students, and the interaction of the two. All of the three components will be explored, in sequence.

Although campuses that did not participate in vertical teaming (28.33) had a higher total mean than campuses that practiced vertical teaming (24.45), statistically the means of the two groups were the same. The p-value attained from the procedure involving to vertical teaming was 0.119. Therefore, campuses that participated in vertical teaming and those who did not participate gained the same on the Grade 5 Science TAKS.

Table 9. Two-way ANOVA Results for 5th Grade Science, Gain in Percent Mastered Scores, by Vertical Teaming Participation, by Percent Minority

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.
Corrected Model	4892.272(a)	7	698.896	3.047	.005
Intercept	93132.379	1	93132.379	406.010	.000
Verteam	562.804	1	562.804	2.454	.119
Minority	3884.825	3	1294.942	5.645	.001*
Verteam * Minor	259.519	3	86.506	.377	.770
Error	33948.875	148	229.384		
Total	143415.000	156			
Corrected Total	38841.147	155			

Note. Coding of vertical teaming: 0=no, 1=yes.
*p<.05, two-tailed.

The p-value obtained from the procedure concerning percent of minority students was 0.001. The Scheffé *post hoc* indicated that the means were different. The significantly different means were the bottom quartile (19.47), and the mid-high quartile

(31.00) with a percent mean difference of 11.53 in addition to the bottom quartile (19.47) and top quartile (30.45) with a percent mean difference of 10.98. Accordingly, campuses in the mid-high quartile and top quartile statistically gained more on the Grade 5 Science TAKS than campuses in the bottom quartile.

Analysis of the interaction between vertical teaming and percent minority indicated that there was not a significant difference, p=0.770. The impact of percent of minority students did not change between the two teaming options. Hence, the level of percent of minority students impacted campuses the same despite vertical teaming participation on the Grade 5 Science TAKS.

Percent of English Language Learners

Research Question #2c: Is there a relationship between percent of English language learners and student achievement on Science TAKS controlling for the demographic variable?

Related Null Hypothesis #2c: There is no relationship between percent of English language learners and student achievement on Science TAKS controlling for the demographic variable.

The null hypothesis #2a was investigated using a two-way ANOVA. The descriptive statistics used by this analysis are organized in the Table 10.

Table 10. Descriptive Statistics for 5th Grade Science, Gain in Percent Mastered Scores, by Vertical Teaming Participation, by Percent of English Language Learners

Vertical Teaming	Percent English Language Learners	Mean	Standard Deviation	*N*
No	Bottom Quartile	27.37	21.985	19
	Mid-Low Quartile	23.71	11.906	14
	Mid-High Quartile	32.85	7.841	13
	Top Quartile	30.33	13.924	12
	Total	28.33	15.696	58
Yes	Bottom Quartile	18.74	12.020	23
	Mid-Low Quartile	22.20	19.204	20
	Mid-High Quartile	27.12	14.217	25
	Top Quartile	28.10	16.384	30
	Total	24.45	15.811	98
Total	Bottom Quartile	22.64	17.568	42
	Mid-Low Quartile	22.82	16.394	34
	Mid-High Quartile	29.08	12.594	38
	Top Quartile	28.74	15.586	42
	Total	25.89	15.830	156

Table 11 shows the three elements that are compared in the two-way ANOVA – the impact of vertical teaming, the impact of percent of English language learners, and the interaction of the two. Every element will be investigated, consecutively.

Regarding the procedure relating to vertical teaming, the means of the two groups were the same, p=0.087. There was not a statistical difference. Thus, campuses that participated in vertical teaming and those who did not participate had similar gains on the Grade 5 Science TAKS.

Table 11. Two-way ANOVA Results for 5th Grade Science, Gain in Percent Mastered Scores, by Vertical Teaming Participation, by Percent English Language Learners

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.
Corrected Model	2606.535(a)	7	372.362	1.521	.164
Intercept	98147.574	1	98147.574	400.883	.000
Verteam	726.447	1	726.447	2.967	.087
PerELL	1559.839	3	519.946	2.124	.100
Verteam * PerELL	305.233	3	101.744	.416	.742
Error	36234.612	148	244.828		
Total	143415.000	156			
Corrected Total	38841.147	155			

Note: Coding of vertical teaming: 0=no, 1=yes

The p-value obtained from the procedure involving percent of English language learners was 0.100. It was concluded that the means of the four groups were the same. As a result, campuses in all four quartiles for percent of English language learners also gained the same on Grade 5 Science TAKS.

Analysis of the interaction between vertical teaming and percent of English language learners indicated that there were no statistically significant differences in the means presented, $p = 0.742$. The impact of percent of English language learners did not change between the two teaming options. For this reason, the level of percent of English language learners impacted campuses the same regardless of vertical teaming participation on the Grade 5 Science TAKS.

Percent of Mobile Students

Research Question #2d: Is there a relationship between percent of mobile students and student achievement on Science TAKS controlling for the demographic variable?

Related Null Hypothesis #2d: There is no relationship between percent of mobile students and student achievement on Science TAKS controlling for the demographic variable.

The null hypothesis #2a was evaluated using a two-way ANOVA. The descriptive statistics used by this analysis are displayed in the Table 12.

Table 12. Descriptive Statistics for 5th Grade Science, Gain in Percent Mastered Scores, by Vertical Teaming Participation, by Percent Mobility

Vertical Teaming	Percent Mobility	Mean	Standard Deviation	*N*
No	Bottom Quartile	18.44	8.960	9
	Mid-Low Quartile	28.85	16.458	20
	Mid-High Quartile	31.94	16.342	17
	Top Quartile	29.75	16.097	12
	Total	28.33	15.696	58
Yes	Bottom Quartile	19.23	13.952	26
	Mid-Low Quartile	27.36	16.692	22
	Mid-High Quartile	24.79	16.325	24
	Top Quartile	26.88	15.938	26
	Total	24.45	15.811	98
Total	Bottom Quartile	19.03	12.734	35
	Mid-Low Quartile	28.07	16.395	42
	Mid-High Quartile	27.76	16.516	41
	Top Quartile	27.79	15.827	38
	Total	25.89	15.830	156

Table 13 organizes the three elements that are compared in the two-way ANOVA – the impact of vertical teaming, the impact of percent of mobile students, and the interaction of the two. Each one was inspected sequentially.

The researcher did not observe a significant difference in the procedure regarding vertical teaming, $p = 0.317$. Therefore, the decision was made to accept the null hypothesis of no difference attributed to vertical teaming. It was consequently inferred that, in the population from which this sample was pulled, the means of the two groups are the same. Campuses that participated in vertical teaming and those who did not participate gained the same on the Grade 5 Science TAKS.

Table 13. Two-way ANOVA Results for 5th Grade Science, Gain in Percent Mastered Scores, by Vertical Teaming Participation, by Percent Mobility

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.
Corrected Model	2730.866(a)	7	390.124	1.599	.140
Intercept	91919.645	1	91919.645	376.738	.000
Verteam	245.681	1	245.681	1.007	.317
Mobile	1925.360	3	641.787	2.630	.052
Verteam * mobile	291.316	3	97.105	.398	.755
Error	36110.282	148	243.988		
Total	143415.000	156			
Corrected Total	38841.147	155			

Note. Coding of vertical teaming: 0=no, 1=yes.

The data suggested that in regards to percent of mobile students and the interaction between vertical teaming and percent of mobile students, there were no significant differences. Thus, percentage of mobility impacted campuses the same, p=0.052. The p-value obtained from the procedure relating to the interaction between vertical teaming and percent of mobile students was 0.755. The impact of percent of mobile students did not change between the two teaming options. In fact, the level of mobility impacted campuses the same irrespective of vertical teaming participation on the Grade 5 Science TAKS.

Percent of Experienced Teachers

Research Question #2e: Is there a relationship between percent of experienced teachers and student achievement on Science TAKS controlling for the demographic variable?

Related Null Hypothesis #2e: There is no relationship between percent of experienced teachers and student achievement on Science TAKS controlling for the demographic variable.

The null hypothesis #2a was analyzed using a two-way ANOVA. The descriptive statistics used by this analysis are presented in the Table 14.

Table 14. Descriptive Statistics for 5th Grade Science, Gain in Percent Mastered Scores, by Vertical Teaming Participation, by Percent of Experienced Teachers

Vertical Teaming	Percent Experienced Teachers	Mean	Standard Deviation	*N*
No	Bottom Quartile	32.44	21.615	18
	Mid-Low Quartile	28.17	12.988	12
	Mid-High Quartile	25.00	11.206	15
	Top Quartile	26.62	12.836	13
	Total	28.33	15.696	58
Yes	Bottom Quartile	26.62	14.256	21
	Mid-Low Quartile	26.40	19.881	25
	Mid-High Quartile	23.25	11.704	24
	Top Quartile	22.11	16.292	28
	Total	24.45	15.811	98
Total	Bottom Quartile	29.31	18.018	39
	Mid-Low Quartile	26.97	17.769	37
	Mid-High Quartile	23.92	11.398	39
	Top Quartile	23.54	15.268	41
	Total	25.89	15.830	156

Table 15 exhibits the three elements that are compared in the two-way ANOVA – the impact of vertical teaming, the impact of percent of experienced teachers, and the interaction of the two. Every component was evaluated.

Table 15. Two-way ANOVA Results for 5th Grade Science, Gain in Percent Mastered Scores, by Vertical Teaming Participation, by Percent of Experienced Teachers

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.
Corrected Model	2730.866(a)	7	390.124	1.599	.140
Corrected Model	1439.828(a)	7	205.690	.814	.577
Intercept	96118.680	1	99118.680	392.221	.000
Verteam	428.693	1	428.693	1.696	.195
ExperTeach	743.973	3	247.991	.981	.403
Verteam * ExperTeach	114.020	3	38.007	.150	.929
Error	37401.309	148	252.712		
Total	143415.000	156			
Corrected Total	38841.147	155			

Note. Coding of vertical teaming: 0=no, 1=yes.

The p-values indicated that none of the main or interaction effects were statistically different. Although there were differences in the means regarding the impact of vertical teaming, these differences were small and were not statistically significant. The smallest mean value was 23.25 (vertical teaming, mid-high quartile), and the largest mean was 32.44 (no vertical teaming, bottom quartile). Both these numbers were close to the average for all 156 cases (25.89). The p-value obtained from the procedure regarding vertical teaming was 0.195. Hence, campuses that participated in vertical teaming and those who did not participate gained the same on the Grade 5 Science TAKS. The p-value obtained from the procedure involving percent of experienced teachers was 0.403. Thus, the percent of experienced teachers impacted campuses the same. The p-value obtained from the procedure relating to the interaction between vertical teaming and percent of experienced teachers was 0.929. The impact of percent of experienced teachers did not change between the two teaming options. In other words, the level of experienced teachers impacted campuses the same without consideration of vertical teaming participation on the Grade 5 Science TAKS.

Summary

Chapter IV contained an analysis of the data pertaining to the relationship between vertical teaming in science on student achievement as reported in AEIS at selected public elementary schools in Bexar County, Texas. The independent sample t-test in the data analysis was instrumental in determining whether campuses practicing vertical teaming in science and campuses that did not practice vertical teaming in science were different from each other. The independent sample t-test helped resolve this concern. The resulting data indicated that there was not a significant difference with respect to gains in Science TAKS scores between campuses practicing vertical teaming in science and campuses that do not practice vertical teaming in science.

In answering the second question, the researcher utilized a two-way analysis of variance (ANOVA). The researcher was able to examine differences among elementary campus regarding their percent economically disadvantaged, percent of minority students, percent of English language learners, percent of mobility students and percent of experienced teachers. The inferential comparisons of the various demographic subgroups yielded significant differences among the means of differences in Science TAKS gains regarding the relationship between two campus variables and student achievement on Science TAKS controlling for demographic variables. Those campus variables were percent of economically disadvantaged and percent of minority students.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

As our nation moves into more specialized science assessments at the elementary levels and the expectation that our students lead the world in scientific literacy (DeBoer, 2000; National Research Council, 2007), school systems are challenged to provide a strong infrastructure. This infrastructure includes reforms such as vertical teaming that are designed to coordinate collaborative work. With the increased synchronization that vertical teaming supplies, administrators, teachers, and students have been able to develop clearer visions of how curriculum unfolded from grade-to-grade (College Board, 2004). By coordinating efforts, members of a vertical team in science could reinforce student understanding of principles by ensuring that content, issues, and topics were introduced in early grades and then revisited in greater depth in later grades. Together the coordination of vertical teaming and vertical curriculum provide the infrastructure that shapes a "synergistic system (with mutual support between different aspects of instruction) for helping students learn higher-level thinking skills" (College Board, 2004, p. 17).

The purpose of this study was to examine the relationship between vertical teaming in science and student achievement at the 5th grade level. This study sought to compare student achievement of campuses implementing vertical teaming with the student achievement of schools that do not use vertical teaming. In addition, this study also investigated the degree to which vertical teaming interacted with selected demographic variables as reflected in the Science TAKS results in the Academic Excellence Indicator System (AEIS). Since all of these would be occurring simultaneously on a campus, it is difficult to separate the interactions of each one.

The study was conducted in the fall of 2007. The sample population consisted of 156 elementary campuses from 18 public school districts in Bexar County, Texas. A call-out to the 231 qualifying campuses yielded 168 responses (72.7%). Out of the 168 campuses that participated in the study, 12 were not included in the analysis due to several factors. Those factors included the following: (a) reorganization – for example, a campus that originally contained a population of kinder through 5th grade was reorganized to a primary or intermediate campus; (b) the campus did not exist in the school year 2003-2004; or (c) the campus science score was not reported. With the exclusion of the 12 campuses, a total of 156 (67.53%) remained in the study out of the 231 traditional campuses in Bexar County that qualified. During the months of November and December of 2007, data were compiled.

In identifying campus involvement with vertical teaming, years of implementation were the criteria. Campuses that were determined to have utilized the vertical teaming process for a minimum of two years were included. Out of the 156 campuses that participated in the study, a total of 63% of the campuses were identified as practicing vertical teaming in science, while 37% did not implement vertical teaming in science.

The science Texas Assessment of Knowledge and Skills (TAKS) was the instrument used to measure student achievement in this study. The Science TAKS reports for 156 elementary campuses for the 2004 and 2007 were examined. The gain in percent mastered for Science TAKS scores from 2004 to 2007 was used as the Science TAKS score variable. The Texas Academic Excellence Indicator System (AEIS) provided the data for the (a) percent English language learner, (b) percent economically disadvantaged, (c) percent minority, (d) percent mobility, and (e) percent of experienced teachers. These demographic independent variables were included to explore the possible effects of each on Grade 5 Science TAKS scores.

Data collected in this study were subjected to quantitative analyses in December of 2007. Analysis and interpretation of the data followed the principles prescribed by Gall et al. (2007), Fields (2005), and Spatz (2005). The data collected from AEIS were analyzed with the Statistical Package for the Social Sciences (SPSS) 13.0 for Windows. Data analysis included specific statistical procedures for use in answering each research question.

As a result of the analysis of the data, this study produced empirical evidence of the relationship of student achievement among elementary campuses practicing vertical teaming in science and elementary campuses that did not utilized vertical teaming in science. The analyses answered the research questions and prompted suggestions for further studies.

Conclusions

Research Question #1

Is there a difference in student achievement as reported in AEIS between elementary campuses practicing vertical teaming in science and elementary campuses that do not utilize vertical teaming in science?

An independent sample t-test was conducted to evaluate the difference in student achievement for elementary campuses that practiced vertical teaming in science and campuses that did not practice vertical teaming in science (Table 4). The t-test of independent means indicated that there was a difference in student achievement between elementary campuses that practiced vertical teaming in science and campuses that did not utilize vertical teaming in science. The study revealed that the mean scores for campuses that did not practice vertical teams were higher than those on campuses that did practice vertical teaming. The t-test for independent samples, however, did not yield a significant difference in mean scores. As a result, there was no significant difference between the means of student achievement between those campuses practicing vertical teaming and those that did not practice vertical teaming.

One of the limitations of this study was that vertical teaming cannot be isolated from other reform efforts that the campuses have adopted that can contribute to student achievement. In addition, the TAKS test was first administered in 2003 and is relatively new to the testing program. It was also not possible within the confines of this study to determine the degree of implementation of vertical teaming. For these reasons, the researcher cannot arrive at a definitive conclusion that the effort to practice vertical teaming in elementary campuses in Bexar County, Texas had no significant effect on student achievement.

A related study in South Texas Regions 1 and 2 supported the findings for Research Question #1. Bergman, Calzada, LaPointe, Lee, and Sullivan (1998) investigated vertical alignment and collaboration in South Texas Regions 1 and 2. The researchers determined growth of student achievement on Grade 10 TAAS by calculating the difference between the 1997 grade 10 on percent passing all tests and the 1994 grade 10 on percent passing all tests. Their study also found no significant correlation between the degree of vertical alignment/collaboration and the percent of students passing all tests on the Grade 10 TAAS.

The findings in question #1 of this study are, however, contrary to indications from other research literature that asserted that teaming could result in significant gains in student achievement as measured on standardized tests (Flowers et al., 1999; Kremen & Kremen, 2001; Wheelan & Kesselring, 2005). Wheelan and Kesselring (2005) found that schools where teachers perceived that faculty groups functioned at higher stages of group development had significantly higher student achievement in science, citizenship, and reading than campuses where teachers perceived that their faculty group functioned at the lower stages of group developments. Vertical teams were a type of faculty group included in their investigation (Wheelan & Kesselring, 2005). In addition, Lee and Smith (1996) discovered that teaming can produce a sense of collective responsibility, which has shown to have a positive relationship with students' engagement and academic achievement. In each of the studies, vertical teaming was a type of teaming included in the investigations that yielded positive results; yet, the positive effects of vertical teaming as a tool to improve standardized test scores were not evident for the campuses in this study. Although the literature does not specifically address vertical teaming and science, the literature led the researcher to believe that vertical teaming would have a positive relationship with vertical teaming. Therefore, it was with caution that the researcher arrived at the conclusion.

Research Question #2

Is there a relationship between school variables (i.e., percent economically disadvantaged, percent English language learners, percent minority, percent mobility, and percent of experienced teachers) and student achievement on Science TAKS controlling for demographic variables?

Economically Disadvantaged

The study tested the null hypothesis that there was no relationship between percent economically disadvantaged and student achievement on Science TAKS controlling for the demographic variable. The two-way ANOVA compared three elements: (a) the impact of vertical teaming, (b) the impact of economic disadvantage, and (c) the interaction of the two (Table 7). In examining the impact of vertical teaming, the study found that in Bexar County, Texas, campuses that participated in vertical teaming and those who did not participate gained the same on the Grade 5 Science TAKS. In regards to the interaction of vertical teaming and percent economically disadvantaged, the means of the four economic quartiles across the two teaming options were the same. The impact of percent of economically disadvantaged did not change between the two teaming options. In other words, in Bexar County, Texas, the level of economic disadvantaged impacted campuses the same irrespective of vertical teaming participation on the Grade 5 Science TAKS.

However, the two-way ANOVA showed that there was a significant difference between percent economically disadvantaged and student achievement on Science TAKS. This finding was true for both groups in the study, vertical teaming campuses and non-vertical teaming campuses in science. The Scheffe *post hoc* indicated that the means of the bottom and mid-low quartile groups were the same. The means of the mid-low, mid-high, and top quartile groups were the same. Campuses in the top quartile and mid-high quartile statistically gained more on the Grade 5 Science TAKS than campuses in the bottom quartile. The top quartile and mid-high quartile had the lower percentage of economically disadvantaged campuses, while the bottom quartile contained campuses that had the highest percentage of economically disadvantaged students.

It can be concluded that the percent of economically disadvantaged students was a significant influence on student achievement as measured by Science TAKS, yet vertical teaming did not have a significant effect on student achievement. In Bexar County, Texas, campuses that had low percentages of economically distressed students were likely to have higher student achievement than campuses that had high percentages of economically disadvantaged students.

This conclusion is supported by research from Heck (2006) and Eisner (2001). Heck (2006) and Eisner (2001) found that students who are economically disadvantaged are behind their counterparts in standardized tests. They agreed that the greater the concentration of poverty, the lower the student achievement. Conversely, Wheelan and Kesselring (2005) found no significant difference in science student achievement in high- versus low- or average- poverty areas. With regards to growth across time, Heck (2006) noted that campuses with a high percentage of economically distressed students made slightly greater growth across time than students in higher socio economic status on the Stanford Achievement Test.

Percent of Minority Students

The study tested the null hypothesis that there was no relationship between percent of minority students and student achievement on Science TAKS controlling for the demographic variable. Three elements that were compared in the two-way ANOVA were (a) the impact of vertical teaming, (b) the impact of percent of minority students, and (c) the interaction of the two (Table 9). In examining the impact of vertical teaming, the study found that, in Bexar County, Texas, the means of both vertical teaming and non-vertical teaming campuses were the same. Therefore, campuses that participated in vertical teaming and those who did not participate gained the same on the Grade 5 Science TAKS.

Additionally, the two-way ANOVA indicated that there was no interaction between vertical teaming and percent minority. In Bexar County, Texas, the means of the four minority quartiles across the two teaming options were the same. The finding indicated that the level of percent of minority students impacted campuses the same despite vertical teaming participation on the Grade 5 Science TAKS.

Yet, in exploring the impact of percent of minority students, the study found a statistical difference. The Scheffe *post hoc* indicated that the bottom quartile was statistically different from the top two quartiles. Thus, campuses in the mid-high quartile and top quartile statistically gained more on the Grade 5 Science TAKS than campuses in the bottom quartile. The top quartile and mid-high quartile had the lower percentage of minority campuses, while the bottom quartile contained campuses that had the highest percentage of minority campuses.

This study indicated that the percent of minority students had a significant influence on student achievement as measured by Science TAKS, but vertical teaming when used with minority students did not have a significant effect on student achievement. In Bexar County, campuses that have low percentages of minority students were likely to have higher student achievement than campuses that have high percentages of minority students.

These findings were consistent with previous research findings. Heck (2006) and Sanchez et al. (2000) agreed that minority students had lower test scores than their counterparts. Eisner (2001) found significant achievement gaps between White and non-White urban test-takers. In regards to growth overtime, Heck (2006) found that minority students made slightly greater growth across time than their non-minority counterparts.

Percent of English Language Learners

The study tested the null hypothesis that there was no relationship between percent of English language learners and student achievement on Science TAKS controlling for the demographic variable. Three elements that were compared in the two-way ANOVA were (a) the impact of vertical teaming, (b) the impact of percent of English language learners, and (c) the interaction of the two (Table 11). In examining the impact of vertical teaming, the study found that, in Bexar County, Texas, the means of both vertical teaming and non-vertical teaming campuses were the same. Therefore, campuses that participated in vertical teaming and those who did not participate gained the same on the Grade 5 Science TAKS. For the impact of percent of English language learners, the study revealed that there was no significant difference in student achievement for percent of English language learners. Campuses in all four quartiles for percent of English language learners gained the same on Grade 5 Science TAKS. In investigating the interaction of vertical teaming and percent of English language learners, the study found the level of percent of English language learners impacted campuses the same regardless of vertical teaming participation on the Grade 5 Science TAKS. In Bexar County, Texas, there was no difference attributed to the interaction between vertical teaming and percent of English language learners.

The researcher concluded that there was no relationship between percent of English language learners and student achievement on Science TAKS controlling for the demographic variable. In Bexar County, Texas, the percent of English language learners impacted campuses the same. These findings were true for both groups in the study, vertical teaming and non-vertical teaming campuses.

These findings were in contrast to Herman et al. (2000). They concluded that ELL scored lower than English-proficient students on the Stanford Achievement Test (SAT) across all subject areas and grade levels. In regards to teaming, Fradd (1992) emphasized that collaboration addressed the needs of learners with disabilities and English language learners. She noted that bilingual teachers served as cultural informants and served as resources for the development of students’ English skills.

The assessment of ELL continues to be highly controversial. Some argue that it is not fair to test students in a language they do not understand that does not allow them to fully show what they know and can do in content areas such as math and science (Herman et al., 2000). Yet, others rely on ELL achievement and progress in order to monitor all students. In this study the researcher concluded that there was no relationship between percent of English language learners and student achievement controlling for the demographic variable.

Percent of Mobile Students

The study tested the null hypothesis that there was no relationship between percent of mobile students and student achievement on Science TAKS controlling for the demographic variable. Three elements that were compared in the two-way ANOVA were (a) the impact of vertical teaming, (b) the impact of percent of English language learners, and (c) the interaction of the two. In examining the impact of vertical teaming, the study found that, in Bexar County, Texas, the means of both vertical teaming and non-vertical teaming campuses were the same. Consequently, campuses that participated in vertical teaming and those who did not participate gained the same on the Grade 5 Science TAKS. For the impact of percent of mobile students, the study showed that there was no significant difference in student achievement for percent of mobile students. Campuses in all four quartiles for percent of mobile students gained the same on Grade 5 Science

TAKS. In investigating the interaction of vertical teaming and percent of mobile students, the study found the level of percent of mobile students impacted campuses the same irrespective of vertical teaming participation on the Grade 5 Science TAKS. In Bexar County, Texas, there was no difference attributed to the interaction between vertical teaming and percent of mobile students.

The researcher concluded that there was no relationship between percent of mobility and student achievement on Science TAKS controlling for the demographic variable. In Bexar County, Texas, the percent of mobility impacted campuses the same. These findings were true for both groups in the study, vertical teaming and non-vertical teaming.

This conclusion is contrary to the assertions of Rumberger (2002) that high student mobility rates have a negative impact on academic performance. Swanson and Schneider (1999) revealed that high student mobility in late changers in their sophomore and senior years, creates low achievement, while there was no evidence that educational mobility during early years in high school had an immediate effect on achievement. Mobile students may have personal and family problems that contribute to their mobility; therefore, researchers should take into account those prior characteristics in order to properly identify whether mobility is the variable for achievement (Swanson & Schneider, 1999).

Percent of Experienced Teachers

The study tested the null hypothesis that there was no relationship between percent of experienced teachers and student achievement on Science TAKS controlling for the demographic variable. The three elements that were compared in the two-way ANOVA were (a) the impact of vertical teaming, (b) the impact of percent of English language learners, and (c) the interaction of the two (Table 15). In examining the impact of vertical teaming, the study found that, in Bexar County, Texas, the means of both vertical teaming and non-vertical teaming campuses were the same. Hence, campuses that participated in vertical teaming and those who did not participate gained the same on the Grade 5 Science TAKS. For the impact of percent of experienced teachers, the study showed that there was no significant difference in student achievement for percent of experienced teachers. Campuses in all four quartiles for percent of experienced teachers gained the same on Grade 5 Science TAKS. In investigating the interaction of vertical teaming and percent of experienced teachers, the study found the level of percent of experienced teachers impacted campuses the same without consideration of vertical teaming participation on the Grade 5 Science TAKS. There was no difference attributed to the interaction between vertical teaming and percent of experienced teachers.

The researcher concluded that there was no relationship between percent of experienced teachers and student achievement on Science TAKS controlling for the demographic variable. In Bexar County, Texas, the percent of experienced teachers impacted campuses the same. These findings were true for vertical teaming and non-vertical teaming groups in the study.

Zigarelli's (1996) study supported these findings. Zigarelli found that the variable, of teacher experience, was not significant and did not have a significant effect on achievement (Zigarelli, 1996). In contrast, Sergiovanni (1992) declared that educators in mature faculty groups should be more committed than members of other groups to making improvements in curriculum and teaching methods necessary to improve student outcomes. Teacher experience is considered an indicator of teacher quality and even a predictor of student achievement (Darling-Hammond, 2003; Laczko-Kerr & Berliner, 2003; Rich & Almozlino, 1999), yet this study found that teacher experience did not have a direct positive effect on student achievement in science.

Implications

This study contributes to the understanding regarding the vertical teaming initiative in the subject of science and the relationship it has had on student achievement. With the topic of vertical teaming being relatively new, a few studies have researched the topic in a qualitative manner. Even fewer examine vertical teaming quantitatively. The findings of this study were both consistent and contrary with the literature regarding how campuses respond to improving student achievement in order to address both state and national accountability goals.

Because prior studies reinforced positive outcomes for faculty and student achievement regarding teaming, a positive relationship between vertical teaming and student achievement was expected. This study found that in Bexar County, Texas, there was no significant difference in campuses practicing vertical teaming and those that did not. Reasons for this difference could be that (a) the other studies addressed different forms of teaming strategies and did not exclusively focus on vertical teaming, (b) the campuses had adopted other reforms that can contribute to high student achievement, but were not identified, (c) and measurement of student achievement used in the studies was more firmly established and thus more stable. Consequently, the researcher cannot arrive at a conclusion with certainty that there is no relationship between vertical teaming and student achievement in science. The study cannot be used in any definitive way. The researcher cannot provide evidence that vertical teaming as a strategy in and of itself makes a difference.

In Texas, campuses are dealing with several unknowns with vertical teaming and science. Testing in science is relatively new nationally (2008) and in the state of Texas (2003). Educators are still becoming familiar with the test and standards. Although vertical teaming has been utilized in advanced placement courses at the secondary level, vertical teaming initiatives in elementary education are relatively new (College Board, 2004; Piland, 1981). In addition, there are varying degrees of implementing vertical teaming. Therefore, schools need to approach vertical teaming thoughtfully and carefully. Districts should consider employing campus leaders who practice transformational leadership. Administrative support is needed in order for new initiatives to be successful (Fradd, 1992). Clarifying the expected roles of staff members, and explaining the benefits and challenges of vertical teaming could be expected to improve the success of vertical teaming.

Vertical teaming is a complex event. Commitment in leadership is imperative in order to support and explain roles of the professionals involved. Roles for teachers include exchanging information of the curriculum at their assigned grade level and working cooperatively to develop a curriculum that provides a seamless transition from grade-to-grade. This process focuses on linking grade levels and possibly discovers gaps between grade levels in the curriculum. Although the collaboration and networking in vertical teaming provide a support system for the educators, in some instances, teachers may feel reluctant to share information. Administrators should be aware of this and address issues appropriately and swiftly. In addition, varying schedules of educators may make it difficult to meet; therefore, leaders can support vertical teaming efforts by using in-service time for the vertical teaming program.

Recommendations for Practice

The following recommendations are presented for consideration based on the findings in the study:

1. In Bexar County, Texas, there is not a difference in student achievement between elementary campuses practicing vertical teaming in science and elementary campuses that do not utilize vertical teaming in science as reported in AEIS. However, since the literature indicated studies in which vertical teaming was shown to impact student achievement, it is recommended that teachers should be interviewed after the conclusion of their school year in practicing vertical teaming in order to evaluate the vertical teaming process and develop suggestions for improving the process.
2. The data presented in the study illustrate the significant relationship between the percent of economically disadvantaged students and student achievement on Science TAKS. A higher the percentage of economically disadvantaged students on a campus resulted in lower student achievement on Science TAKS. For that reason, it is recommended that districts, state, and federal

agencies provide campuses with high percentages of economically disadvantaged students with more resources and greater flexibility in using those resources. For example, when a district chooses to use their resources for staff development, the training should include instructional opportunities in science for diverse populations and parental involvement strategies in order for all parents to become active in their child's science education.

3. The data reveled that there is a relationship between percent of minority students and student achievement. The higher the percent of minority students on a campus, the lower student achievement on Science TAKS. Therefore, it is recommended that elementary campuses invest in formal student support programs. The support programs could help students withstand the peer, economic, and societal pressures minority students face and should provide more individualized attention and instructional opportunities.

Recommendations for Further Study

Based on the information in this study, the following are recommendations for further research in this area.

1. A supplemental study could be performed to further investigate the findings. The recommendation is to include a qualitative element that could explore the data from the viewpoint of the practitioners.
2. This study focused on public elementary campuses. Further study could be conducted on public secondary schools and alternative campuses.

3. This study obtained the population for the study from the selected public school districts in Bexar County, Texas. Studies in other areas of the state would be useful in determining whether the results of this study are unique to the area in which it was conducted.
4. Further study comparing the relationship between student achievement on campuses practicing vertical teaming in science and campuses that do not practice vertical teaming in science should include a distinction in the degree of implementation of vertical teaming.

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