THE EFFECT OF A STATE DEPARTMENT OF EDUCATION MENTORING PROGRAM FOR TEACHERS ON SCIENCE STUDENT ACHIEVEMENT

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Gilda Darlene Lyon
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DEDICATION

This dissertation is dedicated to my family, parents William and Elizabeth Lyon, sister, Tanjie Lyon Kling, brothers, Randy and Bruce Lyon for always accepting my eccentricities with a laugh and a head shake, and for inspiring and encouraging me with a noble work ethic. I also dedicate this volume to my friends and colleagues in the Science Mentor Program who exemplify the true meaning of extraordinary educators: Dr. Juan-Carlos Aquilar, Adrian Neeley, Dr. Bernie Peiffer, Terri Hayes, Dr. Lanre Osindele, Dr. Warren Bernard, Dr. Betty Ellis, Cindy Hillsman, Anna Treohan, Linda Landers, Terry Belflower, Steve Tester, Teddye Martin, Jo Farrell, Kristen Crawford, Amy Heidt, and Linda van Horn. You will always have a podium in my classroom.

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Abstract

The purpose of this study was to assess the effect of the Georgia Department of Education Science Specialist teacher-mentoring program on student achievement on science standardized tests. This study analyzed the impact this program has had on student achievement in participating high schools when compared with high schools across the state where the program had not intervened. The Georgia High School Graduation Test, physical science end-of-course, and biology end-of-course test data, from a three year period, were collected from the Georgia Department of Education website and analyzed using an independent-t test and the Mann-Whitney test. While test score improvements cannot be entirely attributed to the Science Specialist mentoring program, the study revealed state-wide increases in physical science end-of-course tests and the Georgia High School Graduation Test scores over the three-year period in those schools participating in the teacher-mentoring program. Significant increases in students with disabilities populations and economically disadvantaged populations were also noted.

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INTRODUCTION

This dissertation research was an investigation into the effect of a statewide teacher mentoring program on improving student achievement on science standardized tests in Georgia public schools. The study will focus on the Science Implementation Specialist (SIS) program initiated by the state of Georgia to increase science achievement in high schools across the state.

Background

In 2001, Congress enacted Public Law 107-110 to be implemented in schools across America as a federal statute named No Child Left Behind (NCLB). Every state in the United States was required to demonstrate that it has adopted challenging academic content standards coupled with strong student academic achievement standards that will be used by that State, its local educational agencies, and its schools to fulfill this legislation (U.S. Department of Education, 2001, p. 20).

In order to comply with NCLB mandates, the state of Georgia instituted a Graduation Test which is administered during a student's junior year. The Graduation Test requires evidence of knowledge in English, mathematics, social studies, and science. The science portion includes questions from biology and physical science. Students must pass all four sections of the test in order to graduate from high school. A student has the opportunity to re-take the test if failed, as many as three more times prior to the graduation date he/she has in order to receive a high school diploma. A student may continue to take the test in the summer and on other subsequent testing dates after their target graduation date in an effort to secure the diploma even though they may not continue to be actively enrolled in school.

Other states have similar requirements for graduation. Alabama also requires a high school graduation exam that is first administered during a student's 10th grade year and again is given in the 11th grade year. Alabama's test also includes the same four core academic areas as Georgia (Alabama Department of Education, 2007). Tennessee does not require a graduation test but tests students in an end-of-course test in algebra I, biology, and English at the tenth grade in order to obtain a diploma. (Tennessee Department of Education, 2009). Florida administers the Florida Comprehensive Assessment Test (FCAT) to all 10th graders who must pass the reading and mathematics portion in order to earn a high school diploma (Florida Department of Education, 2009). South Carolina administers the High School Assessment Program (HSAP) to all students above the 9th grade and includes a test for English and mathematics (South Carolina Department of Education, 2008). The state of California also requires a state test called the California High School Exit Exam. This test is initially administered to students in the 10th grade and includes mathematics and English-language arts components only (California Department of Education, 2009). The state of New York requires passage of Regents Competency Tests of English (which includes reading and writing), United States history and government, global history and geography, science, and mathematics (New York Department of Education, 2005). The state of Michigan administers the Michigan Merit Exam to high school juniors that consists of tests in English language arts, mathematics, reading, and science at such a level of rigor that may be used for college placement. There is also a social studies component (Michigan Department of Education, 2008). State requirements and testing standards vary across the nation with Georgia testing more of the core subjects than some neighboring states but less than others when compared nationally.

The state of Georgia, in an effort to continue as a recipient of federal grant money, began the task of revising the Quality Core Curriculum (QCC) standards which teachers of the state use as their curriculum guides. Kathy Cox was elected superintendent of schools in 2002 and began an overhaul of state standards and accountability measures. The creation of the Georgia Performance Standards (GPS) has been at the forefront of her campaign as superintendent (Georgia Department of Education, 2005). Specifically related to this study, the GPS in science called for a re-tooling of the ways in which Georgia teachers taught science. Rather than the fact-driven instruction demanded from the old QCCs, the new GPS required that students read, perform, investigate, and apply knowledge to prepare for state standardized tests (Cox, 2004).

Many science teachers across Georgia were baffled when the poor results of the first state standardized test under the new GPS were reported (S. Pruitt, personal correspondence, April, 2008). Stephen Pruitt, the state science program manager at the time, proposed an idea for a program to Georgia state education superintendent Kathy Cox as a means of assisting science teachers in struggling schools. The program, named *Science Initiatives*, involved hiring veteran teachers from the classroom to travel to schools with low Georgia High School Graduation Test scores to work directly in the classroom hand-in-hand with science teachers. The Georgia Department of Education describes the goals of the program as follows:

> Science initiatives have been implemented to support and enhance the quality of science education in the state of Georgia. The goal of the science initiatives is to work at the classroom level to support, implement, and analyze best practices in science education. In order to accomplish this, the state has been divided into four regions. Each region has four science specialists with their main focus centered on classroom instruction. Their role is to mentor and support science teachers at the classroom level, communicate best practices and policies regarding science education, and to

communicate professional opportunities for science teachers (Georgia Department of Education, 2005, p. 1).

The science mentors program has science specialists divided over four regions of Georgia. Region 1 covers north Georgia including metro Atlanta, Region 2 covers east-central Georgia, Region 3 serves schools located in west-central Georgia with I-75 being the dividing line between those two regions, and Region 4 specialists assist schools in south Georgia. The science mentors program is unique to Georgia since no other state has implemented a parallel program. Even though the program is in its third complete year, no concrete data have been analyzed to provide evidence of its effectiveness.

School Selection Process

The science specialists serve schools that are chosen using a formula designed to rank schools based upon academic need (Aguilar, personal communication, July, 2007). The formula was developed by Dr. Juan-Carlos Aguilar, PhD, science program manager for the state of Georgia, by looking at all the indicators that schools used to make adequate yearly progress. The formula takes into consideration six indicators and assigns them a weight based on how important a particular indicator is considered for the determination of the amount of help that a school would receive. The six indicators, with their weights in parentheses, are:

1. Passing Rate on the Science component of the Georgia High School Graduation Test (GHSGT) (25%)

2. End-of-course test (EOCT): total number of students meeting plus exceeding standards for physical science (20%)

3. EOCT: total number of students meeting plus exceeding standards for biology (20%)

4. Graduation Rate (15%)

5. Adequate Yearly Progress (AYP) status (15%)

6. Number of students tested (5%)

The highest percentage is given to the GHSGT science-passing rate, as this rate is the primary reason students fail to graduate. EOCT results for biology and physical science received the second highest percentage. The GHSGT covers the same concepts as the EOCTs so they are considered good indicators of the GHSGT performance. The GHSGT concepts tested are divided into five domains: cells and heredity; ecology; structure and properties of matter; energy transformation; and forces, waves, and electricity. Georgia science administrators felt that addressing the needs of students taking biology and physical science should result in a decrease in the need for remediation interventions later on. The next two indicators, graduation rate and AYP status, provide information about the school's overall program. Graduation rate is an indicator used by several schools as part of their accountability, hence its importance in this study. The number of students in a school is used as an indicator to assure that the limited services available are used to serve the greatest number of students (J. Aguilar, personal communication, July 2007).

A number between 0 and 8, called the Overall Need Factor, determined the amount of support that a school was to receive. Schools with higher need factors were considered high priority schools and received the greatest amount of support (see Appendix A for a full analysis of the calculation of the Overall Need Factor).

Science Specialists

Selection

Job postings to the Georgia Department of Education human resources website indicated that veteran science teachers would be hired to become the science specialists (see Appendix C for the full qualifications of successful candidates). Strong candidates were those using research based best-practices in the science classroom, individuals willing to travel daily from school to school, and educators with personalities that encouraged relationship building with science colleagues. Teachers applied and interviews were conducted with a team of four or five science educators from the Georgia Department of Education conducting the interviews. Successful candidates were then called and offered a position. Interviews continued until a contingent of 16 specialists was employed (J. Aguilar, personal communication, July 2007).

Interventions

The role of the science specialist is to mentor science departments in the assigned schools to implement best practices in science instruction. This includes but is not limited to modeling good instruction in classrooms, assisting teachers one-on-one with planning, observing during instruction and providing feedback, assisting with the development of instructional materials to enhance the teaching/learning process (this includes the use of manipulatives specific to science), assisting with labs, developing laboratory skills in individual teachers, providing reinforcement and acquisition of content where needed by teachers, introducing literacy skills within the content area, helping teachers with organizational skills in relationship to the classroom environment, introducing strategies for increasing time on task, and assisting with classroom management (B. Peiffer, personal correspondence, May 2007).

Problem Statement

Increased accountability measures imposed upon teachers and schools have decreased the amount of time allowed to teachers for planning and collaboration. Teachers attend professional-development learning opportunities, but find little time to plan for implementation of said learning. Exposing classroom science teachers to best practices via science implementation specialists working with teachers in classrooms was expected to provide much-needed assistance to stressed teachers. Some schools began in 2005 with only one, two, or no students passing a particular standardized test. For some schools, within three years, even if only 30% were passing, the growth rate was greatly improved, but the data became skewed with some schools appearing to having large increases in student test performance, yet still being considerably below acceptable performances on standardized tests. However, there had been no formal analyses of collected data to determine if statewide science mentoring was effective in terms of student achievement on standardized test scores.

Purpose of the Study

The purpose of this study was to evaluate the effect of Georgia's statewide teacher mentoring program on improving student achievement on science standardized tests. This study analyzed the impact of this program on student achievement in the participating high schools when compared with high schools across the state where the program had not intervened.

Research Questions

Questions considered for the dissertation were:

1. Does student achievement, as measured by biology end-of-course test scores, increase for schools participating in the Science Specialist program?

2. Does student achievement, as measured by physical science end-of-course test scores, increase for schools participating in the Science Specialist program?

3. Do scores on the science portion of the Georgia High School Graduation Test increase for schools participating in the Science Specialist program?

Significance of the Study

Every state in America that chooses to receive federal dollars for state education is mandated by the United States Government to implement an accountability program designed to determine student achievement (U. S. Department of Education, 2001). While the ideals of this law are noble ones, the implementation at the classroom level continues to be difficult (Snow-Gerono & Franklin, 2006; Mabry and Margolis, 2006). The American public increasingly maintains that the law is unreasonable (Azzam, 2004; American Teacher, 2006; Trotter, 2007). Georgia is no exception to the states that have been affected by NCLB and the past four years have been difficult as the state rolled out its Georgia Performance Standards (GPS) for all subject areas. Specifically, Georgia science students must take an end-of-course test (EOCT) in biology and physical science and a Georgia High School Graduation Test (GHSGT) that includes biology and physical science. Students must pass the GHSGT in all subject areas tested in order to graduate. Georgia tests students in social studies, English, mathematics, and science.

Georgia requires that 70% of students in a school pass the graduation test in order for a school to remain off needs-improvement status, which is imposed by the state. Schools that remain in needs-improvement status for six years are mandated to follow a state curriculum map in all subject areas regardless of which subject area was the culprit. Science has been the harbinger of bad news for most schools that were on needs-improvement status, as it is often the science portion of the test that keeps students in schools from achieving the graduation test requirement. The science mentor program was implemented as an intervention to prevent schools with needs-improvement status from continuing down the slide to state mandates. The science mentors (specialists) work in the classroom modeling best practices, providing teachers feedback and assisting with instructional materials development to aid improved teaching. The role of the specialist is not one of evaluator but of mentor. Regardless whether the teacher is new to the field or a veteran, mentors work by developing trusting relationships that encourage teachers to open their classroom to share problems and successes (B. Peiffer, personal correspondence, May 2007).

Role of Mentors in Schools

When the science mentors have been assigned the high/medium intervention schools in which they will work, based upon test score data, the first step is an introduction to the principal and usually the science department chair of each school. At the initial meeting, a general overview of services to be offered is presented, test-score data may be shared, and an introduction to the entire science faculty is offered. A date for the second visit is set and observation schedule is determined.

The second visit is an observation time for the mentor, who will go into each teacher's classroom and observe the student-teacher interactions and get a general feel for the pedagogy used in the class. Subsequent visits result in the determination of a science department action plan for the school year based upon a departmental self-evaluation. This provides a focus for the science mentor and allows the science department some control over what types of assistance they feel they need from the mentor. Future visits may include working with specific teachers during their planning time on areas the department has pinpointed as a need.

Often, the mentor will meet with the entire science department after school or during the school day if the department has common planning. The School Improvement Plan (SIP) is also considered by the science mentor and if the SIP calls for a school-wide literacy focus, for example, then the mentor will help science teachers find ways to incorporate literacy strategies into their classes. If the mentor introduces a new instructional strategy to a teacher(s) and a particular teacher is uncomfortable using it, the mentor will model the strategy for the teacher with his/her students. Sometimes the entire department may watch the modeling session. Some mentors set up a rotating observation schedule for the department where each teacher observes colleagues during instruction. There is always a feedback debriefing after these observations. The mentor works with science teachers to improve assessments, improve classroom management, increase the rigor and relevance of instruction, increase the rigor and number of laboratory experiences, and move teachers toward inquiry based instruction. This can involve creating and setting up laboratory experiences for students as well as actually conducting the lab with the teacher.

The mentors try to develop a sense of collaboration among the science faculty and encourage common assessments and planning for lessons together. Mentors also provide constructive feedback after observations that focus on improving instructional practice. Observed teachers are asked to reflect upon their lesson delivery and student response while the mentor points out areas where improvements could result in greater student engagement and learning.

Additionally, the mentor works with inclusion teachers to provide them with ideas to better prepare students with disabilities. This usually includes developing manipulatives to aid in instruction and focusing on specific strategies to aid them during labs and on homework. Science mentors also keep in contact with their teachers by e-mail and often send teachers materials and/or websites that may assist specific teachers in some area they need. Teachers have the mentor's phone number and know they have access to the mentor at anytime they need help. Over the course of this first year, a relationship of trust and camaraderie develops between the teacher and mentor that produces a sense of loss when the school improves and the mentor is not assigned to the school any longer. (T. Hayes, personal communication, 2008; C. Hillsman, personal communication, 2008; B. Peiffer, personal communication, 2007; S. Tester, personal communication, 2009; L. Landers, personal communication, 2009).

Research is needed to determine if this type mentorship is effective. While anecdotal evidence and precursory data leads us to believe the program is headed in the right direction, more substantial analysis would provide the evidence needed to sustain and possibly expand the program. This study can also result in implications for use in other states and other subject areas.

Delimitations

This study focuses on science test scores for public high schools located within the state of Georgia. Test results for other subject areas are not addressed because the science specialists work only with science teachers. The results only reflect the first three years of the Science Implementation Specialist Program. Schools are identified by the science specialists and services to the highest-needs schools are offered. Once experimental schools are identified as a result of the factors posted in Appendix A, the superintendent for the school district in which the identified school resides must be contacted by each region coordinator for approval. A superintendent may request that science mentors not work in their school district. In that case the school that may have needed services but electing to refuse the services was relegated to the control group.

Results for the GHSGT were from first-time test takers when they are in the 11th grade. The statistics do not include students' results from re-taking the test. Results of the end-of-course tests are from students enrolled in those courses, regardless if they have taken the course previously and failed. Test results from alternative schools, magnet schools, charter schools, state schools for the deaf, middle, and elementary schools are beyond the scope of this study. Students who are remanded to an alternative school are still required to be tested, but their scores are returned to the base school regardless of whether the student is attending another school with a different teacher. The home base is required by the state to count the test results of alternative students regardless of the qualifications or credentials of the teacher at the alternative school.

Many school systems employed their own science specialists or instructional coaches to work with teachers. The decision not to serve those school systems was only reached when the school system was large and the bulk of the schools in that particular region of Georgia were too overwhelming for the specialists' attention.

Many students take physical science in the freshman year of high school then continue on into biology for the tenth grade year. However, the Georgia High School Graduation Test (GHSGT) is not administered to first-time test takers until their eleventh grade year. Therefore, a lag time of up to two years between students taking physical science and the GHSGT is possible. This could account for a lowering of scores on the GHSGT.

The researcher for this study was employed by the Georgia Department of Education as one of the science mentors for the final year of the three years for which data was collected. However, all data was collected from the Georgia Department of Education website after it had been vetted by the state department. No data used in this study was collected by the researcher from a school or from teachers.

Limitations

There are many variables that influence student achievement. This study does not purport to control for the multiplicity of variables facing teachers on a daily basis when instructing a diverse group of students. This study only looked at the data available in schools where science interventions occurred at some consistent level to determine if there were possibilities that the interventions influenced science achievement.

It is realistic to recognize that some improvements in test scores may have come about because of the *Hawthorne effect.* This effect has been noted by psychologists when subjects increase desirable behaviors simply because they are getting increased attention (McMillan and Schumacher, 2006). This might occur because science specialists visited teachers' classrooms and attention was focused on the teacher. That fact may have caused the teacher to improve instruction as a result. If this occurred on a regular basis, as it did in the high intervention schools, instruction might obviously improve simply because the teacher and mentor are collaborating, the mentor observes the teacher during instruction, and now the teacher receives focused attention previously not received. The natural inclination is for a teacher to represent him/herself well would surface during a visit by a mentor regardless of the mentor's relationship with the teacher. Laboratory experiences, manipulative activities, and other hands-on instruction might become more frequent in these teacher's classrooms resulting in improved instruction and thus improved test score results.

Additionally, no formal training or mentoring instruction was provided to the science mentors. Therefore, each mentor approached his or her school assignment in a manner consistent with his or her own personality, knowledge, and experience. This resulted in 16 different approaches to the mentoring program.

Definitions

Adequate Yearly Progress: The progress needed by schools each year, as demonstrated on standardized tests, in order for the school to avoid "needs improvement" status.

Alternative Schools: Schools in Georgia that are designed to address the specific needs of students who do not function acceptably in regular schools, i.e. fighting, zero tolerance cases, drugs, etc.

Coaching: When a person with expertise in a certain area works with another person in a sports, skills-building model that is short term to increase his/her growth in that area.

Economically Disadvantaged Students-Students who come from families recognized by the United States Department of Health and Human Services as living in poverty. These students are recognized because they are eligible for free or reduced lunches.

End-of-Course Test: Tests administered at the end of specific courses in the state of Georgia. These are not high stakes, but they do count as a portion of a student's semester grade.

First Time Test Takers: Students who are in the 11th grade for the first time and are required to take the Georgia High School Graduation Test in science, social studies, English and math.

Georgia High School Graduation Test: High stakes test administered to all Georgia high school students during their junior year.

High Intervention: Intervention in a school by a Georgia science specialist on a weekly basis or a minimum of three times per month.

High Needs Classroom: Classrooms with a majority of economically disadvantaged students and/or students with disabilities.

Intervention Schools: Schools having a high or medium intervention by Science Implementation Specialists.

Low Intervention: Intervention in a school by a Georgia science specialist only one time in a year, usually at the request of the school for some particular program or work session that may be designed especially for the particular needs of the teachers in that school or no times in a year.

Medium Intervention: Intervention in a school by a Georgia science specialist at least two times per month.

Mentoring: When a person with expertise in some area works with another in a long term relationship to assist in his/her growth in that area.

Needs Factor: A number determined through a calculation designed to order schools in terms of greatest to least need.

Needs Improvement: Status applied to a school that does not make adequate progress on student test scores from year to year. In Georgia, needs improvement can be assigned from 0, for schools who make adequate yearly progress (AYP) to a 10, for 10 years in a row without making AYP.

Non-intervention Schools- Schools having a low or no intervention by Science Implementation Specialists.

Science Implementation Specialist: A person hired by the Georgia Department of Education for the sole purpose of mentoring teachers in schools with low science scores on state standardized tests.

State Schools: Schools run by the state of Georgia to address the needs of hearing and visually impaired students.

Student Achievement: Student performance on the Georgia physical science end-of-course test (EOCT), the Georgia biology end-of-course test (EOCT), or the Georgia High School Graduation Test (GHSGT).

Students with Disabilities-Students requiring specially designed instruction to meet his or her learning goals.

Overview of Methodology

Georgia public high schools that have been served by the Science Implementation Specialist program and Georgia public high schools that have not been served have been compared to determine if interventions by the Science Implementation Specialists have been effective in terms of science student achievement. Service to schools could be classified by three types of interventions: high, medium or low. High interventions were those schools served on a weekly basis but with a minimum of three visits per month. Medium interventions were schools served bi-weekly or during two visits per month. Low interventions were those schools served only once or twice per year. These were considered to be "on-call" schools and were served usually at the request of the school. This study focused on those schools with high and/or medium interventions for at least two of the three years studied for this research.

The levels of improvement over a three-year period of physical science end-of-course test scores, biology end-of-course test scores, and Georgia High School Graduation Test scores, were analyzed to determine if statistical significance existed between schools served and those not served. Additionally, test scores were disaggregated for rural schools, small city schools, mid-sized city schools, urban schools, and student body size to determine any statistical significance there as well. Each of these subcategories was further disaggregated by economically disadvantaged students (EDA) and students with disabilities (SWD). Each of these disaggregates was submitted to an independent-t test and the Mann-Whitney test. Any tests with extreme scores that extended beyond three standard deviations from the mean (outliers) were removed from the test analysis.

Furthermore, to insure no threat to validity, a regression to the mean analysis was conducted on test scores from the beginning year to the final year of testing. The regression analysis was conducted on all test results that indicated a statistical significance.

Summary of Chapter One

Chapter One introduced the purpose of this study which was an investigation into the effectiveness of a statewide mentoring program designed to assist science teachers in the effort of improving student achievement. Research questions were posed and the significance of this study was discussed. Terms to be used throughout the study were defined and limitations and delimitations to the study were outlined. A brief overview of the methodology planned for the study, which include the independent-t tests, the Mann-Whitney, and a regression to the mean analysis, was highlighted. Chapter 2 provides a review of the literature followed by a brief description of the methodology in Chapter 3. The two final chapters, Chapters Four and Five describe the statistical analyses, present the results and interpretation of those analyses, and provide conclusions and recommendations for further research.

CHAPTER TWO

REVIEW OF THE RELATED LITERATURE

This research began with the problem of determining the effectiveness of the Georgia Department of Education Science Specialist mentoring program. The purpose of the study was to test the effectiveness of the Georgia Department of Education Science Specialist mentoring program. Other purposes of the study were to review student achievement on physical science end-of-course tests, biology end-of-course tests, and the Georgia High School Graduation Test as a function of the school's participation in the Georgia Department of Education Science Specialist mentoring program.

History of Mentoring

Mentoring programs or apprenticeships have been reported since Odysseus left his son Telemachus in the trusting care of Mentor in Homer's epic poem of Greek mythology. The first modern usage of the term originated from the French writer, Francois Fenelon in his book *Les Aventures de Telemaque,* published in 1699 with the lead character named Mentor (Roberts, 1999). It is the role of that character that led to the modern definition of the term.

Definition and Purpose of Mentoring

Sociologist Morris Zeldtrich (1990) defines mentors as:

advisors, people with career experience willing to share their knowledge; supporters, people who give emotional and moral encouragement; tutors, people who give specific feedback on one's performance; masters, in the sense of employers to whom one is apprenticed; sponsors, sources of information about and aid in obtaining opportunities; models, of identity, of the kind of person one should be to be an academic (p. 43).

Stoddard (2003) differentiates between mentoring and coaching by defining c*oaching* as the sports, skills-building model that is short term and *mentoring* as a relationship model that is long term. He writes that coaching and mentoring may be used interchangeably, but mentoring is meant to address the whole person and is oriented around relationships.

Statistics gathered by the National Center for Education Statistics in 2008 indicate that only 13.5% of teachers who graduated in 1993 were still teaching, and that most leave teaching because of low pay, poor leadership support, and lack of professional support (Anderson & Carroll, 2008; Carroll & Fulton, 2004). States have become desperate to intervene in this continuing trend in teacher attrition and have begun to implement mentoring programs in an attempt to stem the tide of teacher losses. Mentoring serves many positive purposes that include increasing job satisfaction, easing the transition from college to the classroom for new teachers, reducing teacher attrition, and increasing the effectiveness of new teachers (Holloway, 2001; Archer, 2003; Feiman-Nemser, 2003).

Mentorship Models

One of the most recent models of mentorship is referred to by Scorcinelli and Yun (2007) as *mentoring partners*. This is a collaborative partnership with the mentor as well as the mentee benefiting, as both partners bring new learning to the relationship. Another model, the *double mentor program*, where a protégé has a mentor from two different organizations, has successfully been implemented on Wall Street with the Mason School of Business from the College of William and Mary in Williamsburg, Virginia (AACSB, 2007).

Mentor Programs As Support Structures

School and District Level

One school in Wakefield, Rhode Island, utilizes science mentors who teach class one day per week with the regular teacher observing. The teacher is able to observe effective science instruction and how to organize and manage the classroom (Mangiante, 2007). The Hamilton County Department of Education in Chattanooga, Tennessee conducts a county-wide mentoring program, which includes every school. Individuals from each school are paired with new teachers and trained by district officials to mentor. A checklist of activities and deadlines for accomplishment is submitted at the end of the year to the district for a stipend to the mentor teacher. The purpose of the program is to provide new teachers with a support person who assists them with issues inside and outside of the classroom (B. Traughber, personal correspondence, May 2008).

Addressing the issue of teacher retention, rather than the improvement of teacher quality, seems to be the focus of many school-based mentoring programs. Since implementing a district-wide mentoring program, Lawrence, Massachusetts has seen an increase in the number of teachers they retain after their first year (from 50% to 85%) and after three years (62%) as compared to what it was before implementation (Metz, 2007). The State University of New York at Brockport and the local school district have implemented the Collaborative Internship Masters Program (CIMP) that allows graduates to intern for one year under the tutelage of a mentor in one of the local schools. The graduates complete the program with their master's degree and one-year of experience under their belt. The emphasis is on teacher quality with improved retention being a positive by-product (Schlosser and Balzano, 2002). Wicomico County Public Schools in Maryland developed a teacher-mentor program using retired educators on a part-time basis, as well as using other teachers pulled from the classroom as consultants and assigned to high-need schools. In the Wicomico County schools, the mentor-consultants provide professional development and one-on-one mentoring to new teachers (Leimann, et al, 2008).

State Level

One of the first mentoring programs to focus on teachers statewide was implemented by the state of Alaska. The Alaska Statewide Teacher Mentor Program releases veteran teachers from their classroom in order to mentor beginning teachers across the state. Collaboration from teachers, principals, superintendents, universities, and the state department of education make this program a comprehensive initiative with the goal of retaining and improving beginning teachers (Sampson, 2005). The state of Connecticut conducted an experimental mentoring program during the 80s with the goal of cultivating mentoring relationships among teachers. A seminar for interested staff provided the impetus for a successful process that continued for many years; it was a volunteer program to help provide guidance to young teachers (Krupp, 1984).

The Need for Mentors

Providing practice and internships is common in areas such as medicine, law, electronics, etc., but graduates of teacher education schools are considered to be ready to handle the daunting task of a full classroom. Danielson (1996) described it best when he wrote, “teachers, from the moment they are awarded their first license, are considered full members of the profession” (p. 6). Darling-Hammond (2007) called for the need to invest more money and to train teachers through effective mentorship programs. Thus, talented teachers who struggle in high-need classrooms would have the support base they need to be successful and continue in the profession. The large-scale exodus of beginning teachers from the classroom has been documented extensively over the past ten years. Anderson (2000) reported that approximately 50% of teachers leave the profession within the first five years. DePaul (2000) provided evidence of a 20-30% teacher exodus within the first three years. Weiss & Weiss (1999) documented a first year exodus of 9.3%. Additionally, Adams, and Krockover (1997) found that beginning teachers felt a lack of pre-service dedication to problems related to classroom management, time management and curriculum development.

Demands for teachers in areas such as science, mathematics, and special education have added to the challenges school districts face when staffing schools with experienced instructors. Creating alternative certification programs has resulted in classrooms with teachers who may be content strong but lack the effective pedagogical skills required to be successful. All 50 states and the District of Columbia offer some alternative route to teacher certification that leaves school districts with the challenge of developing induction programs that meet the needs of these inexperienced teachers (Feistritzer, 2008). A recent study conducted by The Battelle Memorial Institute (2009) reports that a systematic approach to teacher professional development is critical to improved instruction and increased student achievement.

Role of Mentors

Smith and Ingersoll (2004) found that teachers were more likely to continue teaching if they had a mentor within their content area. Gschwend and Moir (2007) report that the

University of California's New Teacher Center at Santa Cruz is moving to a mentoring system that is more group oriented rather than focused on one-to-one mentoring. This has improved teacher collaboration, co-planning, use of student work protocols, interventions using student case studies, and identification of teacher learning gaps. According to Ellen Moir, the Center director, an inquiry model seems to work best for improving teacher practice when the mentoring tool allows for teacher reflection to identify challenges, take actions, and create next steps in the teaching/learning process. Shea and Greenwood (2007) found that mentors of alternatively certified teachers recognized pedagogical skill weaknesses that were rated high from the mentees themselves. Traditionally licensed teachers were rated higher in pedagogical skills than alternatively certified teachers by mentors. The researchers suggest mentors might need to focus on skill development in alternatively certified teachers and on demonstrating and modeling how to use formative and summative assessments to facilitate instruction.

Every teacher has a unique personality and style. The role of the mentor is not to create clones of himself or herself but to assist the new teacher in developing his/her own effective style when dealing with classroom issues and instruction (Hicks, et al, 2005).

Benefits of Mentorship

The shortage of teachers across the country, specifically special education, math, and science teachers, seems to be alleviated somewhat by alternative teacher-certification programs.

While data supports the idea that traditionally prepared teachers feel more confident in their teaching assignments than do alternatively prepared teachers whose confidence level is small, this is probably due to a lack of successful mentor programs for the alternative teacher-certification programs (Darling-Hammond, 2002; Zientek, 2006).

Problems with Mentor Programs

Many mentor programs tend to build teacher efficacy one teacher at a time. While this is worthwhile, a study conducted by Goddard, et al (2004) found that increasing a faculty's collective efficacy is more beneficial than focusing on individuals. Additionally, few mentor programs train the mentors themselves, and often the mentor's skills and potential remain stagnant (Hansona and Moir, 2008).

Science Mentor Programs

The National Science Teachers Association facilitates the development of beginning science educators with an official position statement recommending the creation of induction programs within schools (NSTA, 2007). In 2006, the Illinois state legislature passed a bill funding new teacher induction programs to be implemented in schools across the state. This program, aimed at improving educator quality, was piloted in ten diverse school districts to develop a framework for providing high quality induction mentoring programs for all Illinois teachers (Gates Foundation, 2007).

Mentor Effectiveness

The New Teacher Center (NTC) developed at the University of California in Santa Cruz produces one of the premier new-teacher induction programs in the nation. The New Teacher Center hires mentors to serve 15-20 novice teachers on a weekly basis. The NTC uses tools such as protocols, formative assessments, and inquiry in order to allow young teachers to reflect and improve upon their own practice (Olson, 2007). Koballa, et al (2008) suggests that model programs should be developed, based upon the perception of the role of the mentor by each participant. The conceptual compatibility of each partner toward the mentor's role should be considered whether the role is one of a personal-support person, of an apprentice, or one of co-learners, mentor pairings. Koballa suggests that mentoring can help teachers by strengthening content knowledge and instructional practice, which can in turn affect student achievement.

United States Secretary of Education, Arnie Duncan, hails a recent program called the Teacher Advancement Program (TAP) implemented in the Chicago Public Schools during his tenure as superintendent there. This program aligns pay-for-performance with teacher mentorship and student achievement as measured by standardized test scores. The program emphasizes teacher collaboration as the cornerstone of teacher efficacy and resulted in improved student test scores in schools implementing the program over the past five years (Sawchuck, 2009; Jerald, 2009). Although this program shows test score improvements, it is difficult to ascertain if it is the mentorship or the pay-for-performance that is enhancing test score results.

A recent study by Murray, et al. (2009) on mentors and student achievement in math found that mentors often focus on "soft feedback" that encourages and validates what the teacher is actually doing in the classroom and provides little reflection on practice and few meaningful analyses of how to improve classroom instruction. Mentors seemed focused on not hurting the teacher's feelings rather than providing the "hard feedback" essential to make real changes in instruction. This researcher provides insights into mentorship relationships that provide a façade of collaboration and positive feedback but result in no improvement in student standardized test scores.

Summary of Chapter Two

The preponderance of the literature suggests that mentorship is an effective tool for retaining and improving teachers and instruction. Most mentorship programs are centered around induction and are designed to reduce attrition of young teachers from the field. Few programs center on helping any teacher with specific instructional needs, regardless of the number of years in the classroom. More recent literature offering suggestions for mentorship models to assist young teachers in improving their practice seem to be moving toward an instructional focus (Shea and Greenwood, 2007; Murray , 2009). However, few studies connect mentorship with student achievement. Koballa (2008) indirectly ties mentoring to student achievement, but his research focuses on mentor/mentee perceptions of each other so that successful mentorships may be created, rather than making a direct link to student achievement.

Chapter Three

METHODOLOGY

The purpose of this study was to ascertain the impact of the state of Georgia's Science Implementation Specialist Program on student achievement on the biology end-of-course test, physical science end-of-course test, and the science component of the Georgia High School Graduation Test. The study employed a quantitative analysis of the State of Georgia test data using procedures described in this chapter. The sections include the research design, the population and selection of the experimental and control group schools, procedures and data collection methods, and data analysis.

Research Design

The study employed an *ex post facto* research design that compared three years of biology end-of-course, physical science end-of-course, and the science component of the Georgia High School Graduation Tests results in schools with high to medium interventions for a minimum of two years to the same test results in low intervention and non-intervention schools. It was assumed that the state of Georgia maintains validity and reliability in these state tests. The study will divide test results into two groups: high schools across the state of Georgia which will differ only in the variable of having science specialists/mentors in one group and not the other.

School years chosen for the study were 2005-2008 for end-of-course tests and 2005-2007 for GHSGT results. The GHSGT changed in year 2008 and cut-off scores were different from the previous three years, therefore invalidating the use of the 2008 GHSGT test data in this study. Scores used were for end-of-course tests in biology and physical science and first-time test takers in the Georgia High School Graduation Test. The study did not use data from students who retook the test after having failed it in a previous test administration because those data are not reported with the first-time testing cohort. No test data from any other subject area were considered since the Science Specialist Program worked predominantly with science teachers.

Population and Selection of Experimental and Control Group Schools

Individual schools were chosen as the unit of study. Schools in group one (experimental group) were chosen from Georgia public high schools that have received the services of a science mentor for at least two years at a medium level (intervention in a school by a Georgia science specialist at least two times per month) or three years at a medium to high level (intervention in a school by a Georgia science specialist on a weekly basis or a minimum of three times per month). This consisted of 71 public high schools across the state of Georgia as shown in Appendix B. Schools in group two (control group) were Georgia public high schools that had never received services of a science mentor or had received services only one time at the request of the school. The control group consisted of 261 high schools across the state of Georgia. A total of 332 high schools were used in this study. Magnet schools, charter schools, and alternative schools were excluded from the study because they had not been served by the Specialist Program due to the specific nature of the student population in those schools.

School size, type of city where the school was located (rural, small city, mid-sized city, or urban as defined by the United States Census Bureau), and student diversity indicators (students with disabilities and socio-economic status) were used to disaggregate or narrow comparison groupings to the most similar schools within each group. Multiple schools were chosen as matches for each experimental and control group to lend weight and robustness to any statistically significant differences found in the data between the two groups.

Methods and Procedures

Data from the 332 schools chosen for this study were collected from the Georgia Department of Education Testing Website, which reports all standardized testing data for every school in the state. The data were organized into experimental and control groups that included comparison data between all schools served and those not served. Further tests were conducted on disaggregated data to include school size based upon student population, size of city where the school was located, students with disabilities, and economically disadvantaged students.

The primary value analyzed for each school test result was the percent change. This is defined as the change in a value over time (Niles, 1995). The percent change in test scores for each school between testing year 2006 and 2008 was calculated by subtracting the 2006 test score from the 2008 test score then dividing by the 2006 test score and multiplying that result by 100. The percent change in each school for each test category was statistically analyzed using the Statistical Package for the Social Sciences (SPSS). Percent change results from the experimental and control groups in each of the key variables were tested for significant differences using an independent t-test. The independent t-test was used because the experimental and control groups come from two different populations; all data were from a post-test-only design. The data for this study were examined for extreme variances and outliers. Any outliers beyond three standard deviations from the mean were removed. The data were also subjected to the Mann-Whitney statistical analysis because this test is appropriate as an alternative to the independent-t test when the assumption of equality of variance is not met. Additionally, analysis to determine if the results suggest a regression toward the mean was conducted on all data sets. This was done by running a Pearson r statistical test on each significant result and then subtracting 1-r and multiplying times 100 to determine the regression threat. These analyses were used to answer and examine each research question.

Summary of Chapter Three

The methodology utilized for this *ex post facto* study was to collect test data from three Georgia state science tests and compare the results of each test for experimental groups with high to medium science mentor interventions to control groups with low or no interventions for a period of three years. See Appendix B for a list of schools having high to medium interventions. The percent change for each of the tests over the three-year period was determined and the percent change in the test results was compared using an independent-t test and Mann-Whitney for statistical significance with a regression to the mean test to determine if improvement was a normal statistical phenomenon or as a result of science teacher interventions.

CHAPTER FOUR

ANALYSIS OF DATA

The statistical analysis, numerical data, and research-question testing are presented in this chapter. All results were calculated using the Statistical Package for the Social Sciences (SPSS). Student achievement data for Georgia High Schools were obtained from the Georgia Department of Education Testing Website via the Internet. The state of Georgia collected these data from the biology end-of-course tests results that were administered at the completion of a biology class, the physical science end-of-course tests results, administered at the completion of a physical science course, and the science portion of the Georgia High School Graduation Tests results, administered during a student's junior year in high school. The Georgia High School Graduation Test encompassed biology and physical science questions. All three tests were multiple-choice untimed tests administered by teachers. There were 71 high schools that were intervened by the Georgia Department of Education Science Implementation Specialists at a medium to high level for a minimum of two years and 261 schools with little or no interventions from the Science Specialists. See Appendix B for a list of schools with medium to high interventions over the three-year study period.

A discussion of the results relative to each research question is followed by a presentation of the data in a table. The tables for the standardized biology end-of-course tests, physical science end-of course tests, and Georgia High School Graduation Tests identified for this study present the means, standard deviations, t-test results and degrees of freedom for experimental schools (those with high to medium Science Specialist interventions with science teachers) and control schools (those with minimal Science Specialist interventions with science teachers). Independent-t tests and Mann-Whitney tests were used to determine whether a statistically significant difference existed between the means for the control and experimental schools for each hypothesis. There were more control group schools in the total population than there were experimental group schools. Outliers were removed to control for variance differences prior to subjecting data to the independent-t statistic. Since, for some schools, the data could be argued to be nonparametric, additional tests for statistical significance were administered using the Mann-Whitney test. In order to recognize any regression artifacts that may have occurred from one testing year to the next, a Regression to the Mean analysis was conducted using the Pearson correlation test and submitting the *r* statistic to a more rigorous examination using the formula for percent regression to the mean = ($P_{r\,m}$=100(1-r).

Research Questions

Research Question One

Is there a statistically significant difference in the means of test scores on the biology end-of-course tests between those science teachers who received interventions by the Georgia Department of Education Science Implementation Specialists and those who did not receive interventions? Georgia Science Specialist interventions appear to be having significant impact in several areas. Independent t-tests showed there were significant differences to support the research hypothesis that the science mentor program resulted in significant differences in student test scores for biology. In particular, test scores for biology in students with disabilities, $t(55)=1.959$, $p=.05$ showed significant improvements. Similarly when test scores of intervention schools and non-intervention schools throughout the state were compared, economically disadvantaged students, urban students, and schools with greater than 2000 students in biology end-of-course tests, showed significant improvement as shown in Table 4.1.

Statewide data were further disaggregated by subjecting the sub-groups of students with disabilities (SWD) and economically disadvantaged (EDA) of rural schools, schools in small cities, mid-size cities, urban schools, and the various student body populations to an independent-t test to determine if interventions were significant in those subgroup populations. Biology data shown in Table 4.2 indicate significant intervention impact for economically disadvantaged students attending school in a rural area and in schools with greater than 2000 students. Biology data shown in Table 4.2 indicate significant intervention impact for students with disabilities who attended an urban school or a school with a student body population between 1000-1500.

The independent-t test for biology end-of-course tests for experimental and control groups indicated the most significant results were found for economically disadvantaged populations across Georgia and for students testing in biology in schools with a student body greater than 2000.

Table 4.1

Distribution, Means, Independent-T Test Results for Biology End-of Course Tests for Experimental and Control Groups in All Georgia High Schools

All Georgia High Schools (AGHS)					
	Experimental	Control	t	*p*	df
SWD Populations of AGHS	3.02 (8.11)	6.38 (4.56)	1.959	.055*	55
EDA Populations of AGHS	1.63 (3.59)	2.30 (1.68)	3.017	.004*	71
Urban Schools of AGHS	21.58 (14.79)	4.48 (14.69)	2.268	.026*	77
>2001 Student Body of AGHS	1.78 (1.37)	4.33 (1.03)	2.448	.018*	49

Note. * = $p < .05$, Standard Deviations appear in parentheses below means

The independent-t test for sub-groups of biology end-of-course tests indicated the most significant results were for economically disadvantaged populations attending schools with greater than 2001 student bodies and in SWD populations attending urban schools.

Table 4.2

Distribution, Means, Independent-t Test Results for Sub-groups of School Type and Size for Biology End-of Course Tests

	Experimental	Control	t	*p*	df
Rural Schools					
EDA	1.53 (3.76)	1.01 (1.95)	2.214	.031*	97
Urban Schools					
SWD	1.11 (5.09)	1.28 (5.71)	2.922	.005*	71
1001-1500 Student Body Schools					
SWD	-1.34 (3.23)	1.70 (5.15)	3.313	.012*	74
Greater than 2001 Student Body Schools					
EDA	2.48 (1.87)	1.23 (1.20)	3.570	.001*	42

The Mann-Whitney results also supported the independent-t results for schools with greater than 2000 students as shown in Table 4.3. The Mann-Whitney provided evidence of significant improvements in urban SWD populations and economically disadvantaged. SWD populations in schools with a student body between 500 and 1500 showed test score increases. Student bodies greater than 2000 indicated test score increases in SWD and economically disadvantaged populations as shown in Table 4.4.

The Mann-Whitney test for all Georgia high schools for the biology end-of-course test indicated the most significant results for urban schools across Georgia. The Mann-Whitney results also supported the independent-t results for schools with greater than 2000 students.

Table 4.3

Mean Rank, Mann-Whitney Results for All Georgia High Schools for Biology End-of Course Tests for Experimental and Control Groups

All Georgia High Schools (AGHS)			
	Experimental M	Control M	*p*
Urban Schools of AGHS	67.60	43.65	.044*
>2001 Student Body of AGHS	39.88	24.82	.052*

Note. * = *p* <. .05

The Mann-Whitney test for sub-groups of biology end-of-course tests indicated the most significant results were for SWD populations in urban schools and in schools with a student body greater than 2000.

Table 4.4

Mean Rank, Mann-Whitney Results for Sub-groups of School Type and School Size for Biology End-of Course Tests for Experimental and Control Groups

	Urban Schools		
	Experimental	Control	*p*
SWD	70.62	39.46	.010*
EDA	22.83	24.74	.022*
	501 to 1000 Student Body Schools		
SWD	18.62	29.13	.030*
	1001 to 1500 Student Body Schools		
SWD	49.83	37.50	.033*
	Greater than 2001 Student Body Schools		
SWD	44.00	24.47	.012*
EDA	39.75	24.83	.054*

Research Question Two

Is there a statistically significant difference in the means of the school scores on the physical science end-of-course tests between those science teachers who received interventions by the Georgia Department of Education Science Implementation Specialists and those who did not receive interventions? Georgia Science Specialist interventions also impacted physical science test scores in several areas. Physical science end-of-course test results over the three-year period were significantly improved in schools across Georgia where science teachers intervened, $t(193)=3.050$, $p=.003$, as shown in Table 4.5. Independent t-tests showed there were significant differences to support the research hypothesis that the final test scores in physical science will improve significantly for economically disadvantaged students, $t(230)=3.437$, $p=.001$. Similarly when test scores of intervention schools and non-intervention schools throughout the state were compared, students who attended rural schools, schools in mid-size cities, and schools with a student population between 1000-1500 showed significant improvements in test score results. Statewide data were further disaggregated by subjecting the sub-groups of students with disabilities (SWD) and economically disadvantaged (EDA) of rural schools, schools in small cities, mid-size cities, urban schools, and the various student body populations to an independent-t test to determine if interventions were significant in those subgroup populations.

The independent-t test for physical science end-of-course tests when compared with all schools in Georgia indicated the most significant results for all Georgia high schools and economically disadvantaged populations across Georgia.

Table 4.5

Distribution, Means, Independent-T Test Results for Physical Science End-of Course Tests for Experimental and Control Groups in All Georgia High Schools

All Georgia High Schools (AGHS)					
	Experimental	Control	t	*p*	df
All Georgia High Schools	8.03 (1.73)	1.13 (7.36)	3.050	.003*	193
EDA Populations of AGHS	1.14 (2.03)	1.61 (1.55)	3.437	.001*	230
Rural Schools of AGHS	9.35 (1.75)	1.21 (5.65)	2.844	.006*	76
Schools in Mid-Size Cities of AGHS	1.08 (1.04)	2.05 (7.06)	2.447	.021*	26
1001 to1500 Student Body of AGHS	8.15 (1.15)	8.15 9.86	3.248	.003*	34

Physical science data shown in Table 4.6 indicate significant intervention impact for economically disadvantaged students who attended rural schools or a school with a student body population between 1000-1500. The independent-t test for sub-groups of physical science end-of-course tests indicated the most significant results were for economically disadvantaged populations attending schools in rural areas and in schools with student bodies from 1001 to 1500 students.

Table 4.6

Distribution, Means, Independent-t Test Results for Sub-groups of School Type and School Size for Physical Science End-of Course Tests for Experimental and Control Groups

	Experimental	Control	t	p	df
Rural Schools					
EDA	1.34 (2.35)	1.51 (1.07)	2.980	.004*	81
1001 to 1500 Student Body					
EDA	9.94 (1.45)	-4.27 (1.90)	3.303	.003*	26
Greater than 2001 Student Body					
EDA	4.15 (1.08)	-1.24 (4.74)	3.071	.014*	9

Note. * = $p < .05$, Standard Deviations appear in parentheses below means

For physical science, science teacher interventions appear to have influenced economically disadvantaged students heavily as indicated by the results for the experimental groups across the state. Rural schools and those who attended schools with a student body of 1001 to 1500 as shown in Table 4.6 also indicate significant improvements. The Mann-Whitney statistics as shown in Table 4.7 supports the findings of the independent-t test for increased test scores in physical science across Georgia.

The Mann-Whitney test for physical science end-of-course tests indicated that schools with science teacher mentor interventions showed the most significant improvements when compared with all non-intervention schools from all Georgia High Schools. Student bodies between 1001 and 1500 students also showed high test score significance for physical science.

Table 4.7

Mean Rank, Mann-Whitney Results for All Georgia High Schools for Physical Science End-of Course Tests for Experimental and Control Groups

All Georgia High Schools (AGHS)			
	Experimental	Control	*p*
All Georgia High Schools	174.77	140.36	.003*
EDA Populations of AGHS	161.78	137.80	.037*
Rural Schools of AGHS	67.66	52.70	.020*
Urban Schools of AGHS	50.60	30.40	.018*
1001 to 1500 Student Body of AGHS	56.04	39.66	.006*

The Mann-Whitney test also supported the independent-t test results of economically disadvantaged students across Georgia who improved as a result of science teacher interventions. Scores in rural schools, urban schools, and schools with a student population between 1001 and 1500 were also significant for intervention schools as shown in Table 4.8. Additionally, the Mann-Whitney test indicated significant improvements for the economically disadvantaged students in rural intervention schools across Georgia and for economically disadvantaged students in student bodies with populations that ranged between 1001 and 1500 and in SWD populations in schools greater than 2000.

The Mann-Whitney test for the physical science end-of-course tests indicated the most significant results for economically disadvantaged populations attending schools where the student body is between 1001 to 1500 students.

Table 4.8

Mean Rank, Mann-Whitney Results for Sub-groups of School Type and School Size for Physical Science End-of Course Tests for Experimental and Control Groups (Groups indicating significance only)

	Rural Schools		
AGHS	Experimental	Control	*P*
	67.66	52.70	.020*
	1001 to 1500 Student Body Schools		
EDA	54.94	40.12	.013*
	Greater than 2001 Student Body Schools		
SWD	27.00	15.41	.041*

Note. * = $p < .05$

Research Question Three

Is there a statistically significant difference in the means of the school scores on the Georgia High School Graduation Test between those science teachers who received interventions by the Georgia Department of Education Science Implementation Specialists and those who did not receive interventions? Georgia Science Specialist interventions indicated positive improvements over the three-year study period in the science portion of the Georgia High School Graduation Test (GHSGT). Statistical analysis revealed that science teacher interventions did not positively affect subgroups as in as many areas as they did in the end-of-course results. The independent t-tests indicate the GHSGT results significantly improved for experimental schools across the state of Georgia, $t(243)=2.400$, $p= .019$, economically disadvantaged students in intervention schools, and schools that were located in mid-sized cities, as shown in Table 4.9.

Significant test score improvements were recorded for students with disabilities who attended schools with a 1001 to 1500 student body and economically disadvantaged students living in mid-size cities as shown in Table 4.10. The Mann-Whitney statistics also supported the findings that significant improvements occurred over the three-year period for students taking the GHSGT and who were located in mid-sized cities as shown in Table 4.11

The independent-t test for the GHSGT indicated the most significant results for economically disadvantaged populations across Georgia.

Table 4.9

Distribution, Means, Independent-T Test Results for Georgia High School Graduation Tests for Experimental and Control Groups in All Georgia High Schools

All Georgia High Schools (AGHS)					
	Experimental	Control	t	*p*	df
All Georgia High Schools	4.91 (1.53)	4.91 (5.40)	2.400	.019*	263
EDA Populations of AGHS	1.09 (2.43)	1.72 (1.33)	2.975	.004*	279
Schools in Mid-Size Cities of AGHS	17.31 (12.81)	-.08 (4.61)	3.285	.020*	37

Note. * = p < .05, Standard Deviations appear in parentheses below means

The most significant test result from the Independent-t test for the GHSGT was p=.012 for SWD populations in schools having between 1001 and 1500 students.

Table 4.10

Distribution, Means, Independent-t Test Results for Sub-groups of School Type and School Size for Georgia High School Graduation Tests for Experimental and Control Group

		1001 to 1500 Student Body			
SWD	-1.34 (3.23)	1.70 (5.15)	-2.683	.012*	65
		Mid-Size Cities			
EDA	2.72 (2.94)	6.00 (2.03)	2.268	.028*	46

Note. * = p < .05, Standard Deviations appear in parentheses below means

The only significant test results from the GHSGT indicated by the Mann-Whitney were for students attending schools in mid-size cities throughout Georgia

Table 4.11

Mean Rank, Mann-Whitney Results for All Georgia High Schools for Georgia High School Graduation Tests for Experimental and Control Groups (Groups indicating significance only)

	All Georgia High Schools (AGHS)		
	Experimental	Control	*p*
Schools in Mid-Size Cities of AGHS	41.42	23.33	.004*

Note. * = $p < .05$

Regression to the Mean Results

The data for this research study were nonrandom samples taken from a population of imperfectly correlated measures. Imperfectly correlated means there were extremely high scores and extremely low scores. In any population with these characteristics, a regression threat is possible. In order to assure that any gains in test scores were true gains and not simply a regression artifact, an analysis of regression to the mean statistic was used to validate score gains. All independent– t statistical results from this research study that indicated a significance at the .05 probability level were subjected to a Regression to the Mean analysis to determine any regression artifacts as shown in Table 4.12. A regression artifact of 85% for the experimental biology for urban SWD students and a regression artifact of 76% for the control group of physical science rural EDA students were the only two extreme statistics determined to be regression threats. While there was some regression to the mean in all experimental and control treatments, in all but the two extreme cases there is approximately a less than 50% chance each result actually regressed to the mean on the final testing of each specific test. Therefore, the analysis indicates the majority of the improved test scores result in an actual increase in student achievement rather than a naturally occurring regression to the mean of the population test scores.

The regression artifacts indicate small regression to the mean for all significant tests with the exception of biology urban SWD experimental tests and physical science EDA rural control tests.

Table 4.12

Regression Artifacts for All Significant Results on the Independent-t Test

	Pearson r	Regression to the Mean
Biology Urban Experimental	0.38	38%
Biology Urban Control	0.08	8%
Biology SWD Experimental	0.62	38%
Biology SWD Control	0.7381	27%
Biology EDA Experimental	0.482845	52%
Biology EDA Control	0.670075	33%
Biology Rural EDA Experimental	0.49914	51%
Biology Rural EDA Control	0.462263	54%
Biology Urban SWD Experimental	0.1543	85%
Biology Urban SWD Control	0.772426	23%
Biology EDA >2000 Experimental	0.89794	11%
Biology EDA >2000 Control	0.70684	30%
Biology 1001 to 1500 SWD Experimental	0.644683	36%

Table 4.12

Regression Artifacts for All Significant Results on the Independent-t Test (continued)

Physical Science Experimental	0.65307	35%
Physical Science Control	0.732489	27%
Physical Science EDA Experimental	0.620061	38%
Physical Science EDA Control	0.544157	46%
Physical Science Rural Experimental	0.750482	25%
Physical Science Rural Control	0.462263	54%
Physical Science Mid-Size Experimental	0.902849	10%
Physical Science Mid-Size Control	0.732522	27%
Physical Science 1001 to 1500 Experimental	0.783947	22%
Physical Science 1001 to 1500 Control	0.720782	28%
Physical Science Rural EDA Experimental	0.658014	35%
Physical Science Rural EDA Control	0.241622	76%
Physical Science 1001 to 1500 EDA Exp.	0.708562	30%
Physical Science 1001 to 1500 EDA Control	0.638219	37%
Physical Science >2000 EDA Experimental	0.986529	2%
Physical Science >2000 EDA Control	0.764454	24%

Table 4.12

Regression Artifacts for All Significant Results on the Independent-t Test (continued)

	Pearson r	Regression to the Mean
Biology 1001 to 1500 SWD Control	0.540118	46%
GHSGT Experimental	0.752181	25%
GHSGT Control	0.563157	44%
GHSGT EDA Experimental	0.495588	51%
GHSGT EDA Control	0.563137	44%
GHSGT Mid-Size City Experimental	0.939065	7%
GHSGT Mid-Size City Control	0.915701	9%
GHSGT SWD 1001 to 1500 Experimental	0.751199	25%
GHSGT SWD 1001 to 1500 Control	0.849351	16%
GHSGT EDA Mid-sized Experimental	0.679847	33%
GHSGT EDA Mid-sized Control	0.774176	23%

Summary of Chapter Four

Chapter Four provides the statistical analysis for three research questions and their hypotheses. Two statistical tests were conducted on the data: the independent-t test and the Mann-Whitney test. The independent-t test was used because the two sample populations were independent of each other. The Mann-Whitney was also conducted because the assumption of equality of variance was not met in cases with extreme differences in variances. Evidence that science specialist interventions had a positive effect on student achievement was evident in biology, physical science, and the Georgia High School Graduation Tests.

Further disaggregation of testing results indicated positive effects on populations involving students with disabilities, economically disadvantaged, rural populations, urban populations, and some populations in small cities and mid-sized cities. Some positive results were evident in schools with student bodies between 1001-1500 students. A total of 41 significant differences were found using the independent-t test and the Mann-Whitney. Regressions to the mean were found to be 54% or less by a regression analysis for all but two of the test scores showing significant results. Beyond 54%, there were two extreme regression analyses of 76% and 85% with all others being lower than 54%. The Mann-Whitney test rejected the null hypothesis for the first research question in eight different analyses for the biology end-of-course tests. The independent-t statistical analysis rejected the null hypotheses of the first research question in independent-t seven different analyses of biology end-of-course test results. The Mann-Whitney test rejected the null hypothesis for the second research question in seven different analyses in physical science and in one analysis for the third research question regarding the Georgia High School Graduation Test results. The null hypothesis is rejected in eight independent-t analyses for the second research question regarding physical science end-of-course test results, and five independent-t analyses for the third research question regarding the Georgia High School Graduation Test results.

CHAPTER FIVE

SUMMARY AND DISCUSSION

This final chapter restates the purpose of my study and reviews the methodology. The final two major sections summarize the findings, conclusions, implications of the study, and recommendations for future research.

Purpose of the Study

This study was an investigation into the effect of the Science Implementation Specialist (SIS) program initiated by the Georgia State Department of Education in the effort to improve student achievement in science as measured by standardized tests in the public schools of Georgia. Student achievement in this study was operationally defined as student performance on the Georgia physical science end-of-course test (EOCT), the Georgia biology end-of-course test (EOCT), or the Georgia High School Graduation Test (GHSGT).

The Georgia Department of Education designed the SIS program to assign veteran science teachers as mentors to teachers in schools with failing science test scores in the three state science standardized assessments: the biology end-of-course test, the physical science end-of-course test and the Georgia High School Graduation Test. Mentors, called Science Implementation Specialists (SIS), intervened in schools for a period of three years at different levels of intervention from medium to high. A *medium intervention* involved a Science

Implementation Specialist visiting a school to work with science teachers at least twice a month. A *high intervention* involved a Science Implementation Specialist visiting a school to work with science teachers three or more times a month. A *low intervention* occurred if a Science Implementation Specialist was requested to work with the school by a principal or curriculum director for a one-time visit or never visited a school. This study explored the impact that Science Implementation Specialists had on the science achievement of students taught by teachers where interventions occurred at a high to medium level for at least two of the three years (intervention schools) as opposed to the science achievement of students where low or no interventions (non-intervention schools) occurred.

Methodology

Data for my study were collected from public domain on the Georgia Department of Education Testing Division website. This *ex post facto* study focused on data collected from the inception of the program in year 2005 through the following three years up to 2008. Since the Science Implementation Specialist Program does not provide services to magnet schools, alternative schools, or charter schools, these schools were not considered in this study. Data were identified as experimental (school test scores with medium to high Science Implementation Specialist interventions with science teachers) and control (school test scores with low Science Implementation Specialist interventions with science teachers). Independent-t tests and the

Mann-Whitney test were conducted between experimental and control data to determine any significance in test-score results after the three-year period. A regression to the mean analysis was also conducted to determine if any regression artifacts should be considered. Regression artifacts are statistical phenomenon that may occur when imperfectly correlated measures move or regress back to the mean regardless of the experimental treatment.

Research Question One

Does student achievement, as measured by biology end-of-course test scores, increase for schools participating in the Science Implementation Specialist program?

Findings for Research Question One

Research question one asks whether there was a statistically significant difference in the means of test scores on the biology end-of-course tests between the students of those science teachers who received interventions by the Georgia Department of Education Science Implementation Specialists and those who did not receive interventions. Over the course of the three years studied in experimental schools where Georgia Science Specialists intervened with science teachers, biology test scores were significantly higher ($p < .05$) for the following groups:

students with disabilities

economically disadvantaged students

students in urban schools

schools with large (>2000) student body populations

When the data were further disaggregated so that specific types of schools, i.e. rural, urban, small city, etc. and the size of the student population were considered, the following specific subgroups indicated significant growth in biology end-of-course test scores also:

economically disadvantaged rural students

economically disadvantaged urban students

economically disadvantaged students in schools with greater than 2000 students

students with disabilities in urban schools

students with disabilities in schools with student bodies between 501 and 1000

students with disabilities in schools with larger student bodies (1001 to1500 and greater than 2000)

Research Question Two

Does student achievement, as measured by physical science end-of-course test scores, increase for schools participating in the Science Implementation Specialist program?

Findings for Research Question Two

This research question asks whether there was a statistically significant difference in the means of the school scores on the physical science end-of-course tests between the students of those science teachers who received interventions by the Georgia Department of Education

Science Implementation Specialists and those who did not receive interventions. As in biology, economically disadvantaged students fared well in physical science end-of-course test results in those schools where interventions with a Science Implementation Specialist occurred and specifically in rural schools. However, most significant at an alpha level of $p<.05$ level in the physical science end-of-course test results, is the indication that experimental schools where interventions occurred outscored all Georgia schools where no interventions occurred, $t(193)=3.050$ $p=.003$. The physical science end-of-course test scores also showed significantly higher scores for the following groups:

experimental schools throughout the state

economically disadvantaged throughout the state

rural schools throughout the state

students living in mid-sized cities throughout the state

schools with a 1001 to1500 student body population throughout the state

Further disaggregated data found statistically significant improvements in the physical science end-of-course test results for the following groups:

economically disadvantaged students in rural schools

economically disadvantaged students in schools with a student body population of 1001 to 1500

economically disadvantaged students in schools with a student body greater than 2000 students with disabilities in schools with a student body population of greater than 2000

Research Question Three

Do scores on the science portion of the Georgia High School Graduation Test increase for schools participating in the Science Implementation Specialist program?

Findings for Research Question Three

Research question three asks whether there was a statistically significant difference in the means of the school scores on the Georgia High School Graduation Test between the students of those science teachers who received interventions by the Georgia Department of Education Science Implementation Specialists and those who did not receive interventions. Statewide, the Graduation Test results were significant at the $p<.05$ level in some schools where interventions occurred. For the following groups, the Georgia High School Graduation Test results showed significantly higher scores:

experimental schools across the state

economically disadvantaged students

students attending schools in mid-sized cities

However, the disaggregated data indicated significant improvements in Georgia High School Graduation test results in only two areas:

students with disabilities in schools with a population of 1001 to 1500 students.

students who are economically disadvantaged and attending schools in midsize cities

Regression to the Mean Findings

There were a total of 71 experimental schools and 261 control schools considered for inclusion in this study. This produced imperfectly correlated measures that posed the possibility of a regression threat. A regression threat is a phenomenon that statisticians have found normally exists in samples from two populations that are imperfectly correlated. It is a natural predisposition of populations above the mean and populations below the mean to regress back to the population mean regardless of the research intervention and this possibility poses a statistical threat to any study with pre and post test data. In order to validate score gains, a regression to the mean analysis was conducted on all statistically significant test results for the experimental and control groups.

The experimental biology group for urban students with disabilities had a regression artifact of 85%, and the control physical science group for rural economically disadvantaged students had a regression artifact of 76%. Considering that all other tests results did not indicate such extreme regression, these two outliers could have occurred by chance, which enhances the possibility that the regression threat is of little concern in this study.

Conclusions

This study was designed to report the effect that the Georgia Department of Education Science Implementation Specialist mentor program had on student achievement, as defined by student performance on state standardized end-of-course tests and the Georgia High School Graduation Test. Following are conclusions that were determined from the results of this study.

In schools where a Science Implementation Specialist intervened with their teacher from a medium to high level for at least two of the three years, significant improvement

($p < .05$) occurred with

1. Students taking the physical science EOCT and the Georgia High School Graduation Test.
2. Students in rural schools taking the physical science EOCT.
3. Students in urban schools taking the biology EOCT and physical science EOCT.
4. Students with disabilities taking the biology EOCT.
5. Economically disadvantaged students taking the biology EOCT, physical science EOCT, and the Georgia High School Graduation Test.
6. Students attending schools with a student body between 1001 and 1500 and taking the physical science EOCT.

7. Students living in mid-sized cities and taking the physical science EOCT and the Georgia High School Graduation Test.

8. Students attending schools with a student body greater than 2000 and taking the biology end-of course test.

9. Economically disadvantaged students attending rural schools and taking the biology EOCT.

10. Students with disabilities attending urban schools, a school with a student body size from 501 to 1500 or greater than 2000, and taking the biology EOCT.

11. Economically disadvantaged students attending an urban school, or a school with a student body size larger than 2000 and taking the biology EOCT.

12. Students with disabilities taking the physical science EOCT if they were attending a school with a student body size larger than 2000.

13. Economically disadvantaged students attending a rural school, a school with a student body size from 1001 to 1500, or a school with a student body larger than 2000 and taking the physical science EOCT.

14. Economically disadvantaged students living in a mid-size city and taking the Georgia High School Graduate Test.

15. Students with disabilities attending a school with a student body size from 1001 to 1500 and taking the Georgia High School Graduate Test.

These significant results are presented in Table 4.13.

Table 4.13. *Significant Results of Physical Science, Biology, and Georgia High School Graduation Test Scores of Intervention Schools. Results are to the p=.05 level.*

Biology	**Physical Science**	**Graduation Test**
	All* Georgia High Schools	All Georgia High Schools
	All Rural	
All Urban	All Urban	
All SWD**		
All EDA	All EDA	All EDA
	All 1001-1500	
All >2000**		
All Mid-sized		All Mid-sized
SWD Urban		
SWD 501-1000		
SWD 1001-1500		SWD 1001-1500
SWD >2000	SWD >2000	
EDA Rural	EDA Rural	
		EDA Mid-sized
EDA Urban		
	EDA 1001-1500	
EDA >2000	EDA >2000	

Footnote: * results of intervention schools when compared to the composite of all Georgia High Schools. ** p=.055 and p=.052 respectively.

Discussion

Several issues in this study warrant further discussion. The original purpose of the science mentor program was to increase test score results on the Georgia High School Graduation Test (GHSGT). However, there were not necessarily classes in schools dedicated to that purpose, so science mentors worked with physical science and biology teachers in an effort to improve instruction in those areas because the concepts in these two subjects were reflected on the GHSGT. As a result, physical science and biology standardized test score results benefited.

This study indicates significant gains in physical science test scores in intervention schools across the state. Physical science test score results show that students in intervention schools significantly outscored students in non-intervention schools across the state. Students in rural schools, urban schools, economically disadvantaged students, those attending schools with a student body from 1001 to 1500, and those living in mid-sized cities, showed significant physical science EOCT score gains. Students with disabilities and who took the physical science test and attended a school where the student body was greater than 2000 also showed significant gains. Economically disadvantaged students attending rural schools and attending schools with a student body between 1001 and 1500 or greater than 2000 also showed improved test score results.

Biology test score results across the state in intervention schools did not have significant gains with the exception of specific groups of students. This may be because there are only two domains in the GHSGT associated with biology (cells and heredity and ecology) and three associated with physical science (structure and properties of matter, energy transformation, and forces, waves, and electricity). Therefore, science mentors may have intentionally or unintentionally focused more diligently on physical science teachers than biology teachers. Often, the most inexperienced teachers in the school are placed to teach the youngest students in the school whereas veteran teachers receive the upper level and more mature students. Since many Georgia schools offer physical science in the 9th grade, those inexperienced teachers often end up teaching physical science to the youngest students, which may have presented more of a challenge than did teaching the more mature students. As the Science Specialists visited schools, they focused on teachers with the greatest need, which were usually the physical science teachers, for the reasons just stated. This could be another possible explanation for why the physical science scores in intervention schools were higher across the state than they were in non-intervention schools.

There were areas of success in biology, however. Students with disabilities, economically disadvantaged, students in urban schools, and students attending schools with a student body greater than 2000, showed significant gains in biology. Economically disadvantaged students attending rural schools, urban schools, or schools with student bodies larger than 2000, showed significant gains in biology. Students with disabilities (SWD) in urban schools or schools with a student body from 501 to 1500, between 1001 and 1500 or greater than 2000, also showed significant gains in biology test score results.

Students with disabilities (SWD) in intervention schools outscored their counterparts in non-intervention schools in several areas: biology, urban schools in biology, in biology for schools with a student body population from 501 to 1500, and in physical science for schools with a student body population larger than 2000. It was reported in an earlier section of this study that science mentors introduced manipulatives to science teachers. Since this requires students to be more kinesthetic, this could have played a significant role in the improvement of students with disabilities, especially since research indicates that using kinesthetic instructional strategies is effective with SWD students (Synder, 1999; Stange and Ponder,1999; Ploude and Klemm, 2004).

Economically disadvantaged (EDA) students showed significant state-wide gains in all the physical science and biology EOCTs, as well as the GHSGT. This subgroup also outscored their counterparts in non-intervention schools in physical science if they attended rural schools, a school with a student body from 1001 to 1500, or a school with a student body larger than 2000. EDA students also showed significant gains in the GHSGT if they lived in a mid-size city.

Science mentors introduced best practices for teaching science to teachers in intervention schools. The result of the implementation of these practices is evident in the test score increases for economically disadvantaged youth. Scores for the Georgia High School Graduation Test were significantly higher for intervention schools across the state. This was an expected gain since the GHSGT was the focus for the first three years of this program. Students with disabilities who took the GHSGT also showed significant improvement if they attended a school with a student body from 1001 to 1500. All students living in mid-sized cities improved on the GHSGT but specifically economically disadvantaged students showed significant gains in those mid-sized cities.

The Georgia High School Graduation Test is a high stakes test for Georgia students. If they do not pass all four portions of the test, they cannot graduate from high school. In many cases, the Science Implementation Specialist assisted teachers in preparing juniors for this important test. The primary intent of this program was to improve the GHSGT science scores and focus on the end-of-course tests secondarily. Therefore, much time was spent in classrooms helping teachers prepare students for the GHSGT test as are reflected in the results of this study (C. Hillsman, personal communication, 2008; B. Peiffer, personal communication, 2007; L. Landers, personal communication, 2007, B. Ellis, 2007).

An interesting artifact of this study revealed the significant increase in test scores in physical science and biology from students who attended larger schools (from 1001 to 1500 and 2000+ students). Little impact seemed to take place in smaller schools (less than 1001 students) with the exception of students with disabilities taking biology in schools with a student body size from 501-1500. This could be attributed to the fact that the formula for school selection (see Appendix A) takes into account the size of the school for one of the needs factors. Larger schools would have garnered a greater needs factor and therefore placed them at a higher advantage for being selected. However, noticeably missing from significant results are school sizes with a student body ranging from 1501-2000. While schools with student bodies immediately below that number (1001-1500) and immediately above that number (>2000) have several incidences of significant student test score improvements, (physical science EOCT, EDA biology EOCT, SWD physical science EOCT, EDA physical science EOCT, SWD GHSGT) there are inexplicably none in the 1501-2000 range.

The results of this study suggest that the Science Implementation Specialist program is working. 50% of analyses (36 of 72 tests) of the data showed statistical significant improvement where Science Implementation Specialist interventions occurred. Therefore, this study indicates support for acknowledging a successful Science Implementation Specialist program.

Implications for Practice

If significant gains can be made in science test scores through teacher mentorships, then mathematics, English language arts, and social studies might also benefit. A science mentor program such as the one described in this study seems to have positive applications to a diverse population of schools. Test score gains were found in urban schools, rural schools, and schools in mid-sized cities. Gains were also noted in students with disabilities, economically disadvantaged youth, and students in a variety of school sizes. The results of this study show that schools looking to increase the science standardized test scores of students with disabilities and economically disadvantaged students, as well as those in urban, rural, and mid-sized cities, or schools with a population between 1001 and 1500 and larger than 2000, may want to look closely at a teacher mentor program of the magnitude described in this paper.

Recommendations for Future Studies

Experimental gains that were statistically significant in all categories were not expected because of the many variables to be controlled for in a study of this nature. Variables such as home life, individual student abilities, poverty level, student readiness-to-learn, teacher pre-service training, teacher professional development, etc., all play roles in student achievement. Therefore, areas in which statistically significant gains in test scores were not observed cannot be explained away by stating the mentor program is ineffective. The program may provide support and reassurance to inexperienced teachers who need it, but their test scores may not reflect that at this point in their careers. Therefore, the program may be providing the unintended service of retaining young teachers in the science classroom as similar programs in other states have done (Sampson, 2005, Krupp, 1984). This is an area for consideration for future research.

Additional studies need to be conducted beyond the three-year period of this study to determine if test scores have continued to rise in experimental schools. Any of the other variables that may influence student achievement (poverty, readiness-to-learn, learning disabilities, pre-service training, professional development, etc.) should be included in future research.

Many of the control schools were not selected for inclusion in the SIS program because those schools, or the school system they were a part of, employed science instructional coaches or specialists to assist science teachers. Schools that had access to instructional coaches were not identified nor were those schools selected out of this study. Therefore, some of the control group schools actually had science teachers with access to some teacher mentoring external to the SIS program. Whether or not this affected the results was not considered and should be considered for inclusion in a future study.

This research showed statistically significant results that connected science teacher mentorship to student achievement. While this is reassuring to the researcher, questions still remain that were beyond the scope of this study. There was ultimately no focused training for the Science Implementation Specialists on how to intervene with teachers. Therefore, each specialist took his/her individual personality and strengths to the various teachers for intervention. Certainly some Science Implementation Specialists were more effective than others, but the techniques and strategies employed need further study. In light of the recent research of Murray, et. al. (2009) where teacher mentor collaborations and feedback showed mentors tended to provide “soft feedback” with little substance in terms of critical analysis of instruction. The feedback and collaboration techniques used by the SIS needs to be explored.

This study addressed the question of whether or not student achievement was improved as a result of Science Specialist mentorship to teachers. The results indicate a positive answer to that question. The question of what strategies were employed that resulted in a positive outcome remain unanswered and a possibility of future research.

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APPENDIXES

Appendix A

Overall Need Factor Calculation

The first step in the calculation of the Overall Need Factor is to calculate a need factor for each one of the indicators. This is done as follows:

For the passing rate on the science component of the GHSGT, the EOCT results, the number of students tested, and the graduation rate, the school scores in each region are sorted from the lowest to the highest percentage. This distribution of values is then divided into quartiles and each quartile subsequently subdivided in half by calculating the mean for each quartile. A need factor from 8 (for the lowest percentages) to 0 (for the highest percentages) is then given to each school.

For the AYP status indicator the schools are given a need factor accordingly (Table A1).

Table A1

Need factor assignment for AYP

Needs Improvement Level	Need Factor
0 (has always made AYP)	1
0 (did not meet AYP last year)	8
6	6
4	5
3	4
1	3
5	2
7	7

The second step of the calculation is to calculate the Overall Need Factor for each school by adding the weighted need factors (nf) for each indicator (Table A2). This second step involves a series of calculations which are described as follows:

The science graduation test percent passing is needs factor is multiplied times .25 since it has a weight of 25%. The biology EOCT percent passing and physical science EOCT percent passing is added together and that number is multiplied by .20 since it has a weight of 20%.

The AYP status number is added to the graduation rate percentage which is multiplied by .15 for a 15% weight. Finally, the number of students in the school is multiplied by .05 for a 5% weight. Each of these numbers are added together to determine the Overall Need Factor that is then placed in decreasing order for the science specialists to determine which schools will be served.

Table A2.

Calculation of Overall Need Factor

Overall
Need = (.25)(GHSGT nf) + (.20)(Biology nf + Physical Science nf) + (.15)
Factor (AYP nf + Graduation Rate nf) + (.05)(# students nf)

** nf means partial need factor* (Aguilar, personal correspondence. July, 2007).

Appendix B

List of Georgia Schools with High and/or Medium Interventions by Science Specialists

SCHOOL	SCHOOL SYSTEM
Americus High School South	Sumter County
Atkinson County High School	Atkinson County
Bacon County High School	Bacon County
Baldwin County High School	Baldwin County
Bradwell Institute	Liberty County
Brantley County High School	Brantley County
Brooks County High School	Brooks County
Burke County High School	Burke County
Cairo High School	Grady County
Carver High School	Muscogee County
Cedartown High School	Polk County
Central High School	Talbot County
Charlton County High School	Charlton County
Chattooga High School	Chattooga County
Chestatee High School	Hall County
Clarke Central High School	Clarke County
Clinch County High School	Clinch County
Coffee County High School	Coffee County
Colquitt County High School	Colquitt County

Columbia High School	Dekalb County
Creekside High School	Fulton County
Cross Keys High School	Dekalb County
Dodge County High School	Dodge County
Dooley County High School	Dooley County
Dougherty Comp. High School	Dougherty County
Early County High School	Early County
East Hall High School	Hall County
Fitzgerald High School	Ben Hill County
Franklin County High School	Franklin County
Glascock County High School	Glascock County
Glenn Hills High School	Richmond County
Greenville High School	Meriwether County
Griffin High School	Spalding County
Hancock Central High School	Hancock County
Haralson County High School	Haralson County
Hephzibah High School	Richmond County
Irwin County High School	Irwin County
Jackson High School	Butts County
Jasper County High School	Jasper County
Jefferson County High School	Jefferson County
Kendrick High School	Muscogee County
Lafayette High School	Walker County

Lanier County High School	Lanier County
Lithia Springs Comp. High	Douglas County
Lithonia High School	Dekalb County
Lowndes County High School	Lowndes County
Madison County High School	Madison County
Manchester High School	Meriwether County
McIntosh County Academy	McIntosh County
McNair High School	Dekalb County
Mitchell County High School	Mitchell County
MLK High School	Dekalb County
Murray County High School	Murray County
Oglethorpe County High School	Oglethorpe County
Paulding County High School	Paulding County
Peach County High School	Peach County
Ridgeland High School	Walker County
Seminole County High School	Seminole County
Stewart-Quitman High School	Stewart County
Taliaferro County High School	Taliaferro County
Telfair County High School	Telfair County
Terrell County High School	Terrell County
Thomasville High School	Thomasville City Schools
Turner County High School	Turner County
Upson-Lee High School	Thomaston-Upson County

Valdosta High School	Valdosta City Schools
Villa Rica High School	Carroll County
Ware County High School	Ware County
Warren County High School	Warren County
Wilkinson County High School	Wilkinson County
Worth County High School	Worth County

Appendix C

Qualifications and Basic Duties of Science Implementation Specialists

Georgia Department of Education
Job Announcement

<table>
<tr><td colspan="2">Posting Date:

Announcement: 07-</td><td>Apply by: Until Filled</td></tr>
<tr><td>Position Title:
Education Program Specialist (GPS/Science Implementation – High School Facilitator)

Position: 00184479</td><td>Location:
Positions located in Region 4. See Regional Map.</td><td>Program/Unit:
Science Program/Academic Standards Division/Office of Standards, Instruction and Assessment</td></tr>
<tr><td colspan="3">Description of Duties:
Provides leadership and coordination in the implementation of statewide grades 9-12 Georgia Performance Standards (GPS). Duties include serving as the science and general GPS liaison to systems and Regional Education Service Agencies (RESA); coordinating the implementation of the GPS in all content areas; implementing programs that facilitate achievement of goals and objectives and conform to policies and rules for grades 9-12 science programs; establishing an effective communication network for disseminating pertinent science education, GPS, and Master Teacher/Academic Coach Program information; providing technical assistance to local school system personnel; developing and conducting professional learning/staff development activities; serving as a member to the local Regional Support Team (RST); collaborating with the School Improvement and Teacher Quality divisions to develop and implement the Academic Coaching Academy; and applying current knowledge and professional expertise to job duties.</td></tr>
<tr><td colspan="3">Minimum Qualifications:
Master’s degree in education, education administration, science, or a related field and three years of professional-level high school science classroom experience. Must be eligible for</td></tr>
</table>

Georgia teaching certification in a high school science field.

Preferred Qualifications:

Preference will be given to applicants who, in addition to meeting the minimum qualifications, possess one or more of the following:

- Experience teaching science at the high school level
- Experience with grades 9-12 testing/assessment programs
- Experience with professional learning/staff development
- Experience with academic mentoring or coaching
- Excellent presentation and communication skills
- Strong computer skills including proficiency with Microsoft Office (Word, Excel, Access, and PowerPoint)

Salary/Benefits:

Pay grade 18 – Annual salary range $45,903.12 (minimum) to $80,545.92 (maximum). Hiring salary is generally between $45,903.12 and $70,000, commensurate with current employment and relevant education/training and work experience. Benefit options include life, disability, dental and health insurance, annual/sick leave, and Employees' Retirement or Teachers' Retirement.

Submit a letter of application and a resume or State of Georgia Application to:

Georgia Department of Education
Human Resources Office
2052 Twin Towers East
Atlanta, Georgia 30334
Telephone: 404-656-2510; Fax: 404-657-7840
E-mail: human.resources@doe.k12.ga.us
Internet address: http://www.gadoe.org

See Regional Map. Indicate the region you are applying for in your cover letter or on your resume. Consideration/interviews will begin as soon as a list of applicants is established. Applications/resumes will be evaluated and only those meeting the qualifications will be considered. Top candidates will be contacted for interviews. No notification will be sent to applicants except those who are selected for interviews. Due to the large volume of applications received by this office, we are unable to provide information on your application status. Resume/application should include daytime telephone number and prior employment and salary history with addresses and telephone numbers. If a resume is submitted, it must be accompanied by a cover letter.

An Equal Opportunity Employer

VITA

Gilda Darlene Lyon was born in Huntsville, Alabama on September 27, 1951, the daughter of William and Elizabeth Lyon. She completed her Bachelor of Science degree from the University of Montevallo in Montevallo, Alabama. After receiving the BS degree in 1973, she began teaching science at Howard School in Chattanooga, Tennessee where she taught biology and chemistry for thirty years. During that tenure, she was awarded the Howard Hughes Fellowship to Brown University in 1990-91 where she spent a year studying and working with the Coalition of Essential Schools under the tutelage of Grace Taylor. She completed her Master's Degree in Secondary Education in 1992 from the University of Tennessee at Chattanooga. In 2001 she won the American Association for University Women's $10,000 Award for outstanding project to increase the interest of girls in math and science and in 2002 won the $6,000 Christa McAuliffe Award for top project in Tennessee to involve students in science. During the summers of 2005-2008 she travelled across the states conducting professional development with the United States Department of Education's Teacher-to-Teacher Institute. From 2004-2007 she was the magnet school facilitator for the Multimedia and Information Technology Academy at Howard School. She retired from Tennessee in 2007 and is presently a Science Implementation Specialist with the Georgia Department of Education.