Spring 5-16-2016

High School Teacher Perceptions on the Influence of Inquiry Science Labs on Student Performance on the Georgia High School Graduation Test (GHSGT) in an Urban School District

Zawadaski Robinson
zrobinson678@msn.com

ABSTRACT

EDUCATIONAL LEADERSHIP

ROBINSON, ZAWADASKI L. B.S. CLARK ATLANTA UNIVERSITY, 1998

M.P.A. TROY STATE UNIVERSITY, 2002

HIGH SCHOOL TEACHER PERCEPTIONS ON THE INFLUENCE OF INQUIRY SCIENCE LABS ON STUDENT PERFORMANCE ON THE GEORGIA HIGH SCHOOL GRADUATION TEST (GHSGT) IN AN URBAN SCHOOL DISTRICT

Committee Chair: Barbara Hill, Ed.D.

Dissertation dated May 2016

This study served to properly illustrate the relationship between teacher perceptions of science instruction in both traditional schools and small learning community-based schools. Further, this study also served to illustrate how these perceptions and ideologies impact student achievement as evidenced on state standardized tests. Using the independent variables of number of years of teaching experience for the teacher, teacher perceptions of science instruction in traditional schools, teacher perceptions of science instruction in small learning communities, and teacher perceptions of correlation between teaching style and student achievement, this study determined the manner of correlation between perception and practice.

A mixed method approach was used to collect, review, and analyze data in the form of a survey with a Likert scale and questionnaire component to obtain population

data on the teachers and also to determine their perceptions of various factors of science instruction in their particular environments. Findings and conclusions showed that there is still more research to be conducted in the area of science instructional methodology and student achievement, as there are other variables that may have a profound impact on the academic achievement of students in high school science courses.

HIGH SCHOOL TEACHER PERCEPTIONS ON THE INFLUENCE OF INQUIRY SCIENCE LABS ON STUDENT PERFORMANCE ON THE GEORGIA HIGH SCHOOL GRADUATION TEST (GHSGT) IN AN URBAN SCHOOL DISTRICT

A DISSERTATION

SUBMITTED TO THE FACULTY OF CLARK ATLANTA UNIVERSITY

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR

THE DEGREE OF DOCTOR OF EDUCATION

BY

ZAWADASKI L. ROBINSON

DEPARTMENT OF EDUCATIONAL LEADERSHIP

ATLANTA, GEORGIA

MAY 2016

TABLE OFF CONTENTS

CHAPTER

LIST OF FIGURES

Figure

LIST OF TABLES

Table

CHAPTER I

INTRODUCTION

The research of Marzano (2001) indicated that the effects of well-prepared and instructionally sound teachers on student achievement can be stronger than the influences of student background factors, including socioeconomic status and parental involvement. Teachers who tailor their instructional delivery model to the needs of their students in a consistent manner are far more likely to influence student academic achievement than external factors, such as poverty, language background, and minority status. The 2004 research of Vandevoort, Amrein-Beardsley, and Berliner asserted that the instructional style of the teacher in the classroom is the single most important factor in determining the levels of student achievement as evidenced by state standardized assessments. In a variant vein, the work of Finn and Voelkl (1994) asserted that smaller class sizes contribute to student learning, but the gains associated with smaller classes are most likely to be realized when they are aligned with the hiring of well-qualified teachers who engage in consistent research-based best practices.

In the metropolitan school district that has been identified by the researcher, 15% of the student population that participated in the administration of the Georgia High School Graduation Test (GHSGT) did not pass the test after five opportunities during the 2010-2011 academic year (Georgia Department of Education, 2012). As it pertains to the science assessments, students within the state of Georgia are not required to pass a standardized test in science until they reach the 11th grade. As a result, the researcher could find no previous studies analyzing the relationship between low student achievement, as evidenced by standardized test scores in the content of science, and the varying delivery methods used in instruction in the science curriculum. In addition, this assessment is no longer a requirement by the state of Georgia for graduation for all students, although there is a small percentage of students who are grandfathered into the test and must pass in order to graduate.

Based on the work of Marzano (2001), there is a correlation between state testing policies, chosen teaching strategies and instructional methods, and students' academic performance. States with low student performance and less qualified teachers who vary their instructional methods and lend their methods to more inquiry and lab-based methodology are more likely to pursue education improvements through student testing strategies and curriculum controls (Brown, Smith, & Stein, 1995). Regional differences in education investments and centralization happen to be correlated with policies regarding both testing and teacher investments.

Statement of the Problem

Student achievement in science content courses has proven to be problematic in many of the urban school districts in the Southeastern United States where the study is conducted. In 2006, through funding from the Bill and Melinda Gates Foundation, this urban school district aimed to address achievement in the sciences and technology by implementing a large-scale high school transformation initiative. The school district's goal was to transform all of its large, traditional high schools into small schools or small learning communities to ensure all students receive a high-quality education that prepares them for the challenges of today's global economy (Bill and Melinda Gates Foundation, 2006).

Although this attempt at reform is honorable, students are not achieving at nearly as high levels as other content areas, such as English. When reviewing achievement data for all 18 schools in this study, the researcher determined that 77% of students passed the GHSGT in English on the first attempt and only 52% passed in science. This study examines the researcher's perceived factors that influence the student achievement on the GHSGT in science of students in a selected school district. More specifically, the study focuses on identifying any significant correlation between student achievement on state science standardized tests for students in traditional schools receiving traditional teaching methods and students in small learning communities' receiving inquiry-based labs and experiments. A preeminent variable that led to the development of this study was the noticeable failure of students taking the Georgia High School Graduation Test during the 2010-2011 academic school years.

Science standardized tests in Georgia continue to go through major reforms with overlapping undertones for measurement. The state of Georgia is currently phasing out the Georgia High School Graduation Test for a science course driven End-of-Course Exam to measure science achievement. There are still students who fall under the umbrella of the Georgia High School Graduation Test as a requirement.

Purpose of the Study

The purpose of the study was to utilize the theories of critical race theory, constructivist theory, and cooperative learning theory in a mixed-method case study of 18 high schools in an urban school district to investigate the relationship between teacher perceptions, school structure (traditional or small learning community), and teaching style (traditional or inquiry-based labs and experiments) and the impact these variables have on student achievement on the Georgia High School Graduation Science Tests. This study sought to determine if certain variables, such as teaching styles geared toward inquiry-based labs and experiments and teacher perceptions of learning environments, have a negative or positive impact on the student achievement level on state science standardized tests.

Two models were fitted and interpreted for mathematics and science achievement. Perception of success and socioeconomic status were identified as two important latent variables to predict achievement in mathematics and science. On the other hand, as the frequency of classroom activities increase, which could be considered as student-centered, such as project works, classroom discussions and group work, student achievement level decreases. This points out that the educational strategies being used within the educational system should be reconsidered again with reference to teacher competencies and students expectations (Dergisi, 2005). Do teacher perceptions of science instruction, the instructional method, and the socioeconomic status affect student achievement on state science standardized test scores? Is there a correlation between the traditional methods and inquiry-based labs and experiments?

These questions yielded both a sense of urgency and practical rationale for the research study.

Research Questions

RQ1: To what extent do students who receive science instruction utilizing inquiry labs and experiments as the instructional method perform better on the Georgia High School Graduation Tests than students who receive instruction in a more traditional manner?

RQ2: What are high school teacher perceptions about teaching science in small learning community educational environments?

RQ3: What are high school teacher perceptions about teaching science in traditional school environments?

RQ4: What is the relationship between a high school teachers' perceptional on philosophy of pedagogy and the use of inquiry labs and experiments?

RQ5: What is the relationship between teacher years of experience and school environment?

RQ6: What is the relationship between teacher years of experience and pedagogical practice?

Significance of the Study

This study is significant as the results from the findings from this study may prove valuable to school leaders and policy makers at the state, district, and the local school levels as they aim to develop strategies to close the achievement gap in science in America's schools**.** The underlying issue that gives this study significance is that the study involves a concept, inquiry-based labs and experiments on science student achievement, with numerous known and unknown research factors that could explain why students are or are not successful. More specifically, there are no existing evident and valid solutions to the problem. Therefore, results from the study serve to be useful to educational leaders at the school level and the district level, as well as policymakers, in urban school districts in changing policies, procedures, and practices for affecting future student achievement success rates. The best practice would be to determine a specific plan of action to increase science student achievement. This study may equate to the acid in a chemical reaction by dissolving inadequate science instructional practices and creating a new vaccine for change in how America delivers science instruction.

Summary

Minimal research efforts have explored the intricate instructional relationships impacting science achievement on state standardizes tests. Teacher preparation and sound instructional pedagogy may overcome the stereotypical socioeconomic and parental influences that negatively impact student achievement. Smaller class sizes in collaboration with effective teachers using strategies proven through research increase the probability that students will learn. The battle over-lecture driven or inquiry-based classrooms continues to divide ideologies for achievement in science with miniscule research to validate, justify, or defend either side.

CHAPTER II

REVIEW OF THE RESEARCH LITERATURE

Organization of the Review

The purpose of review of literature was to examine relevant literature in support of the research study and guiding research questions. The sections are presented as follows: (a) Science Curriculum Reforms, (b) Purpose for Standardized Tests, (c) Inquiry–based Science Curriculum, and (d) perceptions about instruction.

The birth of science as a fundamental content component in public education came into existence in the early part of the 20th century. A formidable argument for science as an inquiry based curriculum with emphasis on measurement and Dewey (1910) debated scientific thinking. In 1957, the Soviet Union launched Sputnik and as the United States watched, the urgency of education in science became apparent. Since the beginning of the race for space exploration a more consistent and intentional inference has been placed on creating a scientifically strong United States. The United States has consistently increased the amount of standards required for science education but has not increased the amount of standardized tests to determine the effectiveness of the curriculum (Flynt, 2004). This is consistent with little amount of research that has done around factors impacting student achievement on science standardized tests and correlation to inquiry based labs and experiments.

Emergent Themes

Science Curriculum Reforms

A Nation at Risk (1983) opened the floodgates of knowledge in the United States and called for specific and intentional reform in science education. The science curriculum needed to be revised from the kindergarten level through graduate school (Elbert-May, 1997). The United States understood the responsibility and urgency of ensuring students not only comprehended the scientific concepts, but also able to connect the practical application of the content to its relevance in the real world. Students engaged in science curriculums needed to be able to with confidence analyze, solve, and communicate scientific problems (Elbert-May & Brewer, 1997). Science education at all levels requires active participation in the curriculum by the teacher and the student (Glasson & Lalik, 1993).

Since the launching of Sputnik, science educators have debated the best method of teaching science. This see saw controversy has direct instruction on one side and discovery learning on the other as the most effective method of teaching science (Bruner, 1960). A more recent science education debate discusses whole group instruction versus a more differentiated approach. Average students need practical courses that increase their positive attitudes towards content and academic courses are for students who plan to pursue graduate studies or careers in science (Goodson, 1993).

In 1989, the American Association for the Advance of Science (AAAS) reported that all science education should be engaged in scientific teaching. Scientific teaching incorporates student engagement with active learning strategies within the science curriculum. Science reform was not clear until recently when efforts specifically focused on scientific inquiry and the nature of science. The goal of developing a science curriculum with specific nature of science concepts and scientific inquiry has been generally accepted by the science community (Lederman, 1992). There continues to be debate among science educators over science pedagogy but there is consistency in the agreement of teaching nature of science and scientific inquiry.

Active participation in classrooms and inquiry-based lessons aid in the students development of critical analytical skills (Handelsman et al., 2004). The method in which science curriculum is taught needs to be explored. High school science classes are composed of lectures with textbook labs that require little of not conceptual or analytical reasoning skills (Handelsman et al., 2004). Handelsman also confirms that there is an overabundance of lecturing in science curriculum. Minimizing the lecture and increasing the engagement of students in active learning strategies through relevant discovery during the scientific process increases the probability that students will retain the knowledge (Handelsman et al., 2004).

Purpose for Standardized Tests

A Nation At Risk (1983) stated, "American students were not studying the right subjects, were not working hard enough, and were not learning enough" (p. 12). After release of *A Nation at Risk,* standardized test usage in the United States became the norm. Science is put on the back burner in many schools and is often not a tested subject (Adams, 2003). Standardized tests are a direct result of standards based reform and are an important indicator of educational success (Guzenhsuser, 2003). Standardized tests in science should focus on understanding how students are learning and what to do to increase student potential for learning (Finneran, 2003).

With increased attention focused on student performance, science educators have debated if standardized tests could truly measure student performance in such a complex content as science. Labs and experiments, the main measurements of success in a science curriculum, are consequently complicated to assess. Research designates a need to increase testing in science but the problem is in the development of the test itself (Victor & Kellough, 1993).

The Georgia High School Graduation Test (1997) required all students to pass a standardized test in science, math, language arts, and social studies to receive a state certified diploma. More students failed the science part of the Georgia High School Graduation Test than any other content (Georgia Department of Education, 2006). After the science portion of the Georgia High School Graduation test became a qualifying factor for a high school diploma, the number of Georgia High School Graduates decreased (Georgia Department of Education, 2006).

Inquiry–Based Science Curriculum

Inquiry-based science curriculum is the primary component in the current reform approach to increase the comprehension of critical science concepts. The inquiry–based method of teaching science should be utilized because it will promote: (a) understanding of fundamental facts, concepts, principles, laws, and theories, (b) development of skills that enhance the acquisition of knowledge and understanding of natural phenomena,

(c) cultivation of the disposition to find answers to questions and to question the truthfulness of statements about the natural world, (d) formation of positive attitudes toward science, and (e) acquisition of understanding about the nature of science (Chiappetta, 2004). In 2003, the American Association for the Advancement of Science published "Project 2061," a report that suggested that the science curriculum should be aligned with the scientific inquiry process.

Inquiry is classified a discovery approach or method to understanding and processing information (Haury, 1993). Student inquiry and hands on lab activities or experiments with activities are key components of engaging the student in learning (Haury, 1993). There continues to be a debate between science educators and scientists over which method is best, inquiry-based process method or the science process method. The science process method and inquiry-based process method both develop the following process skills: interpreting, inferring, analyzing data, measuring, classifying, observing, and questioning (Lederman & Abd-El-Khalick, 1998). The difference becomes evident when inquiry-based curriculum goes beyond the process skills and extends from scientific reasoning to utilizing critical thinking skills in order to create solutions (Lederman & Abd-El-Khalick, 1998).

In 1997, the American Association for the Advancement of Science referenced that hands-on activities in science include all hands-on activities within the classroom and during the lab. When students use the hands-on method, they only follow scripted steps and procedures without necessarily comprehending the concept (AAAS, 1997). Definitively discovery learning, inquiry–based science instruction, process skills, and hands-on activities cannot be considered equal to inquiry–based learning (Haury, 2004).

Lederman and Abd-El-Khalick (1998) viewed scientific inquiry as systemic where scientists investigated problems in which they were interested and Wilfred (2005) stated that when the inquiry-based method is utilized in the curriculum, the outcome yields student comprehension of the concept. The culmination of these views drives the focus of the current study: inquiry-based labs and experiments versus the traditional approach of teacher lectures while students complete procedural labs or experiments.

Ask seven different science educators for the definition of inquiry-based curriculum and you will get seven vague answers. Lederman and Abd-El-Khalick (1998) viewed inquiry as what students were able to do with the goal of using student interests to make connections to scientific concepts. Science educators need a consistent and clear understanding of the term inquiry-based curriculum. Several researchers have documented science educator instructional attempts to define the inquiry-based curriculum. Science educators have provided students with the specific equipment and materials necessary to solve a specific problem (Igelsrud & Leonard, 1998). Science educators made connections between science concepts and things in student everyday lives to bridge a concept (Germann, 1991). Science educators gave little direction to students about a science concept and allowed students to individually explore or search in their own way for understanding (Tinnesand & Chan, 1987).

Based on the data obtained from the Georgia Department of Education (2009), student performance on the Georgia High School Graduation Test in Science has been dismal, since 53% of the 1,615,066 students who were administrated the test in the state exceeded the standards. In other words, 47% of the students in Georgia received a percent score of less than 50% on the GHSGT in Science.

Inquiry-Based Science Instruction

Between 1984 and 2002, Minner, Levy, and Century (2010) conducted 138 studies in an Inquiry Synthesis Project to address the research question, "What is the impact of inquiry science instruction on K–12 student outcomes?" Their mixed method research analyzed text and numerical data yielded results with 51% of the study participants having positive impacts on science content student achievement when inquiry based instruction was applied. "Hands-on experiences with scientific or natural phenomena also were found to be associated with increased conceptual learning" (Minner et al., 2010, p. 20) in inquiry-based instruction. The next logical step would be to determine if a connection between science standardized test scores and inquiry based approach.

Tretter and Jones (2003) studied the connection between standardized test scores and inquiry based instruction. Their case study results were concluded after a four-year period studying a physical science class in which the first two years the physical science instructor used the traditional method and the last two years the physical science instructor utilized inquiry based approach. According to Tretter and Jones, "inquiry-based instruction resulted in more uniform achievement than did traditional instruction, both in classroom measures and in more objective standardized test measures" (p. 1).

This study serves as an effective collaborative text for the current study as it is inclusive of the traditional method and the inquiry based approach. Deters (2005) conducted an online survey of United States chemistry instructors and of the 571 responses concluded 45.5% of these instructors did not use inquiry based instructional approach. Deters enlisted student feedback and concluded that students who "perform even a few inquiry-based labs each year throughout their middle school and high school careers, by graduation they will be more self-confident, critical-thinking people" (p. 1180). If few teachers utilize the inquiry-based approach, how do you begin to measure the perceptions of science teachers?

Cheung (2011) developed a guided inquiry scale to measure teacher perceptions of the inquiry-based approach. The guided inquiry scale collected data from 200 chemistry teachers on the value, limitation, and implementation issues of inquiry labs using a seven point Likert scale. Cheung concluded that chemistry teachers valued inquiry based approach and the "length of chemistry teaching experience and the level of student ability did not influence teachers' beliefs" (p. 1468) on the inquiry-based approach. Crawford (2007) conducted a one-year study of the knowledge and perceptions of five science teachers on inquiry based approach. The study yielded evidence suggesting that a teachers" intentions and abilities" (p. 636) about inquiry based approach is influenced by "the teacher's complex set of personal beliefs about teaching and of science" (p. 613). This correlation between teacher beliefs and the practice of teaching science corroborates the findings of Luft, Roehrig, and Patterson (2003).

Literature and research studies have found that inquiry based approach has positive effects on students' science achievement, laboratory skills, science process skills, and comprehension of science when compared to students who are taught utilizing the traditional approach (Chang & Mao, 1998). Along the same pattern of work as Chang and Mao, Gibson and Chase's (2002) longitudinal study provided proof that an inquiry based approach science program may have positive influence on middle school students by maintaining their science focus during their high school matriculation.

The effective utility of the inquiry-based learning approach demands inclusion of learners in a self-directed learning environment to teach learners the ability to think critically, and to give them an understanding of how to reflect and reason scientifically. This study shows how when teachers use the inquiry based approach it is an important factor that affects students' future science interest level and students engaged will extend more effort in science class. The most effective way to retain students from underrepresented ethnic groups is to improve the quality of the learning experience (Seymour & Hewitt, 1997). Gibson and Chase (2002) asserted that "traditional methods of instruction, which often include lectures, note taking and cook-book science, may not be as effective as hands-on, inquiry-based methods" (p. 12).

Small Learning Communities

Springer, Stanne, and Donovan (1999) demonstrated that "various forms of small-group learning are effective in promoting greater academic achievement" (p. 21). Cooper and Mueck (1990) wrote that cooperative learning occurs when small groups collaborate to achieve a common goal in a structured instructional environment. Their study described motivational, affective, and cognitive as the three common interrelated theoretical perspectives of small-group learning on science student achievement as follows:

1. Motivational perspective focuses on inclusive connection between competition and reward systems.
2. Affective perspective focuses on nonthreatening intrinsic motivations.

3. Cognitive perspective focusing on extensive information processing interactions among students.

Unfortunately, there is limited research on small learning communities as they relate to science instruction.

The small learning community is often associated with the laboratory exercise in science instruction. Hofstein and Lunetta (2004) looked at how science laboratory activities can be used by teachers to affect student achievement outcomes. The researchers discussed factors that collectively decrease learning outcomes in the science laboratory include the following:

1. Laboratory manuals continue to offer task lists of instructions to follow. The laboratory manuals lack critical thinking and rational for students to justify the purpose of the activity. Student perception of laboratory activity as futile due to lack of the purposes of laboratory inquiry by high stakes tests that propose to assess science standard academic achievement.
2. Poor teacher understanding and rational for laboratory activities and the negative influence the teacher's "rhetoric and practice that is likely to influence students' perceptions and behaviors in laboratory work" (p. 48).
3. Inquiry-based activities in science laboratories lack resources, technology, laboratory facilities, and the "perceived foci of external examinations" (p. 48).

In summary, the research of Hofstein and Lunetta (2004) suggested teachers use laboratory activities performing managerial functions, not probing nor testing hypotheses. Currently, the United States is emerged in an era where standardized science tests drives teacher, parent, and student perceptions and actions. The policy makers who prepare and control standardized testing must improve the connection between the laboratory experiences and science academic achievement.

Traditional Schools

The Tsai (2002) study interviewed 37 science teachers referencing their perceptions about teaching science and student achievement in science. The interviews revealed that most science teachers who had "traditional" (p. 771) perceptions favored a more traditional approach to science education. This study formulated and aligned these traditional beliefs as "nested epistemologies" (p. 773) and suggested that this perception was most prevalent in teachers with more years of teaching experience. Tsai suggested nested epistemologies impact science teacher perceptions about science student achievement.

According to Luft and Roehrig (2007), the following questions are comprehensive enough "to depict the epistemological beliefs of science teachers" (p. 43).

1. How do you maximize student learning in your classroom? (Learning)
2. How do you describe your role as a teacher? (Knowledge)
3. How do you know when your students understand? (Learning)
4. In the school setting, how do you decide what to teach and what not to teach? (Knowledge)
5. How do you decide when to move on to a new topic in your classroom? (Knowledge)
6. How do your students learn science best? (Learning)
7. How do you know when learning is occurring in your classroom? (Learning)

Beliefs research or perceptional research is relatively new and few preliminary researchers attempt to lend depth to this new method for measuring teacher beliefs in science. Luft, Fletcher, and Fortney (2000), Luft, Roehrig, and Patterson (2003), Roehrig and Luft, (2004), and Roehrig and Luft (2006) all suggested viable paper and pencil measures to assess teacher beliefs.

Rivet and Krajcik (2004) conducted a study of 24 science teachers in traditional schools in which an inquiry-based project—How Do Machines Help Me Build Big Things?—was created. This study used pre- and post-achievement tests to determine student science achievement outcomes. “Achievement outcomes as measured by the pre/posttest show significant and consistently high learning gains” (p. 669) which yields further evidence of the argument for the effectiveness of inquiry based approach.

Urban School Science Standardized Reform

The conceptual article by Settlage and Meadows (2002) placed a microscopic lens on the influence science standards based reform impacts upon science education within urban schools. The researchers within the article suggested that the science standards based reforms negatively “undermining urban teachers' professionalism, eroding teacher–student relationships, diluting the science curriculum, and disparate instruction based on predicted individual test performance” (p.114). The science educational community continues to acknowledge science achievement in urban environments must remain a priority (Fraser-Abder, Atwater, & Lee, 2006). Lee and Luykx (2005) alluded to the fact there is “a lack of credible research on effective science instruction and curricula for diverse student populations” (p. 411).

The Detroit Public Schools developed an inquiry-based approach to a cohort of seventh and eighth graders and compared them to non-cohort participant using the state standardized science test. The seventh and eighth grade cohorts had significant higher pass rates on the state science standardized test. "Examination of results by gender reveals that the curriculum effort succeeds in reducing the gender gap in achievement experienced by urban African-American boys" (Geier et al., 2008). Consequently, this further demonstrates how inquiry based approach can lead to science standardized achievement gains in a traditional urban school district.

A strategic approach to science-standardized reform materializes as a university partnership with an urban school district. Johns Hopkins University in collaboration with Philadelphia schools developed a teacher support model based on National Science Foundation supported science curriculum materials that were commercially available to address low science achievement. Philadelphia schools compared gains in Stanford Achievement Test of three cohort schools to 23 traditional schools not supported by the program. According to Ruby (2006), gains in science achievement and achievement levels were substantially greater within the three cohort schools than the remaining 23 school populations. The model lacks feasibility for urban school districts due to the necessity of a university or private entity to fund revenue required for implementation.

Perceptions about Instruction

The data derived from the study provides evidence of disproportionate science experiences in classroom size, resources, curriculum, funding, hands on activities, and classroom opportunities for low-income minority students. Teachers' perceptions, expectations, and behaviors interact with students' beliefs, behaviors, and work habits in ways that help to perpetuate the black-white test score gap (Ferguson, 2003). These race and gender findings have critical implications for understanding science student achievement and socialization in not only poor minority students but also ethnically diverse populations.

Summary

The United States of America continues to enact laws that hold educators accountable for student progress through instruments of measurement known as standardized tests. The pressure to provide evidence of student achievement affects the decisions made by educators, policy makers, and local education agencies. Since the race for space exploration began, science education has gone through a metamorphosis of reforms with minimal effort into the creation of clear valid solutions to closing the gap in science achievement. Unfortunately, the science achievement gap increases as urban minorities matriculate from elementary to high school with fewer opportunities to learn or experience science.

CHAPTER III

THEORETICAL FRAMEWORK

Introduction

The researcher utilized a mixed method case study of GHSGT achievement in 18 high schools in an urban school district to determine how GHSGT achievement is affected by the following variables:

- number of number of years of teaching experience for the teacher
- teacher perceptions of science instruction in traditional schools
- teacher perceptions of science instruction in small learning communities
- teacher perceptions of correlation between teaching style and student achievement

For the purposes of this study, the researcher used the Critical Race Theory (Ladson-Billings, 1999), Constructivist Theory (Duffy & Tobias, 2009), and Collaborative Learning Theory (Panitz, 1999) to determine the following:

RQ1: To what extent do students who receive science instruction utilizing inquiry labs and experiments as the instructional method perform better on the Georgia High School Graduation Tests than students who receive instruction in a more traditional manner?

RQ2: What are high school teacher perceptions about teaching science in small learning community educational environments?

RQ3: What are high school teacher perceptions about teaching science in traditional school environments?

RQ4: What is the relationship between a high school teachers' perceptional on philosophy of pedagogy and the use of inquiry labs and experiments?

RQ5: What is the relationship between teacher years of experience and school environment?

RQ6: What is the relationship between teacher years of experience and pedagogical practice?

Critical Race Theory (Ladson-Billings, 1999)

Critical Race Theory applies to this study in that this theory serves to examine the intersection between law, race, policy, and justice in the social sciences. For this study, this theory shapes the lens through which this predominantly African-American school district approaches reform in the 18 high school used in this study. The high school reform initiative referred to in Chapter I of this study was most aggressive in the schools with higher percentages of African-American students and higher percentages of students on free and reduced lunch. Only two of the schools used in this study have more than 12% of students not identified as African American. These two schools did not undergo the small learning community project in the district.

Constructivist Theory (Duffy & Tobias, 2009)

In this study, the Constructivist Theory lends itself to the theory that inquiry-based learning is a dynamic course of learning in which learners build, or construct, new thoughts, considerations, and concepts based upon their current/past knowledge, coupled with new experiences. The learner selects and transmutes information, constructs assumptions, and makes conclusions, relying on a cerebral construction to do so. This schema provides meaning and organization to experiences and allows the individual to learn far past the information given by his or her teacher, making the teacher a facilitator (Duffy & Tobias, 2009).

As far as instruction is concerned, the instructor in constructivist theory must encourage learners to discover principles without much teacher intervention. The instructor and student (facilitator and learner) should engage in active discourse (i.e., Socratic learning). The task of the instructor is to translate information to be learned into a format appropriate to the learner's current state of understanding. As it pertains to this study, this particular learning environment is most readily seen in the inquiry-based classrooms used in this study.

Cooperative Learning Theory (Panitz, 1999)

A third theory applicable to this study is the Cooperative Learning Theory. This theory is a student-centered, instructor-facilitated approach to classroom instruction that allows for small groups of students to work collaborative within certain criteria. The cooperative group is responsible for its own learning and the learning of all group members, eliminating the idea of one individual being responsible for the acquisition of knowledge. Students interact with each other in the same group to obtain and work through the elements of a subject matter in order to solve a problem, complete a task or achieve a goal (Panitz, 1999).

Research Design

A mixed method case study of 18 schools within one urban school district is used in the study to clarify the relationship between the variables. The mixed methods research encompasses the acquisition of multiple ways to explore a research problem. Based on the research of Gall, Gall, and Borg (2007), correlational research is simplistic in design. Data are collected on two or more variables for each participant in a sampled population.

A correlational design is utilized throughout this study. The purpose of this design as it pertains to this research is to ascertain whether or not there is a relationship between state Georgia High School Graduation Tests test scores in Science and teacher perceptions of inquiry labs and experiments. A survey/questionnaire was used as the primary data collection instrument used in the study. Questions were developed using a Likert scale for collecting data. The results from data collection were analyzed from the Likert scale using descriptive statistics in order to explain the relationships between the hypothesized variables. This measurement of the mode from the survey results calculates the percentages for the most frequent response as well as other responses.

Theory of Variables

The dependent variables for this study were the control group's Georgia High School Graduation Test in science scores for all students whose teachers in traditional high schools used the traditional approach. The GHSGT scores achieved by students whose teachers in small learning communities used inquiry–based labs and experiments to provide instruction provide the experimental group's data set. Due to the nature of the variables of this case study, there were several theories in the canon of educational research that apply to the construct of this study, including critical race theory, constructivist theory, and cooperative learning theory.

The study is comprised of two groups: control (traditional high school) and experimental (small learning community schools). The independent variables for both the control group and experimental group used in this study consist of the following: number of years of teaching experience for the teacher, teacher perceptions of science instruction in traditional schools, teacher perceptions of science instruction in small learning communities, and teacher perceptions of correlation between teaching style and student achievement. The aforementioned independent variables all serve to work within one another to impact the dependent variable of student achievement on the GHSGT. Neither of these variables works independently of the others, as they all impact one another (see Figure 1).

Figure 1. Theoretical framework of the study.

Teacher perceptions of student achievement on Georgia High School Graduation Tests in science are examined by surveying teacher perceptions about the structure in which teachers implement the science curriculum. The analysis of student mastery of science curriculum in thoroughly emphasized through the teachers' methodology on labs and experiments, as well as GHSGT scores. The interconnectivity of the independent variables and their relationship to the dependent variable has been defined as a result of the data derived from this study.

Definition of Variables and Other Terms

Inquiry-based teaching is defined as the teachers' perception of the level of differentiation in the classroom by using inquiry labs and experiments.

Teacher assessment of student achievement in Georgia High School Graduation Test is defined as the teachers' perception of student achievement on the Georgia High School Graduation Test.

Definitions of Related Terms

For the purpose of this study, other terms were defined as follows:

Discovery-learning: Discovery learning pertains to the act of figuring out something for one's self (Chiappetta & Koballa, 2002).

Georgia High School Graduation Test (GHSGT): The GHSGT is given to all students in their junior year in the state in the areas of language arts, mathematics, social studies, and science. The GHSGT program helps to ensure that all students in the state have access to a rigorous curriculum that meets high performance standards. The purpose of the GHSGT is to provide diagnostic data that can be used to enhance instructional programs. For the purpose of this study, scores discussed are derived from the science GHSGT (Georgia Department of Education, 2010).

Hands-on-learning: According to the AAAS (1997), hands-on-science includes all hands-on activities carried out by students' experiments and completed in the classroom or in a laboratory. In other words, the term defines a specific method of instruction, based on activities carried out by students, but its use does not preclude other instructional methods because it is often used in conjunction with other methods.

Inquiry–based science curriculum: For this study, inquiry–based science teaching involved activity and skills, but the focus was on the active search for knowledge or understanding to satisfy a curiosity (Haury, 1993).

Traditional method of science teaching is defined as **c**lassrooms where teachers transmit information to students via lecture, worksheets, or individual assignments, or very little interaction among students and teacher; the classroom is teacher-centered (Chiappetta & Koballa, 2002).

Relationship among Variables

Figure 2 serves to illustrate the relationship between the independent variables—number of years of teaching experience for the teacher, teacher perceptions of science instruction in traditional schools, teacher perceptions of science instruction in small learning communities, teacher perceptions of correlation between teaching style, and student achievement. This study determined the manner of correlation between perception and practice.

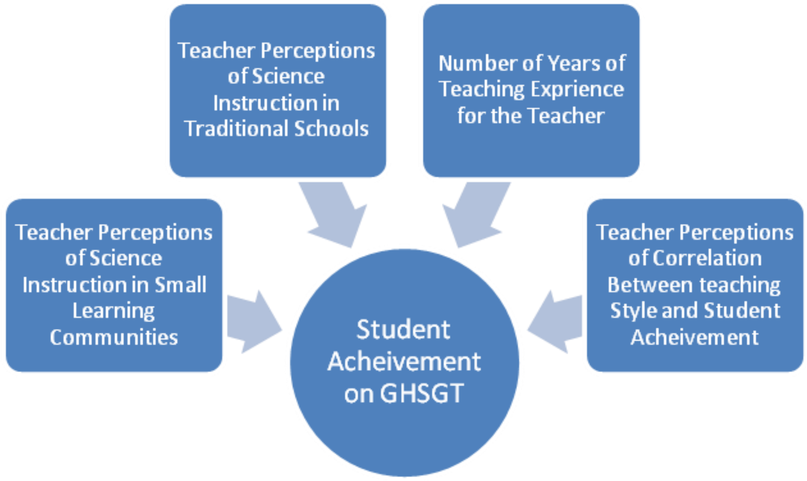

Figure 2: Relationship among the independent and dependent variables.

Limitations of the Study

A focus on inquiry-based learning in science classrooms is an ancient concept, but one seldom researched. Consequently, the limited amount of research provides minimal preliminary literature and data to refer to. The limitations contained in this study consisted of the following:

- availability of participants
- communication
- methods of data collection

Availability of Participants

Due to the large number of research participants used in this case study, scheduling proved to be an issue, as many of the participants had varying work schedules. This led to being able to collect data from the participants by purely electronic means, such as email and Google.

Communication

All communication with the research participants was through email and Google, which did not allow for more in-depth questioning and follow through.

Methods of Data Collection

Due to the nature of the study, multiple uses of data proved nearly impossible. The use of triangulation would prove to add depth to the study, but the use of 69 research participants who all teach at various school sites in the city rendered this extremely difficult. This case study would have greatly benefitted from other methods of data collection, such as focus groups and interviews, in order to obtain more teacher perception data.

Summary

The purpose of the research was to evaluate teacher perceptions of the influence that inquiry labs and experiments might have on student test scores on Georgia High School Science Graduation in an urban school district. The investigation was also designed to ascertain the degree to which student performance on Georgia High School Graduation Tests increases or decreases as a result of teacher instructional style (teaching inquiry labs and experiments) as well as the environment to which this occurs (in a small learning community versus the traditional method of teaching science.) The data derived as an outcome of this study should be beneficial to other urban districts in the United States in identifying an effective pedagogical strategy for teaching science

There have not been numerous studies that have investigated the impact that inquiry-based laboratory investigations have on student performance on high stakes science exams and teachers' perceptions. The literature review lends itself to utilizing to posing the following questions:

RQ1: To what extent do students who receive science instruction utilizing inquiry labs and experiments as the instructional method perform better on the Georgia High School Graduation Tests than students who receive instruction in a more traditional manner?

RQ2: What are high school teacher perceptions about teaching science in small learning community educational environments?

RQ3: What are high school teacher perceptions about teaching science in traditional school environments?

RQ4: What is the relationship between a high school teachers' perceptional on philosophy of pedagogy and the use of inquiry labs and experiments?

RQ5: What is the relationship between teacher years of experience and school environment?

RQ6: What is the relationship between teacher years of experience and pedagogical practice?

CHAPTER IV

RESEARCH METHODOLOGY

Research Design

A mixed-method case study approach is utilized for case study, consisting of a survey research design with a Likert scale and questionnaire component. A Likert scale is used because it serves as a psychometric scale where the research participants specify their level of agreement or disagreement on a symmetric agree/disagree scale for a series of statements while responding to a particular Likert questionnaire item. The range of Likert scale captures the intensity of their feelings for a given item (Barua, 2013). Quantitatively driven approaches and designs similar to that of this research study is, at its core, a quantitative study with qualitative data/method added to supplement and improve the quantitative study. This is achieved by providing additional value and more in-depth fuller and more complex answers to research questions.

Qualitative data for the purposes of this study was collected by having teachers in the high school complete a questionnaire survey to determine their perceptions on the factors that measure student achievement in science on the Georgia High School Graduation Test. Student assessment data on the science portion of the Georgia High School Graduation Test, as well as the teacher Likert scale responses served as the quantitative measure of data.

Description of the Setting

The research conducted in this study was not conducted at a singular location. Data collected were from 69 participants in 18 schools in an urban metropolitan school district. Educators in the 18 schools are considered “highly-qualified,” as 89% of the teachers hold certification in their classroom instructional area and 69% of the educators hold advanced degrees, or are working toward advanced degrees.

The schools used in this case study had an average of 79% of students on free or reduced lunch and every school was considered a Title I school. Title I, which is a federally funded program, aims to address the achievement gap in America by providing additional services and funding for student who are considered at risk.

There were two types of schools used in this case study: traditional and small learning communities. Traditional schools are considered schools that function in the traditional method of one teacher in a class of students within a larger school setting. A Small Learning Community (SLC), which functions as a school within a larger school, is a form of school structure that divides large school populations into smaller, autonomous groups of students and teachers. These SLCs usually have themes or foci, such as law and policy, technology, or early college.

Sampling Procedures

The teacher participants in the study were selected on a volunteer basis. The participants were selected from the 18 high schools within the urban school district used in this study.

Instrumentation

The instrument used in this study was an electronic questionnaire consisting of a combination of Likert scale and additional prompts, developed to measure the defined variables. Traditional school and small learning community-based school data from the Georgia High School Graduation Test in science were also obtained, reviewed, and analyzed.

Instrument Description (Survey)

The instrument was self-developed and examined by professors whose expertise is in the field of educational research. The development of the Likert-scale instrument is based on research conducted by indicating a high degree of validity and reliability**.** In addition to the Likert scale component of the survey, there was also a qualitative component in the additional survey prompts.

Dependent Variable

The dependent variable for the study is the Georgia High School Graduation Test scores in science for traditional schools and small learning communities who used either traditional instruction or inquiry-based labs and experiments.

Independent Variables

The independent variables for the study are as follows:

1. number of years of teaching experience for the teacher;
2. teacher perceptions of science instruction in traditional schools;
3. teacher perceptions of science instruction in small learning communities; and

4. teacher perceptions of correlation between teaching style and student achievement.

Participants/Location of Research

All of the participants for the purposes of this study are educators who teach science in secondary schools. Approximately 69 high school science teachers were selected for the study within the designated urban school district. The targeted population completed the study using a Google Form. Table 1 shows the population of research participants broken down by school type and years of experience.

Table 1

Years of Experience by School Type

Years of Experience	Traditional	SLC
0-5 Years	5	7
6-10 Years	7	10
11-15 Years	11	6
16- 20 Years	10	4
21-25 Years	4	2
26 + Years	2	1

Data Collection Procedure

The researcher identified all high school science teachers within the designated urban school district and emailed the link to the Google Forms survey to all 69 participants. Traditional schools and small learning communities are differentiated by the qualitative responses provided in the questionnaire in order to identify each, with the questionnaires completed within two weeks. As an added incentive for participants, the researcher held a drawing for two gift certificates each valued at $100.

Georgia High School Test data in science were collected for each school within the designated urban school district from the Georgia Department of Education and carefully analyzed and cross-referenced with teacher responses inclusive of course content course taught during the school year.

Description of Data Analysis Methods

The data from the Science Teacher Inquiry-Based Survey (see Appendix) were analyzed to provide answers for the research. The Science Teacher Inquiry-Based Survey is a Likert scale instrument used to measure teachers' perceptions about inquiry-based laboratory investigation on high stakes science exams. The data from the Georgia High School Graduation Test in Science for traditional and small learning communities were analyzed to indicate the most effective method for teaching science within an urban district. The examination of the organizational chart at the regional level and principal level is studied to determine their level of awareness on the variances of the independent and dependent variables.

Summary

The use of Likert surveys produced rich perception data that were most easily collected and analyzed within the limitations of this study. Utility of teacher perception data is an essential component to the previously mentioned research process. Science educators and their perceptions play a large role in the manner in which they instruct students in their classrooms. Collection and analysis of this perception data provided a springboard from which other research may launch and facilitate student achievement in science courses.

CHAPTER V

ANALYSIS OF THE DATA

Introduction

This chapter presents the results of the study and analyzes the effects that the independent variables for this study: number of years of teaching experience for the teacher, teacher perceptions of science instruction in traditional schools, teacher perceptions of science instruction in small learning communities, and teacher perceptions of correlation between teaching style have on student achievement on the GHSGT. Consequently, six purposefully chosen research questions were used to guide and provide focus to the study in order to determine if and how the aforementioned variables affect teacher perceptions. These purposeful research questions are as follows:

RQ1: To what extent do students who receive science instruction utilizing inquiry labs and experiments as the instructional method perform better on the Georgia High School Graduation Tests than students who receive instruction in a more traditional manner?

RQ2: What are high school teacher perceptions about teaching science in small learning community educational environments?

RQ3: What are high school teacher perceptions about teaching science in traditional school environments?

RQ4: What is the relationship between a high school teachers' perceptional on philosophy of pedagogy and the use of inquiry labs and experiments?

RQ5: What is the relationship between teacher years of experience and school environment?

RQ6: What is the relationship between teacher years of experience and pedagogical practice?

Characteristics of Sample

All of the 69 research participants were representative of various types of educators who serve in the school district used in this qualitative study. The educators used in this study vary in years of teaching experience, age, race, and gender (see Table 2).

Table 2

Number of Participants per Type of Environment

Descriptor	Number of Participants
Traditional Environment	40
Small Learning Environment	17
Virtual/Online	5
Alternative	7

Methods of Data Collection

For the purposes of this study, research was collected through completion of Likert scale surveys. Data, such as school achievement information, were collected from multiple sources, including the Georgia Department of Education and teacher-provided assessment data.

Data in Response to Research Questions

RQ1: To what extent do students who receive science instruction utilizing inquiry labs and experiments as the instructional method perform better on the Georgia High School Graduation Tests than students who receive instruction in a more traditional manner?

The data collected show that the students of those educators who provide the students with inquiry labs and experiments as the primary instructional method perform slightly better on the Georgia High School Graduation Tests than students who received more traditional methods of instruction, such as lecture and PowerPoint presentation coupled with note taking. There was not a substantial difference in the scores between these groups of students, as the average scores of the students taught by the teachers do not show a broad range of variance in scoring.

RQ2: What are high school teacher perceptions about teaching science in small learning community educational environments?

When responding to the short answer components of the survey, teacher responses lent themselves to the perception that these science educators prefer providing instruction in small learning communities, as opposed to larger educational environments.

RQ3: What are high school teacher perceptions about teaching science in traditional school environments?

Teachers who taught science in traditional school environments perceived the instruction of science in a very stoic manner. These teachers responded to the survey in a manner that suggests that putting additional effort into instructing students in the sciences has no impact on the level of mastery that students achieve. The teachers' methods were not refined and these educators respond to various prompts in the survey that illustrate an inability and attitude about modifying science instruction to become more student-centered and less teacher-centered.

RQ4: What is the relationship between a high school teachers' perceptional on philosophy of pedagogy and the use of inquiry labs and experiments?

The relationship between a high school teacher's perceptional philosophy of pedagogy and the use of inquiry labs and experiments illustrates that a majority of the teachers (29 traditional instructors out of 40) hold the ideology that inquiry labs and experiments, if performed in class, should be teacher-centered. This teacher-centered ideology, as opposed to student-centered, with the teacher leading the activity, as opposed to facilitating and allowing students to master and learn permeates the perceptions and pedagogical practices of the teachers used in this study.

RQ5: What is the relationship between teacher years of experience and school environment?

Although there was a mixture of both novice and veteran teachers at the two types of schools used in this study, there appeared to be a disproportionality as it pertained to the number of veteran teachers who taught at small learning environment-based schools. More than three-fourths of the teachers in the aforementioned environment are newer teachers (those with zero to five years of teaching experience and those who fall between the age range of 21 years of age and 40 years of age).

RQ6: What is the relationship between teacher years of experience and pedagogical practice?

The data as evidenced in the surveys, illustrate that novice teachers (those with zero to five years of teaching experience) lend themselves to less traditional manners of student instruction. They are confident in their ability to communicate the purpose of labs and experiments to the students in their classes and feel the textbook is far less effective in the instruction of the science curriculum.

Emergent Themes

During the process of data collection and analysis, the following major themes were identified:

- a focus on teacher-centered instruction in traditional classrooms;
- more experienced teachers work in traditional environments;
- traditional teachers see no correlation between their instruction and student assessment data;
- unique culture in small learning community-based environments; and
- overall teacher desire for student success.

These themes developed almost immediately in the survey instruments, as the study participants appeared eager to share their perceptions on their respective school environments, teaching methodology. and how these impact student achievement as seen on the state assessments used in this study (see Figure 3).

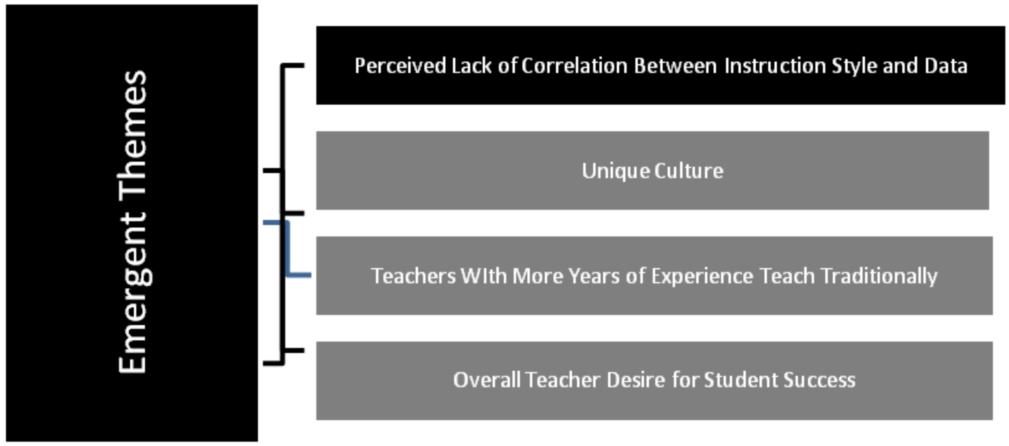

Figure 3. Emergent themes in order of prominence.

The most common emergent themes from the data used in this study are as follows:

- Thirty-nine of the 69 teachers in this case study illustrated a perceived lack in correlation between a teacher's instructional practices.
- All teachers used in this study who taught in small learning environment-based schools agreed that the environment in which they teach is unique in culture. The responses from the survey display a correlation between the more diverse pedagogical method of instruction and the unique and vibrant nature of the school's culture.
- After review of data, another theme was the prevalence of older and more experienced teachers working in traditional environments. Out of the 40 research participants who worked in traditional environments, 27 of those have more than 10 years of experience in education.

- The final theme observed in data is the dedication of the teaching staff, regardless of their perceptions and teacher styles. This theme itself is prevalent in the culture in the schools where these teachers work. These teachers shared that maximizing student achievement is a consensual goal among the staff, regardless of any other factors, including school structure, teaching style and years of experience.

Summary

The rationale behind this particular process of study was to ascertain the manner in which the aforementioned independent variables of number of years of teaching experience for the teacher, teacher perceptions of science instruction in traditional schools, teacher perceptions of science instruction in small learning communities, teacher perceptions of correlation between teaching style, and student achievement directly impact the measure of student achievement in these science classrooms.

CHAPTER VI

FINDINGS, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Introduction

Inquiry-based learning, which begins by posing questions or identifying problems rather than simply presenting established facts and direct instruction, allows more depth of learning by exposing a more pluralistic path to student acquisition of knowledge. The process functions with teacher serving as the facilitator, as opposed to the carrier or single source of information. Students taught in this methodology identify and research issues and questions to develop their knowledge or solutions (Dostál, 2015). Dewey's propensity to criticize the idea that traditional science education was not taught in a way to develop young scientific thinkers and proposed that science is to be taught in the inquiry-based model (Dewey, 1910).

Findings

Throughout this study, it has been the perception of the researcher that the independent variables of number of years of teaching experience for the teacher, teacher perceptions of science instruction in traditional schools, teacher perceptions of science instruction in small learning communities, teacher perceptions of correlation between teaching style, and student achievement are equally interrelated and all directly impact the measure of student achievement science classrooms. This has been only partially substantiated by the data collection and analysis process of the study. It has been the outcome of this focused research that the variables of number of years of teaching experience for the teacher, teacher perceptions of science instruction in traditional schools, teacher perceptions of science instruction in small learning communities, teacher perceptions of correlation between teaching style and student achievement are determined to have correlation, but are not the sole achievement-determinant variables as there are many other variables that contribute to the manner in which student achievement is attained in the urban classrooms of this study's research participants.

Findings: Number of Years of Teaching Experience

The amount of time in which a teacher has been working in the field of education has illustrated an adverse correlation, as it appears that novice educators have experienced more success in their classes, as evidenced by the data from the GHSGT, which is contrary to the researcher's initial perceptions. A majority (43 of 58) had the lowest percent (39%) of scores as seen in the data of the veteran teachers (those with more than five years of experience) (see Table 3).

Table 3

Years of Experience by Teacher Age Group

Number of Years of Teaching Experience	Number of Respondents
0 - 5	11
6 - 10	18
11 - 15	17
16 - 20	14
21 - 25	6
26 +	3

Findings: Teacher Perceptions of Science Instruction in Traditional Schools

Teacher perceptions of science instruction in traditional schools appears to differ from that of those in small learning community based schools. Many of these teacher responses, as observed in the data lend themselves to the idea that these teachers are the primary and sometimes only source of knowledge in the classroom. This had a correlation with the student achievement data of these particular teachers. There are various additional variables that may attribute to the data, such as learning styles of the students, years of science preparation, past assessment data of the students, and additional remediation, such as tutorial, that may have been available to the students.

Findings: Teacher Perceptions of Science Instruction in Small Learning Communities

Teacher perceptions of science instruction in small learning community-based schools lend themselves to more innovation in the classrooms. Many of these teacher responses, as observed in the data, lend themselves to the idea that these teachers are facilitators and are only one source of knowledge in the classroom. This had a correlation with the student achievement data of these particular teachers. There are various additional variables that may attribute to the data, such as learning styles of the students, years of science preparation, past assessment data of the students, and additional remediation, such as tutorial, that may have been available to the students.

Findings: Teacher Perceptions of Correlation between Teaching Style and Student Achievement

The teacher perceptions of correlation between teaching style and student achievement show a stark contrast between the teachers who work in traditional environments and those who work in small learning environment based schools. The rationale behind the development and facility of small learning communities is to create a more personalized learning environment to meet the individual needs of students. It is assumed that this purpose drives the inquiry and student-centered nature of instruction that permeates the classrooms of the teachers used in this study.

Conclusions

It can be concluded that teacher perceptions have a direct correlation with their method instructional delivery in science classrooms. There is not a direct correlation to the delivery method of the teacher impacting average GHSGT scores. It may also be concluded that philosophy, based on school structure, also plays a role in the way content knowledge is disseminated in the science classrooms of the research participants. Further inquiry should make available more understanding of all that is needed to improve science education so that student achievement, as defined through state assessments, increases while also increasing student interest in the sciences.

Implications

Granted, there are other variables that may contribute to student achievement on science assessments other than those described in this study, it can be inferred by the findings of this study that science educators in public high schools may benefit greatly by tailoring their instruction to address the variables that directly correlate to student achievement. In order to produce high levels of achievement in the sciences, there must be comprehensive reform in science instruction that impacts every child at every school.

This study has also allowed the researcher to infer a substantial amount about the unknown components of the research environment. As the purpose of this research was to identify and analyze appropriately the correlation between the aforementioned independent variables, and the subsequent effects of the variables on student achievement, the researcher has to imply that this study only partially fulfilled its purpose. This study is only foundational, as there must be future research on the variables that aid in increased student achievement in science education.

Limitations of the Study

The limitations contained in this study consisted primarily of time constraints. Research participants used in this study were spread out among a large research environment, which made communication and data collection a taxing process. The use of triangulation would prove to add depth to the study, but the use of sixty nine research participants who all teach at various school sites in the city rendered other methods of data collection, such as focus groups and interviews, nearly impossible, but useful for future research studies of this nature.

Recommendations

This study formulates an epic recommendation for next steps for all staff members dealing directly with instruction. This includes individuals at the District Office, School-Based Administrators, Curriculum Support Staff, and Science Teachers.

District Office

Administrators at the school district or LEA level must ensure that consistency of practice occurs in the schools in the district. This consists modifications of district policy that allow for careful analysis of the instructional practices that tend to make some schools successful, while others do not. This includes practices of human resources and fiscal resources pertaining to the allotments some schools receive in comparison to others. It is also a recommendation of this study that LEAs carefully implement and monitor instructional shifts that are research-driven, inquiry-based and data-rich, in order to build measures of success in science classrooms.

School-Based Administration

As the administrators in the schools, it is essential that they hire teachers who are strong in the analysis of data and inquiry-based instruction, as to allow for more innovation and academic growth to occur in the buildings. This is inclusive of hiring curriculum support staff that will train, model, evaluate, and support the instructional practices of teachers in the building.

Curriculum Support Staff

It is essential for curriculum support staff, such as instructional coaches and core content specialist to research and implement instructional strategies that will move students to high levels of mastery. Focusing on the learning styles of students and providing more innovative supports to science teaches will allow for more facility of high-quality science instruction that will meet students where they are and move them to achievement, as identified in standardized tests.

Science Teachers

Although, LEA personnel, school administration, and curriculum support staff have a great deal of responsibility in the achievement of students, it is ultimately up to the teacher to utilize the tools provided by the aforementioned staff members. It was evident from study participant responses that a dynamic shift in science culture is necessary. Tenure or years in the field do not equate to science student achievement. Science instruction historically has placed the teacher on a mantle of knowledge with little emphasis on the learner. The new lens must be laser focused on students encompassing, specifically, their engagement levels during science instruction. This focus can be accomplished by consistent district wide teacher specific student science data driven dialogues. Evidence of science academic success should drive the culture shift and influence the change within the classroom.

It is the overarching recommendation of this study that more in-depth research be conducted in the area of inquiry-based instruction versus traditional modes of instruction in science classrooms. There must be the utility of a broader research population and more independent variables identified in order to obtain a holistic view of the variables that determine academic success in science classrooms based on state and national assessments. It is also recommended that there be a plan put in place to obtain additional strains of data, such as interview and focus group data from the participants. The next steps in this genre of educational research would be to determine how these variables all work together to help define achievement and attain achievement in urban school districts similar to the school district used in this study.

Summary

Achievement is the overall goal of today's educational environment. It is essential to understand the direct correlation between the content knowledge and pedagogical delivery of the teacher and the levels of student mastery. Science educators must be fluid in their methodologies to ensure that students master content and retain the knowledge necessary to do well on state assessments. There must be modifications in the way educators perceive their content and pedagogical prowess in order to shift the manner in which they educate America's students.

APPENDIX

SCIENCE TEACHER INQUIRY–BASED SURVEY

Teachers:

This survey is designed to obtain your opinion about teaching high school science. Your responses will be kept totally confidential, and used to compile Atlanta Public Schools'- approved data for the purposes of dissertation research. Please answer each item based on your experiences within your school district. Thank you for your cooperation in this matter!

Directions: Please select the number (1-5) that best represents your thinking about each of the following statements.

Key: 1=Not Applicable, 2=Strongly Disagree, 3=Disagree, 4=Agree, 5=Strongly Agree

1.) When a student performs better than the norm in science, it is because the teacher puts extra effort in the instructional delivery.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

2.) I consistently refine my method of teaching science.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

3.) My educational beliefs and values support the district's mission, vision, goals, and objectives.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

4.) Even when I plan effectively, I don’t teach science well.

- 1
- 2
- 3
- 4
- 5

5.) My students’ science grades improve after I try a more effective teaching strategy.

- 1
- 2
- 3
- 4
- 5

6.) I am not comfortable in performing science labs and experiments.

- 1
- 2
- 3
- 4
- 5

7.) If students do not perform well on state science standardized tests, it is most likely due to ineffective science teaching.

- 1
- 2
- 3
- 4
- 5

8.) I generally teach science out of a textbook with low expectations for students.

- 1
- 2
- 3
- 4
- 5

9.) A student with little or no prior science background can be successful through good teaching.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

10.) The low science GHSGT scores students cannot generally be blamed on high school teachers.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

11.) When a low achieving child passes a state standardized science test it is usually contributed to extra attention given by the teacher.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

12.) I understand my content area well enough to be effective in teaching high school science.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

13.) No matter how much effort I put into teaching science some students will not do well on state standardized tests.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

14.) The teacher is generally responsible for student scores on state science standardized tests.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

15.) Students' achievement on state science GHSGT tests is directly related to their teacher's ability to teach labs and experiments.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

16.) It is difficult for me to explain to students the purpose behind science labs and experiments.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

17.) I am confident in my ability to answer students' science content questions.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

18.) I am concerned about my qualifications and knowledge to teach science labs and experiments.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

19.) My formal college and/or university teaching program was adequate in helping prepare me to meet the high demands of a high school science teacher.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

20.) Lab and experiments have little influence on the GHSGT scores of students with little motivation.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

21.) I am not comfortable with anyone coming to evaluate my science classroom.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

22.) I find it difficult to help a student who is consistently having a difficulty understanding a science concept.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

23.) My science delivery style negatively affects student performance state science standardized tests.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

24.) I usually welcome science questions in my classroom.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

25.) I am unable to get students to be interested in science.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

26.) Teachers with good science teaching abilities cannot help some kids pass state science standardized tests.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

27.) What students need to know to pass state science standardized tests has little to do with the world outside of school.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

28.) My students accept changes in scientific knowledge based on new research

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

29.) Science content learning should begin with real world problems.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

30.) Students are comfortable telling me that labs and experiments are hard or confusing.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

31.) My science classroom encourages student interest in science.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

32.) Science labs and experiments are a waste of time.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

33.) Students feel free to question my way of teaching.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

34.) Students understand that science is influenced by people's opinions and values.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

35.) Students get the chance to talk to each other during class.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

36.) It is acceptable in my classroom for students to ask "Why do we have to learn this?"

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

Present content position:

- ○ Physics
- ○ Biology
- ○ Physical Science
- ○ Chemistry

What is your race?

- ○ Caucasian
- ○ African American
- ○ Hispanic
- ○ Asian
- ○ Other

What is your age range?

- 21-30
- 31-40
- 41-50
- 51-60
- 61-70

Years of HS teaching experience

- 0-5
- 6-10
- 11-15
- 16-20
- 21-25
- 26+

Please indicate the major of your highest degree

- Biology
- Chemistry
- Physics
- Education
- Other

In what type of school do you work?

- Traditional
- Virtual/Online
- Small Learning Community
- Other

REFERENCES

Adams, C. M. (2003). Twenty-five years later—spinning our wheels or moving forward? *Roper Review*, *25*(3), 116-118.

American Association for the Advancement of Science (AAAS). (1989). *Science for all Americans: Project 2061*. New York: Oxford University Press.

American Association for the Advancement of Science (AAAS). (1997). *Benchmarks of Science Literacy*. New York: Oxford University Press.

A Nation at Risk. (1983). The imperative for educational reform. Retrieved from http://www2.ed.gov/pubs/NatAtRisk/index.html

Bara, A. (2013). Methods for decision-making in survey questionnaires based on Likert scale. *Journal of Asian Scientific Research, 3*, 35-38. Retrieved from http://www.aessweb.com/pdf-files/35-38.pdf

Bill and Melinda Gates Foundation. (2006). *Atlanta Public schools to accelerate high school reform efforts – Bill & Melinda Gates Foundation*. Retrieved from www.gatesfoundation.org

Brown, C. A., Smith, M. S., & Stein, M. K. (1995). *Linking teacher support to enhanced classroom instruction*. Paper presented at the annual meeting of the *American Educational Research Association*. New York.

Bruner, J. S. (1960). *The process of education*. Cambridge, MA: Harvard University Press.

Chang, C.-Y., & Mao, S.-L. (1998). The effects of an inquiry-based instructional method on earth science students' achievement. Washington, DC: ERIC Document Reproduction Service No. ED418 858.

Cheung, D. (2011). Teacher beliefs about implementing guided-inquiry laboratory experiments for secondary school chemistry. *Journal of Chemical Education*, *88*(11), 1462-1468.

Chiappetta, E. I. (2004). Inquiry–based instruction: Understanding how content and process go hand-in-hand with school science. *The Science Teacher*, *71*, 46-50.

Chiappetta, E. I., & Koballa, T. R. (2002). *Science instruction in the middle and secondary schools*. Upper Saddle River, NJ: Merrill/Prentice Hall.

Conant, J. (1959). *The American high school today: A first report to interested citizens*. New York: McGraw-Hill.

Cooper, J., & Mueck, R. (1990). Student involvement in learning: Cooperative learning and college instruction. *Journal on Excellence in College Teaching*, *1*(1), 68-76.

Crawford, B. A. (2007). Learning to teach science as inquiry in the rough and tumble of practice. *Journal of Research in Science Teaching*, *44*(4), 613-642.

Dergisi, D. (2005). Philosophical sources of holistic education. *Journal of Values Education*, *3*(10), 1.

Deters, K. M. (2005). Student opinions regarding inquiry-based labs. *Journal of Chemical Education*, *82*, 1178.

Dewey, J. (1910). *How we think.* Boston, MA: Health Publishing.

Dostál, J. (2015). *Inquiry-based instruction: Concept, essence, importance and contribution*. Olomouc: Palacký University. ISBN 978-80-244-4507-6, doi 10.5507/pdf.15.24445076

Duffy, T. M., & Tobias, S. (2009). *Constructivist instruction: Success or failure?* New York: Taylor & Francis. ISBN 9780415994231.

Elbert-May, D. (1997). Teaching for active learning. *Bioscience*, *47*, 601-607.

Elbert-May, D, & Brewer, D. (1997). Innovation in large lectures-teaching for active learning. *Journal of Bioscience*, *47*(3), 9-16.

Ferguson, R. F. (2003). Teachers' perceptions and expectations and the black-white test score gap. *Urban Education*, *38*(4), 460-507

Finn, J. D., & Voelkl, K. E. (1994). *Class size*. In T. Husen & T. N. Postlethwaite (Eds.), *International encyclopedia of education* (2nd ed.). Oxford*: Pergamon Press.*

Finneran, K. (2003). Testy and testing. *Issue in Science & Technology*, *19*(2), 41-43.

Flynt, S. W. (2004). *The impact of a science professional development program on student achievement in high school* (unpublished doctoral dissertation). University of Georgia, Athens, GA.

Fraser-Abder, P., Atwater, M., & Lee, O. (2006). Research in urban science education: An essential journey. *Journal of Research in Science Teaching*, *43*(7), 599–606.

Gall, M., Gall, J., & Borg, W. (2007). *Educational research: An introduction* (8th ed.). Boston, MA: Pearson.

Geier, R., Blumenfeld, P. C., Marx, R. W., Krajcik, J. S., Fishman, B., Soloway, E., & Clay-Chambers, J. (2008). Standardized test outcomes for students engaged in inquiry-based science curricula in the context of urban reform. *Journal of Research in Science Teaching, 45*(8), 922-939.

Georgia Department of Education. (2006). *Curriculum, instruction, and assessment*. Retrieved from http://archives.gadoe.org/ci_testing.aspx

Georgia Department of Education. (2009). *2009 Adequate Yearly Progress (AYP) overview report, GHSGT system score summary 2008, and GHSGT school score summary 2008.* Retrieved from http://www.gadoe.org/Curriculum-Instruction-and-Assessment/Assessment/Pages/GHSGT-Statewide-Scores.aspx

Georgia Department of Education. (2010*). 2010 system score summary*. Retrieved from http://www.gadoe.org/Curriculum-Instruction-and-Assessment/Assessment/Pages/GHSGT-Statewide-Scores.aspx

Georgia Department of Education. (2012). *2011 school summaries and 2011 school system summaries*. Retrieved from http://www.gadoe.org/Curriculum-Instruction-and-Assessment/Assessment/Pages/GHSGT-Statewide-Scores.aspx

Germann, P. J. (1991). Developing science process skills through directed inquiry. *American Biology Teacher, 53*, 243-247.

Gibson, H. L., & Chase, C. (2002). Longitudinal impact of an inquiry-based science program on middle school students' attitudes toward science. *Science Education, 86*(5), 693-705.

Glasson, G., & Lalik, R. (1993). Reinterpreting the learning cycle from a social constructivist perspective: A qualitative study of teachers' beliefs and practices. *Journal of Research in Science Teaching, 30*, 187-207.

Goodson, I. (1993). School subjects and curriculum change: Studies in curriculum History (3rd ed.). London: Falmer.

Guzenhauser, M. G. (2003). High-stakes testing and the default philosophy of education. *Theory into Practice, 42*(1), 51-57.

Handelsman J., Elbert-May, D., Beichner, R, Bruns, P., Chang, A., DeHaan, R., Gentile, J., et al. (2004). Scientific teaching. *Science*, *30*, 521–523.

Haury, D. L. (1993). *Teaching science through inquiry*. Washington, DC: Eric Clearinghouse for Science Mathematics and Environmental Education.

Henderson, A., & Mapp, K. (2002). *A new wave of evidence: The impact of school*, *Family and community connections on student achievement: A research synthesis*. Retrieved from www.sedl.org/connections/resources/Keyfindings-reference.pdf

Hofstein, A., & Lunetta, V. N. (2004). The laboratory in science education: Foundation for the twenty-first century. *Science Education*, *88*(1), 28-54.

Howley, C. B. (1995). The Matthew principle: A West Virginia replication? *Education Policy Analysis Archives*, *3*(18), 1-25.

Igelsrud, D., & Leonard, W. H. (1998). Labs: What research says about biology laboratory instruction. *American Biology Teacher*, *50*, 303-306.

Jones, M. G., Howe, A., & Rua, M. J. (2000). Gender differences in students' experiences, interests, and attitudes toward science and scientists. *Science Education*, *84*(2), 180-192.

Ladson-Billings, G. J. (1999). Just what is critical race theory and what's it doing in a nice field like education. In L. Parker, D. Deyhele, & S. Villenas (Eds.), *Race* *is…race isn't: Critical race theory and qualitative studies in education* (pp. 7-30). Boulder, CO: Westview Press

Lederman, N. G. (1992). Students' and teachers' conceptions of the nature of science: A review of the research. *Journal of Research and Science Teaching, 29*, 331-359.

Lederman, N. G., & Abd-El-Khalick, F. (1998). Avoiding de-natured science: Activities That promote understanding of the nature of science. In W. McComas (Ed.), *The nature of science in science education: Rational and strategies* (pp. 83-126). The Netherlands: Kluwer Academic Publishers.

Lee, O., & Luykx, A. (2005). Dilemmas in scaling up innovations in elementary science instruction with nonmainstream students. *American Educational Research Journal*, *42*(3), 411–430.

Luft, J. A., Roehrig, G., & Patterson, N. (2003). Contrasting landscapes: A comparison of The impact of different induction programs on beginning secondary science teachers' practices, beliefs, and experiences. *Journal of Research in Science Teaching*, *40*, 77–97.

Luft, J. A., & Roehrig, G. (2007). Capturing science teachers' epistemological beliefs: The development of the teacher beliefs interview. *Electronic Journal of Science Education*, *11*, 2.

Luft, J. A., Lee, E., Fletcher, S., & Roehrig, G. (in press). Growing or wilting? Beginning biology teachers in a science-focused induction program. *American Biology Teacher.*

Marzano, R. (2001). *Classroom instruction that works*. Alexandria, VA: Association for Supervision and Curriculum Development.

McGuire, K. (1989). School size: The continuing controversy. *Education and Urban Society,* 21(2), 164-174.

Minner, D. D., Levy, A. J., & Century, J. (2010). Inquiry-based science instruction—What is it and does it matter? Results from a research synthesis years 1984 to 2002. *Journal of Research in Science Teaching*, *47*(4), 474-496.

National Center for Education Statistics (NCES). (1995). *Grade 4: Teacher questionnaire weighted percentages and composite proficiency means*. Retrieved from www.nces.ed.gov/nationsreportcard/y25alm/almanac.shtml

National Science Board. (1998). *Science and engineering indicators—1998*. Arlington, VA: National Science Foundation.

Oakes, J. (1990). Multiplying inequalities*: The effects of race, social class, and tracking on opportunities to learn mathematics and science*. Santa Monica, CA: Rand Corp.

Panitz, T. (1999). *Collaborative versus cooperative learning - a comparison of the two concepts which will help us understand the underlying nature of interactive learning*. Retrieved from http://home.capecod.net/~tpanitz/tedsarticles/coopdefinition.htm

Rivet, A. E., & Krajcik, J. S. (2004). Achieving standards in urban systemic reform: An example of a sixth grade project-based science curriculum. *Journal of Research in Science Teaching*, *41*(7), 669-692.

Roehrig, G. H., & Luft, J. A. (2004). Constraints experienced by beginning secondary science teachers in implementing scientific inquiry lessons. *International Journal of Science Education, 26*, 3-24.

Roehrig, G. H., & Luft, J. A. (2006). Does one size fit all? The experiences of beginning teachers from different teacher preparation programs during an induction program. *Journal of Research in Science Teaching*, *43*, 963-985.

Ruby, A. (2006). Improving science achievement at high-poverty urban middle schools. *Science Education*, *90*(6), 1005-1027.

Settlage, J., & Meadows, L. (2002). Standards-based reform and its unintended consequences: Implications for science education within America's urban schools. *Journal of Research in Science Teaching*, *39*(2), 114-127.

Seymour, E., & Hewitt, N. M. (1997). *Talking about leaving: Why undergraduates leave the sciences*. Boulder, CO: Westview Press.

Schwab, J. (1966). *The teaching of science*. Cambridge, MA: Harvard University Press.

Springer, L., Stanne, M. E., & Donovan, S. S. (1999). Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. *Review of Educational Research*, *69*(1), 21-51.

Tinnesand, M., & Chan, A. (1987). Step 1: Throw out the instructions. *Science Teacher, 54*(6), 43-45.

Tretter, T. R., & Jones, M. G. (2003). Relationships between inquiry-based teaching and physical science standardized test scores. *School Science and Mathematics*, *103*(7), 345-350.

Tsai, C. C. (2002). Nested epistemologies: science teachers' beliefs of teaching, learning and science. *International Journal of Science Education*, *24*(8), 771-783.

Vandevoort, L. G., & Amrein-Beardsley, A. (2004). Students of national board certified teachers outperform peers on national test. *Education Policy Analysis Archives, 12*(46). Retrieved from http://epaa.asu.edu/epaa/v12n46/.

Walberg, H. J. (1992). On local control: Is bigger better?" In *Source Book on School and District Size, Cost, and Quality* (pp. 119-132). Minneapolis, MN: Minnesota University.

Wilfred, F. A. (2005). *Inquiry-based approaches to science education: Theory and practice*. Munich, Germany: TUM School of Education, Tchnische Universität München.

Victor, E., & Kellough, R. D. (1993). *Science for elementary school*. New York: Macmillian Publishing Company.