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Bhagyalakshm Gopalsingh

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2010

ABSTRACT

Teacher Perceptions of High School Students Underachievement in Science

by

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M. Phil., Alagappa University, India, 2000
M.Ed., Alagappa University, India, 1998

Doctoral Study Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Education
Administrator Leadership for Teaching and Learning

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ABSTRACT

Low high school graduation rates continue to be a challenge in American public education. The pressure to meet the demands of adequate yearly progress (AYP) under the No Child Left behind Act of 2001 has led to an achievement gap in student performance between science and other core subjects, namely English, math, and social studies, on the Georgia High School Graduation Test (GHSGT). GHSGT statistics have consistently reflected a lower science pass percentage compared with other core subjects on the test. The objective of this nonexperimental, quantitative study was to analyze teacher perceptions on reasons for student science underachievement on the GHSGT. A self-developed questionnaire based on Bloom’s taxonomy model was administered to 115 high school core subject teachers of a single school district. Analyses of variance (ANOVA) and chi-square tests were used to test hypotheses. Results confirmed that teachers perceived that (a) students demonstrated a low rate of proficiency in science because science demands higher cognitive skills, (b) less emphasis was placed on science because it is a non-AYP indicator, and (c) making science an AYP indicator will optimize student science achievement. Based on results, recommendations were made to promote the integration of English, math, and social studies curriculum with science curriculum to enable students to transfer learned skills and information across subjects. The potential benefits of outcome of this study include (a) providing critical insight for policy makers and educational practitioners to understand the impact of science underachievement on graduation rates, and (b) raising student science achievement to improve graduation rates.

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SECTION 1: INTRODUCTION TO THE STUDY

Introduction

The problem of low high school graduation rate has generated increased interest among educators, policymakers, and researchers in recent years. The high school graduation rate is described as a “barometer of the wellness of American society and the skill of its future workforce” (Heckman & LaFontaine, 2007, p. 4). High school graduation has become a “critical prerequisite” for both higher learning and a future workforce (Mintz, Ojeda, & Williamson, 2006). This is because of a significant assertion that academic skills mastered in high school determine students’ pursuit of postsecondary education and a future skillful workforce (Douglass, 2008). Despite the thrust and the drive to have a higher graduation rate, nationally, only about 68% of students graduate (Kauffman & Losen, 2004; Orfield, 2004) with nearly one third of all public high school students fail to graduate (Swanson, 2004). The high school graduation rate in United States is directly influenced by student performance on the test required for graduation.

In the United States, student achievement and accomplishment among high school students is measured based upon the pass percentage scale of the test required for graduation. The accountability and evidence-based components of the No Child Left Behind Act (NCLB, 2002) has increased the emphasis on test assessments required for high school graduation in schools (American Institutes for Research, 2006). Hence, improving students’ performance in state-mandated tests that measure these academic skills and competence has become the focus of educational and social topics (St. John, 2006). According to Noddings (2005), the effectiveness of the provided education in high schools is demonstrated by the improved test scores on the tests required for graduation. Improving the basic literacy, numeric, and other academic skills are critical, as these skills are directly linked to students' performance in high school graduation tests. These skills are considered to be fundamental because they provide the required ability to express the "intellective competence" (North Central Regional Education Laboratory, 2004, p. 1). The NCLB (2002) holds schools accountable for graduation pass percentage using indicators of adequately yearly progress (AYP). Hence, it is imperative to improve student academic skills and competence to enhance the pass percentage on the test required for graduation.

Background on the Test Required for Graduation

Graduation rate statistics indicate that the percentage of U.S. students earning a high school diploma in the traditional 4 years has declined since the early 1980s (National Bureau of Economic Research, 2007; Southern Regional Education Board, 2005). Public schools in the United States striving to enhance student achievement to meet the NCLB (2002) mandates are constantly looking for strategies to resolve the graduation rate crisis (Schroeder, 2006). The focus of this study was on the graduation rate crisis in the state of Georgia. Mintz, Ojeda, and Williamson (2006) estimated in their research study that the graduation rates in Georgia are second lowest in the nation with only 56% of Georgia students receiving high school diplomas.

A research-based report on quality of education in the state of Georgia highlighted that "Georgia secures the highest grade, an A-minus, for curriculum standards and yet, scores the lowest score, a D-plus, in the high school graduation rate" (Quality Counts-

2008, 2008, ¶ 2). Despite acclaiming the strength of the curriculum standards, the report highlighted the concerns over the reasons for the low graduation rate. The report also highlighted that Georgia ranks 49 out of the 50 states with a graduation state average of 56.1%. The state graduation result is a cumulative percentage of the graduation rate of the districts and the individual schools in Georgia.

Strategies to Improve Graduation Rate

Research studies have recommended various strategies to improve student achievement in tests required for graduation. Morris (2003) demonstrated a positive relationship between student behavior and student achievement. Morris recommended improving the physical characteristics of the school to foster positive student behavior. To enhance student performance, Grimm (2007) advocated energizing the curriculum by modifying instructional methods. Callahan (2007) demonstrated that strengthening the locus of control will improve the learning process and academic achievement in science. Herlihy and Quint (n.d.) created a talent development model favoring a small learning community to assist students who enter high school with poor academic skills. The improved student success rate affirmed the benefits of this small learning community. It has also been asserted that a professional learning community (PLC) plays a significant role in enhancing student standardized test scores (Carter, 2008). Finally, Hudgins (2008) demonstrated the potential value of integrating technology to teaching practices in the classroom, to enable students to accomplish at higher levels.

Research studies have recommended different types of strategies to enhance student achievement. Providing appropriate professional orientation programs to improve teacher performance, thereby improving student achievement, is one of the signficant strategies advocated in the past research (Flynt, 2004; Yannacone, 2007). A professional development program was considered an effective means to influence secondary teachers to adopt standard-based appropriate grading practices to evaluate student achievement (Roorda, 2008). This is because, the standard-based grading practices are considered appropriate to evaluate student achievement (Scriffiny, 2008). Other researchers highlighted a positive correlation between the teachers' level of professional development with their classroom practice (Siliezar, 2005). From a sociological framework, Shepard (2009) highlighted the benefit of collaborative professional development to diminish the culture of teacher isolation, thereby improving both teacher efficacy and student achievement. In addition to the discussed academic factors, research studies also have indicated the importance of parental involvement in improving student achievement.

Researchers have demonstrated that parenting style and parent-child relationship will contribute to a child's academic success (Hayes, 2005; James, 2008; Payne, 2005; Smith-Hill, 2007). Research studies also have confirmed that parental involvement makes a positive impact in enhancing students'graduation success rate (Curry, 2007; Difnam, 2007; Sims, 2008). Additionally, parental guidance is likely to promote adolescent school success when it occurs in the context of an authoritative home environment (Hickman & Crossland, 2004; Steinberg, Lamborn, Dornbusch, & Darling, 1992). The practicing educators have recommended parental involvment to be one of the effective strategies to improve student's academic success on the graduation test.

There are also other proven strategies recommended to improve the graduation rate. For example, it has been proposed that schools facilitate a system of extra help to improve student pass percentage and student achievement (Bottoms & Anthony, 2002). Providing an additional course in study skills was another recommended strategy to help students organize their thoughts and processes to succeed on the graduation test (Smith, 2007). The impact of student efficacy and self-concept on student achievement in the graduation test has been noted by a variety of researchers (Miller, 2007; Tillotson, 2006). For example, Ciaccio (2004) studied self-concept and self-confidence and cautioned that a “teacher is doomed to fail” teaching students who lack confidence (p. 81). Despite these recommendations and initiatives, the graduation rate results remain discouraging. The current study is an effort to improve the graduation rate from a new perspective.

Graduation Test in Georgia

It is mandatory for students seeking a Georgia high school diploma to pass the Georgia High School Graduation Test (GHSGT) in writing and four content areas: English, math, social studies, and science (Georgia Department of Education [GDOE], 2008, ¶ 1). The Georgia Law, O.C.G.A. (Official Code of Georgia Annotated), section 20-2-281, mandated that students must pass a battery of five tests to be eligible to obtain a high school diploma. The GHSGT, an exit exam for secondary schools, is a tool to measure students' acquired proficiency in course content and skills. Students take the graduation test for the first time in the junior year (11^{th}-grade). The statistics gathered by this state-mandated test for 11^{th}-grade students formed a frame of reference to compare student achievement and pass percentage in individual subjects.

Under NCLB (2001) legislation, student pass percentage in English and math on the graduation test are used to determine Adequate Yearly Progress (AYP). The predominance of measuring student pass percentage in English and math emphasizes the importance of test scores on these two AYP indicator subjects.

Empirical Study on GHSGT Data

The 11^{th}-grade first-time test takers' graduation test statistics in four core subjects were compiled and analyzed for the academic years 2000-2001 to 2006-2007 (see Table 1). English, math, social studies, and science subjects together are considered the core subjects of the graduation test. The empirical analysis on this longitudinal study revealed a consistent disparity in students' performance between science and the other three core subjects of the GHSGT. Students' pass percentage statistics in individual core subjects reflected their unequal proficiency in core subjects of the graduation test. The comparative pass percentage between science and other core subjects of 11^{th}-grade first-time test takers on the GHSGT (see Table 1) reflected students' consistent science underachievement.

Table 1

Comparative Performance of Pass Percentages in Core Subjects of GHSGT by 11th-Grade First-Time Test Takers in the State of Georgia

	Academic years						
Subjects	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
English	94	95	95	94	95	96	96
Math	91	91	92	92	92	92	93
S. studies	80	83	81	82	83	86	87
Science	69	72	69	68	68	73	75

Note. The data are from Georgia Department of Education, K-12 Public Schools Annual Report Card, 2007, adapted from the public domain.

The results of individual core subjects for academic years 2000-2001 to 2006-2007 indicated that students' highest pass percentages in English, math, and social studies were 96%, 93%, and 87%, respectively. The highest pass percentage in science was 75%. The result also highlighted a large percentage of students failing the science content of the test (23% to 31%) when compared with the failure rate in the other three core subjects of the test (GDOE, 2007). This variation in student pass percentage in individual core subjects of the graduation test is indicative of the disparity in student performance between science and the other core subjects of the graduation test.

This study also compared students' pass percentage in science with the other three core subjects for eight other major school districts in Georgia for the years 2000-2001 to

2006-2007 (see Appendix A). The science underachievement trend has been consistently reflected in these test results of the GHSGT (GDOE, 2007).

Table 2 highlights students' comparative performance in core contents of the GHSGT for the school district under study (academic years 2000-2001 to 2006-2007).

Table 2

Comparative Performance of Pass Percentage in Core Subjects of GHSGT by 11th-Grade First-Time Test Takers in the School District Under Study

Core subjects	Academic years						
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
English	96	95	96	92	94	95	99
Math	94	94	94	91	92	91	92
S studies	79	82	80	82	81	85	86
Science	61	66	61	57	57	60	60

Note. The data are from Georgia Department of Education, K-12 Public Schools Annual Report Card, 2007, adapted from the public domain.

Table 2 reflected the below-average pass percentage in science content with a failure rate in the range of 34% to 43% on the graduation test. The pass percentage in science is confined to a minimum of 57% and a maximum of 66%. A good-to-excellent pass percentage is evident in the other three core subjects of the test (English, math, and social studies).

Minimal research has been done to examine teachers' perspectives on reasons contributing to students' science underachievement on the graduation test. Because teachers are the main proponents for student success, it is critical to gather teacher perception and insight on this issue. Teachers' judgments, based on their expert knowledge and experience in the field of education, will help the researche to understand the problems associated with science underachievemnt. Section 2 of this study further details and justifies the reasons for examining the achievement gap and science underachievement from teacher viewpoints.

Problem Statement

The empirical data in the study were used to compare students' pass percentages between science and the other three core subjects (English, math, and social studies) for the academic years 2000-2001 to 2006-2007. Chronological evidence suggests that there is an achievement gap in student performance between science and the other three core subjects of the graduation test. In addition, a large percentage of students fail in the science content of the GHSGT (GDOE, 2007). An initial review of the literature, in addition to the longitudinal study on graduation test statistics, revealed two concerns. First, there is a disparity in student performance between science and the other three core subjects of the graduation test. Second, students' underachieve in science content in comparison with the other three core subjects of the graduation test. The disparity in graduation test statistics imply that students are performing comparatively well in the other three core subjects, but are exhibiting a below average performance in science. The number of students failing in science content has negatively affected the overall graduation rate. Therefore, the focus of this study was to explore teachers' perspectives on reasons for students' underachievement in science. Teachers play a key role in student academic success; as such, teachers' insights and perceptions may help to identify and address the reasons for science underacheivment. It is anticipated that teachers' input based on their expertise and practical experience in the field of education will help in resolving this science underachievement crisis. The outcome of the study has the potential to augment science achievement and thus elevate the overall graduation rate.

Teacher perception was an independent variable in this study. The dependent variables were the factors contributing to science underachievement, grouped under three domains: (a) students' proficiency level, (b) reasons for an achievement gap in student performance between science and other core subjects, and (c) policy factors. All the dependent variables and the related constructs are discussed in detail in the methodology section of this study.

Purpose of the Study

The intent of this quantitative research study was to examine teacher perceptions on student proficiency levels, reasons for science underachievement, and policy factors in the context of observed disparate performance in student performance between science and the other three core subjects of the graduation test. There are many factors contributing to the low graduation rate, but the one examined in this study was teacher perceptions on reasons for students' underachievement on the science portion of the GHSGT. The perception input obtained from teachers teaching four different subjects of the graduation test will help to analyze the parallels and points of intersection on recommended strategies to enhance science achievement.

To date, little research has been conducted to examine reasons for students' science underachievement from teachers' perspectives. Scholars from the social, political, and academic fields share a common concern that the U.S. K-12 educational system is failing to provide the science skills necessary for students to compete in the 21st-century workforce. There is a growing concern that the U.S. higher education system cannot produce enough scientists to support the growth of technologically advancing world (Kamierczak & James, 2005). The schools play a vital role in instilling basic academic knowledge and skills in reading, writing, math, and science to prepare for skilled employment (Rothstein, Jacobsen, & Wilder, 2008). Hence the current study will add to the existing literature by recommending strategies to enhance science achievement and improve the graduation rate.

Nature of the Study

This quantitative, nonexperimental study used a survey technique to gather teacher perceptions. Quantitative research is numerically analytic and is anchored on the postpositivist paradigm (Zammito, 2004). A theory in a quantitative study can be tested by collecting evidence in the form of data on a relevant phenomena to support or refute the hypothesis (Creswell, 2003; Gall, Gall, & Borg, 2003, as cited in Mertens, 2004). The chronological data obtained on students' GHSGT scores provided evidence of an achievement gap in students' performance between science and other core subjects of the graduation test. The use of school-wide data on student success was advocated as a scientific tool (Hayes, Nelson, Tabin, Pearson, & Worthy, 2002). The nature of this research topic dictated the use of chronological data on GHSGT pass percentages in individual core subjects to develop and derive a theory. The emerged science underachievement theory was analyzed based on teacher perceptions. The input based on teacher perceptions helped to explore the reasons for student science underachievement and to answer the research question.

Research Question and Objectives

The research question for this study was: What are teacher perceptions on reasons for students' underachievement in science compared with other core subjects of the Georgia High School Graduation Test? The descriptive teacher perception data from the teacher survey provided the basis for answering the research question. The objectives of the study were:

1. To identify the reasons for student science underachievement on the GHSGT.
2. To recommend strategies to enhance student science achievement on the GHSGT to improve the overall graduation rate.

Theoretical Framework

Strauss and Corbin (1990) argued in their qualitative study that "one does not begin with the theory, and then prove it" (p. 23). Instead, it was recommended to begin with an area of study to "allow the theory to emerge relevant to the problem and the data" (Strauss & Corbin, 1990, p. 23). This idea has been reinforced by several other studies (Byram & Fend, 2006; Johnson & Christensen, 2008; Merriam, 2002). Additionally, Reyes (2004) advocated initiating a research study for the development of a theoretical framework with a "well defined theory which governs the research problem" (p. 3). The value of a specific theory can be determined within the context of use (Creswell, 2003) because a theory assumes a specific intention depending upon the situation (Oers, 1998).

In the current study, empirical analysis on GHSGT data was initially carried out to derive the science underachievement theory based on the recommendations of the scholarly literature.

The current study initially examined the GHSGT pass percentage statistics to derive a conceptual framework as recommended by Creswell (2003). The data-based framework provided an objective scientific outcome to the study (Balfanz & Legters, 2004). Standards-based education reforms have necessitated data-driven decisions to improve student achievement by analyzing the data and evaluating educational practices to measure student performance (Protheroe, 2001). The data for the development of a new theory for this study were derived from a longitudinal, 7-year (2000-2001 to 2006-2007) study on GHSGT test scores and pass percentage for the state of Georgia and eight different school districts in Georgia (GDOE, 2008a). The location (urban, metro area, suburban, and rural settings) and student demography of the school districts were taken into account (see Appendix A). The empirical study on the statistics led to the emergence of a theory, an achievement gap and science underachievement theory (AGSUT). Subsequent to examining the graduation test pass percentage data of several school districts in Georgia, I identified two common elements: (a) existence of disparity in students' performance between science and the three core subjects of the GHSGT, and (b) underachievement in science content of GHSGT. These two common characteristics were independent of the location of the school district, student demography, gender, and students' socioeconomic status. For the development of the conceptual framework, Bloom’s (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956) taxonomy model was adopted to examine students’ cognitive aspects.

Bloom’s notion was one of the first theories to identify the unique cognitive aspects of a student’s learning process. Bloom’s (Bloom et al., 1956) taxonomy model was used as a guideline to develop a questionnaire to measure teacher perceptions on student cognitive level as a result of learning experience. Bloom’s taxonomy model was applied to measure teacher perceptions on student ability and proficiency level to understand why student performance varies between science and the other three core subjects of the graduation test. Bloom’s model is considered an appropriate model to measure alignment of policy with standards and assessment (Nasstrom & Henriksson, 2008). It was also an effective tool to interpret the standards to have a consistent outcome (Nasstrom, 2009). Webb (2007) supported the application of Bloom’s taxonomy in the student learning process to illustrate improvement in students’ achievement levels. Bloom’s taxonomy model is discussed in more detail in section 2.

Evidence suggested that students’ attainment of achievement in science is not the same compared with their achievement in English, math, and social studies subjects in the test required for graduation (GDOE, 2007). This inconsistent achievement can be identified using various indicators. The first indicator is the state-mandated GHSGT pass percentage statistics as reported by the GDOE (2008a). The second indicator is the percentage of students opting to pursue higher education in science and science related courses. The statistics on enrollment in postsecondary education and major field of study reflected that a very small percentage of students opt for science and science-related college level education (Digest of Education Statistics, 2008). A third indicator is the comparison of student pass percentage in the core subjects of the eighth-grade Criterion-Referenced Competency Test (CRCT, middle school exit exam) with the GHSGT, high school exit exam. The CRCT test scores and pass percentage on the eighth grade exit exam, which tests students' mastery in the content areas, indicated an identical trend of inequality performance between science and the three core subjects of the test (GDOE, 2005-2008), with science as the least achieved subject. The science underachievement factor appeared to be a continuing trend from the eighth grade exit exam (CRCT) to the high school exit exam (GHSGT). The fifth and final indicator is comparing students' science performance with their peers at the international level. According to the 2003 statistics of the Organization for Economic Cooperation and Development (OECD) program for international student assessment, 15-year-olds in the United States ranked 19th of 38 in science and 26th of 38 in problem solving (Lemke, Calsyn, et al., 2001; Lemke, Sen, et al., 2005). The Trends in International Math and Science Study (TIMSS) showed U.S. 8th-graders ranked 9th out of 45 in science achievement *(*Mullis, Martin, Gonzalez, & Chrostowski, 2004). Students appear to be lagging behind their peers at the international level in science proficiency.

There is a debate on the policy of using the international comparative data because the educational activities successful in one nation may be culturally inappropriate to adopt in other countries. However, the comparison of academic performance at the international level is justified with the assertion that the core teaching practices and teacher beliefs show little national variation (LeTendre, Baker, Motoko, Goesling, & Wiseman, 2001). The procedure of mapping the international data has been a continued practice to determine student achievement.

The United States has the highest literacy rate in the world (The World FactBook, 2009). McGaw stated that the United States remained the “world’s first in the knowledge economy” as recently as 20 years ago (Sorlucco, 2006, p. 283). Unfortunately, the current trend suggests that students lag behind their international peer group at all age levels in their science performance. Schneider observed in respect to international students that “U.S. students are outperformed in science, and our 15-year-old students trail many of our competitors in science literacy” (NCES, 2006, p. 3). The statistics implied that educational reforms and strategies are not producing positive results and helping students to excel (Sorlucco, 2006). It was imperative to examine the science underachievement problem from a critical angle to identify and address the underlying issues.

Operational Definitions

The operational definitions of the terms in the context of the present study:

Achievement gap: the disparity in achievement level in the graduation test between science and other core subjects of the graduation test, irrespective of race, gender, and socioeconomic groups.

Core subjects: English or Language Arts, math, social studies, and science are the core subjects of the graduation test.

Adequate yearly progress (AYP): a measure of year-to-year student achievement on statewide assessments. “One of the major clauses of NCLB states that whether a school meets AYP is currently based on student performance in English and math subjects" (GDOE, 2006, ¶ 1).

End-Of-Course Test (EOCT): a state mandated test administered at the end of the academic year to assess the mastery of the content in each of course subjects. "Beginning from 2004-005 school year, EOCT has become a state mandated test and 15% of the test contributes to the student's final course grade" (GDOE, n.d., p.10).

Georgia High School Graduation Test (GHSGT; also referred as *the graduation test*): a high school exit exam to certify completion of 4 years of high school education. According to Georgia law, "All students who entered grade nine after July 1, 1991 are required to pass curriculum-based achievement tests, namely a writing test, and English, math, social studies, and science tests, to be eligible to receive a high school diploma" (GDOE, 2005-2008,¶ 2).

Regular first-time test taker: special education students, limited English proficient students, and all ethnic groups of the 11^{th} grade student population (GDOE, 2006) taking the graduation test for the first time.

Underachievement: failing to attain a predicted level of achievement when a learner's performance is below than what is expected based on one's ability (Merriam-Webster, 2008).

Assumptions

This study was based on the following assumptions:

1. Teachers will answer the anonymous survey questions truthfully.

2. Teachers will accurately be able to assess students' proficiency level in their respective content areas.
3. Teachers have the ability to analyze reasons for science underachievement problem with multiple critical perspectives.
4. The administration of a paper-pencil survey in an individual setting will prevent exchange of ideas that may bias responses.
5. The GHSGT scores are a reliable measure of student achievement level.

Limitations

Limitations of this study were identified in the following areas:

1. Population. This study was limited to collecting and comparing perception data of teachers teaching English, math, social studies, and science subjects to the first-time test takers of the GHSGT. The reason for this was that the GDOE uses only the data obtained by the 11th grade first-time test takers scores and pass percentage as an indicator to award AYP.
2. The writing test performance data were not considered in this study, even though students are mandated to pass the writing test as well as the four core subjects to be eligible for a high school diploma. These data were excluded because disparate performance was found to exist only between the core subjects of the GHSGT.
3. All teacher perception responses were measured on the same scale regardless of race, gender, educational qualification, and age.

4. Research design. Teacher perceptions were confined to assessing students' proficiency, reasons for achievement gap in student performance, and policy factors for students' science underachievement.
5. Research question. The research question was limited to addressing teacher perception on reasons for student science underachievement based on student proficiency and policy factors related to AYP and replacement of EOCT with GHSGT.
6. Data collection. The data were collected from four different high schools of a single school district. It was not possible to have an equivalent sample from all the four core subjects, as it was difficult to estimate how many teachers would voluntarily participate in the study.
7. Nature of the study. This study was limited to identifying the reasons for science underachievement of the GHSGT. The study was not intended to determine the impact of science underachievement on the overall graduation rate.
8. The purposive sampling procedure that was used in this study decreased the generalizability of findings. This was due to variables within a single school district and between school districts such as Title I schools, schools under the needs improvement (NI) category, and schools awarded with or without AYP, in addition to variation in curriculum patterns.

9. The external factors that influenced teacher perception, such as administrative support, culture of the school, community support, available resources and allocated budget, were excluded from the purview of the study.
10. Private school and charter school statistics were not included in the study, as NCLB requirements apply to public schools only.

Significance of the Study

This study was significant for several reasons. The existing literature was enriched by the current study with research-backed strategies to enhance science achievement and to improve the overall graduation rate. It was anticipated that the study results will fill the deficiency in literature on reasons for students' science underachievement on the GHSGT from teachers' perspectives. There was no research literature available to explore the reasons for science underachievement by measuring teacher perceptions on students' proficiency and policy factors.

The study is significant to educational practitioners including principals, teachers, administrators, and policy makers. The outcome of the study will help professionals and policy makers to identify and resolve the reasons for science underachievement. This study will provide insight to the professionals to initiate innovative strategies to improve student science achievement. The aspirations of the community and society rest on the shoulders of educators and their clear vision to promote student success. The improved graduation rate also helps schools and school districts to achieve AYP status, due to the interdependency of science pass percentage on the overall graduation pass percentage. Former Secretary of Education Spellings remarked in the context of finding a comprehensive solution to a low graduation rate that the “real competition starts at the school level” (U.S. Department of Education, 2006, p. 16). Thus, to accelerate progress in schools, it was important to find innovative, improvement-oriented, and research-based strategies to improve the graduation rate and student achievement.

Improved science achievement, resulting in an enhanced graduation rates, provides a foundation for an individual high school student to succeed. A high school diploma provides a platform for an individual either to pursue higher studies or to have decent earnings, making an individual an asset to the community instead of a liability. Research studies show a strong statistical correlation between lack of a high school diploma and social issues such as unemployment, poverty, drug abuse, and violence related crimes (Martin, Tobin, & Sugai, 2002). Individuals without a high school diploma will earn less than those with a diploma and are left with fewer options for employment or advancement in position. According to Wise (2008), without a high school diploma a young adult’s earning power will be compromised. Persons with a high school diploma have an average annual income of $31, 400; persons without a high school diploma will earn an average income of $21, 000 (U.S. Census Bureau, 2007). Individuals without a diploma may also experience health problems, engage in criminal activities, or become dependent on welfare programs, and thus become a liability to society (Christle, Jolivette, & Nelson, 2007). One of the ways to avoid being poor as an adult is to obtain a good education, because schooling makes an individual more productive (Jacob & Ludwig, 2008). Improved graduation rate leads to reduced crime rate and helps to strengthen the community. Strong communities provide momentum to strengthen the nation and to meet challenges at the national and international level.

The increase in science achievement also has the potential to affect social change at the national and international level. The global challenge calls for a rapidly changing workforce because “a high school diploma once desirable is now an essential” (U.S. Department of Education 2006, p. 5). It is important to realize the significance of science education, because “tomorrow’s jobs will go to those with education in science, ---” (The National Association of Manufacturers 2005, p. 3). Such a workforce is an important key to future growth, productivity, and competitiveness. A skilled workforce is described as an indispensable element for the national economy (Kamierczak & James, 2005). Hicky (2005) advocated investment in science education “to compete with the rest of the world” (¶ 1). The rapid advancement in technology demands an individual to be science literate to be successful in the technology embedded job market.

State Superintendent of Schools Kathy Cox stated that “*ALL* students can learn” (GDOE, n.d., ¶ 2) and this responsibility rests on educators to ensure student success by implementing research-based strategies to perform better in science. Hence, it appears that enhancing the achievement level in science content of GHSGT may advance students’ performance, resulting in improved graduation rates (Bottoms & Mikos, 1995). Improving student science achievement will enhance the graduation rate to optimize students’ competence and performance not merely at the regional level but also at the national and international level. Thus, the outcome of this study is expected to have direct implications for social change.

Summary

The disaggregated empirical data of the GHSGT for the academic years 2000-01 to 2006-07 revealed a disparity in students' pass percentages in core subjects. The statistics revealed that the percentage of students failing in science content is the largest compared with pass percentage in other three core subjects (Appendix A reflects the compiled pass percentages of individual core subjects of eight different school districts in the state of Georgia). This study examined teacher perceptions on reasons for student science underachievement on the GHSGT. Science underachievement in the graduation test is associated to the low graduation rate. U.S. public schools are striving to reinforce the NCLB requirements and are finding strategies to improve the graduation rate.

In this quantitative study reasons for students' science underachievement was identified, and strategies to improve students' graduation rate by enhancing student achievement in the science content of the graduation test was recommended. In the following review of literature the existing research information on reasons for low graduation rate and significance of teacher perceptions was elaborated as a tool for the analyzing students' science underachievement. Section 2 details the scholarly literature on standardized testing, teacher perceptions, and Bloom's taxonomy model. Section 3 outlines the methodology, research design, and the statistical instrument. The analyses of the data and the findings are reported in Section 4. Section 5 provided a description of interpretation of findings, implications for social change, recommendations for action, and suggestions for further study.

SECTION 2: LITERATURE REVIEW

Introduction

One of the major challenges encountered by American public education is the low pass percentage on tests required for high school graduation. The low graduation test results and their negative implications at the regional, national, and international level have become a perpetual educational and social issue (Jacobson & Mokher, 2009). The high school graduation test is a tool to measure the abilities of an individual by a potential employer and provides a pathway for higher education (Marchant & Paulson, 2005). A major impediment to the advancement of America's economic competitiveness is the result of adopting high school graduation as a minimum standard of education (Greaney & Kellaghan, 2007, p. ix). Education and economic growth are linked by a large body of empirical evidence based on two key indicators: (a) improved enrollment and (b) successful graduation completion rate (Barro, 2001; Gylfason, 2001; Heckman**,** & LaFontaine, 2007**;** Ramirez, Luo, Schofer, & Meyer, 2006; Wolf, 2002). The social consequences of poor education will impact the income, health, dependency on public assistance, and political participation of an individual (Belfield & Levin, 2007). A high school diploma is also considered as a "stepping-stone for higher education" (Marchant & Paulson, 2005, ¶ 2). The high school graduation rate statistics indicate that the percentage of U.S. students earning a high school diploma in the traditional 4 years has declined and has become a cause of concern (National Bureau of Economic Research, 2007). The declined graduation rate is also affected by an increase in dropout rates.

My review on the scholarly literature was focused on the descriptors of my study: graduation rate, graduation test in Georgia, No Child Left Behind Act, Adequate yearly Progress (AYP), Bloom's taxonomy, teacher perceptions, reliability and validity of a statistical instrument, survey method, and quantitative research methodology. I searched the following research databases for the needed information: Walden interdisciplinary dissertations and thesis, ProQuest, Walden eLibrary, UMI dissertations publishing, Georgia Department of Education, and Google Scholar. The referred peer reviewed publications and articles are retrieved from Academic search complete, ProQuest central, ERIC, and EBCOhost database.

Studies have confirmed an inverse relationship between graduation rates and dropout rates (Laird, Cataldi, KewalRamani, & Chapman, 2008; Millken, 2007; National Bureau of Economic Research, 2006; Orfield, 2004). Students discontinue and disengage from studies prior to getting a high school diploma due to lack of academic motivation (National Research Council Institute of Medicine, 2003). Thus, an increase in dropout rates is also considered as one of the reasons for the low graduation rates.

The federal government, in its efforts to improve the graduation rate, initiated and implemented policies and guidelines. NCLB (2001), one of the major policies introduced by the federal government, is reinforced by local governments.

Initiatives to Reform Education

The federal government has attempted to improve and reform the struggling education system. With the authorization of the NCLB (U.S. Department of Education, 2002), the reformed education policy emphasized standardized testing procedures to measure the effectiveness and progress of schools as quality indicators and institute specific consequences for failure. The overall purpose of NCLB is to ensure that all children have the opportunity to reach proficiency on state academic standards and assessments (Lunenburg, 2006). In spite of having a divided opinion over the current reauthorization and efficacy of the Elementary Secondary Education Act (NCLB, 2002), there are studies that have supported this initiative to reinforce and strengthen NCLB guidelines (Birman et al., 2009; Johnstone, Altman, Thurlow, & Thompson, 2006). According to a report, this reauthorization upheld the federal government’s commitment by mandating all “schools and districts to implement a single statewide accountability system for ensuring equal educational outcomes” [(NCLB, 2002, §6311 [2] [a], as cited in Sundrmann, Kim, & Orfield, 2005, p. ix)]. A single statewide accountability system is in place in majority of the U.S states to assess student mastery in content areas of tests required for graduation. Use of standardized testing to assess the accountability factor has become a widely accepted form of testing by state governments.

Background on Standardized Testing

Standardized tests have been used in United States since the early 20th century and have become the most common method for monitoring the effectiveness of instructional programs and comparing schools and their educational performances (Paul & Supon, 2002). The intention of standardized testing is to promote positive educational outcome based on four principles: “stronger accountability for results, increased flexibility, expanded options for parents, and an emphasis on teaching methods” (Hamilton, Stecher, & Klein, 2002, p. 6). A research study compared the effects of common testing at various levels (high, medium, and low) on student achievement in relation to policy implications to confirm that these tests do raise student achievement (Bishop, 2001). The state accountability system proponents confirmed the positive effect of NCLB in "providing direction and coherence to public education", ensuring academic progress of all students (Chubb, & Loveless, 2002, p. 109). Standardized testing is in force in the majority of U.S. states to determine accountability effectively.

Even though *accountability* and *assessment* are the key words associated with standardized testing, the validity of these two key words was questioned by Linn (2001). Linn's observation was further supported with a concern that if the standardized test assessment result is exclusively based on student performance in selected subjects, teachers may focus only on raising student achievement on these tests (Meier et al., 2004; Woessmann, 2001). Marx (2002) insisted upon assessing students' multiple talents and intelligences to judge students' achievement level instead of a single testing evaluation procedure. The practice of using multiple choice questions in standardized tests is criticized and blamed for encouraging students to memorize facts instead of promoting critical thinking skills (Wagner, 2008). Another apprehension about standardized testing was that it is likely to measure knowledge that is not being taught in schools (Hirsch, 2006). Some educators also felt that children do not do well on standardized tests, despite mastery of the material, due to a testing anxiety or test-taking skills (Dunning, Johnson, Ehrlinger, & Krug, 2003). Chapman and Snyder's study (2000) reflected a mixed outcome when they adopted testing as a strategy to assess student improvement. They concluded that the testing procedure failed as many times as it succeeded. Hence, an instructional practice model was advocated as an effective strategy by Chapman and Snyder to improve student achievement in place of a testing procedure.

The advantages and disadvantages of standardized testing procedures have been debated. However, the controversies are a “sign of the intellectual vitality of American education as long as it is used creatively and made a part of the educational process itself” (Graff, 1993, p. 5). In contrast to the contradicting studies that highlighted the shortcomings of standardized tests, the procedure of using standardized tests to assess students’ mastery in the content areas became a process, and this practice continues.

The focus of standardized testing in the current study was narrowed down to the state of Georgia. This single accountability standardized test in the state of Georgia is an exit exam, referred to as the GHSGT or the graduation test.

Georgia High School Graduation Test and AYP

Georgia has adopted a single statewide accountability system to assess student mastery in content areas of the GHSGT to improve the graduation rate. Public education in Georgia is governed by the GDOE. To facilitate the development of Georgia’s single statewide accountability plan and to reinforce NCLB guidelines, the Governor’s Office of Student Achievement (GOSA) was established. GOSA, a Georgia body established in 2000, is responsible for compiling and publishing annual report cards, which include the graduation test statistics on K-12 public schools on the state website (GDOE, 2006). GOSA defined that the pass percentages of English and math subjects on the GHSGT will be a measure to award AYP as required by the NCLB (GDOE, 2001b). Accordingly, out of the four core subjects of the graduation test, students’ performance in English and math subjects are the only two subjects to determine the AYP status of an individual school.

According to Georgia law (O.C.G.A., Section 20-20281), students wishing to obtain a high school diploma must pass the GHSGT and meet local system requirements. This graduation test is an exit exam for the secondary schools and a tool to measure student academic strengths and areas of improvement. According to GDOE (2008), the graduation test comprises a battery of five different tests: writing and four core subjects, namely English, math, social studies, and science. The testing procedure includes a multiple choice format based on ninth and tenth grade curriculum standards. The graduation test is administered for the first time to juniors in the 11^{th}-grade. If students fail, they have several opportunities to retake it before the end of their senior year.

According to the NCLB-reauthorized ESEA, one of the major responsibilities of every school and district is they make AYP.

> Adequate Yearly Progress must be based on test score improvements and acceptable graduation rates for high school students, as well as one other measure of academic progress—increases in the attendance rate or decreases in the rate which students are held back at grade level. The end-goal of AYP is 100% proficiency by 2014. The NCLB requires every district to have every one of its students "proficient" in reading and math twelve years from the NCLB's enactment in 2001. (Kauffman & Losen, 2004, p. 3)

The federal and state governments have initiated several strategies to support students at risk to improve graduation rates and to strengthen the NCLB guidelines. These initiatives are implemented and executed at the school level.

Federal and State Government Initiatives to Support Student Achievement

There are several programs in place to support student success in school. The GDOE initiated a Student Support Unit (SST) program to remove student achievement barriers by involving teachers and parents. SST is a three-tiered process aimed at helping teacher referred student to achieve success (GDOE, SST, 2008). Family Connection Partnership (FCP) is a community initiative program to support a child's health and readiness, sustain success at school, and build a strong and self-sufficient family (GDOE, 2005-2008b, ¶ 1). The underlying belief of the school social work program is that the key to achieve success is "home-to school and community collaboration" (GDOE, 2005-2008e, ¶ 1). The Learn and Serve program provides opportunities to use the academic knowledge and skills in the community to improve student self-concept and motivation to learn (GDOE, 2005-2008c). School guidance and counseling services help students make the right academic and career decisions (GDOE, 2005-2008d). Additionally, programs such as the Georgia scholar program, governor's honors program, and Robert C. Byrd honors scholarship are in place to motivate and recognize the academically high achievers.

A teacher quality (TQ) division created in 2005 oversees student success in the graduation test through an academic coach program (GDOE, 2005-2008f). The coaches identify, recruit, and engage parents, organizations, and government agencies to collaborate in a variety of roles to provide support to at-risk students (NASSP, 2007). Georgia's graduation coach initiative is playing a vital role in increasing the graduation test pass percentage.

Further, to help students who are unable to pass a section of the GHSGT and to be successful in the graduation test, a graduation test waiver plan is in force. If an individual is unable to pass a content area test because of circumstances beyond an individual's control, a waiver will be granted. Also, a variance plan is another course of action available for an individual to demonstrate academic proficiency in the content area by an alternative means (GDOE, 2005-2008g).

Research studies recommended strategies to improve student achievement in the graduation test. The multifaceted issues such as student, family, community, and district policy implications related to the graduation rate were examined, and Shannon and Bylsma (2006) recommended a school-reform initiative. Several researchers recommended strategies to close the achievement gap between minority and majority students to improve the graduation rate (Braun, Wang, Jenkins, & Weinbaum, 2006; Jessop & Williams, 2009; Noguera & Wing, 2006; Ukpokodu, 2004; U.S. Department of Education, 2009). The recommendations include providing extra help to tutor students, improving student attendance, preventing campus violence, and improving teacher quality by proving appropriate professional training to address the needs of diverse student population. Other research studies focused on improving the academic opportunities for students coming from lower socioeconomic status to improve their academic attainment level in the graduation test (Chubb & Loveless, 2002; Crosnoe & Huston, 2007; Davis, Kilburn, & Schultz, 2009; Ediger, 2008). Recommendations to narrow down this achievement gap included having an exemplary principal and dedicated staff, making the test score data available to teachers to identify the at-risk group, and early intervention strategies. Additionally, other studies focused on narrowing the gender gap in learning to enhance the graduation rate by implementing the policies at all levels (Ma, 2008; Marks, 2008). Others, like Fergus (2009), focused on narrowing the racial disparities in academic achievement between Latino American and Black students to improve the graduation rate. The Education Trust (2003) published a report on improving Latino students' performance and suggested encouraging students to enroll for more challenging course work such as advanced placement, honors, or gifted programs to narrow down the achievement gap. Despite these cumulative efforts, the low graduation rate still persists.

In addition, none of those initiatives addressed underachievement in science as one of the critical reasons for the low graduation rate. If the "school-based solutions positively impact the graduation rates" (Stanley & Plucker, 2008, p. 2), then there is a need to draw educators' and policy makers' attention to students' disparate performance between the core subjects and science on the graduation test that affects the graduation rate. If the goal is to increase student graduation rate, it is necessary to close performance gaps between groups of students and between the subject scores of the test (GDOE, Graduation Counts, 2006). An achievement gap in any form ultimately affects the overall graduation rate. Students' unequal attainment levels between science and the core subjects tested for graduation has created a wide achievement gap in student performance. The central point of the present study was to explore a sparsely discussed element responsible for the low graduation rate: students' underachievement in the science content of the GHSGT compared to their performance in the other three core subjects of the test.

Little evidence is available relating the consequence of having only English and math subjects as AYP indicators to students' science underachievement on the GHSGT. There was a concern that teachers focused only on the subjects measured for accountability (English and math) instead of giving equal emphasis on all the core subjects of the graduation test (Stecher & Barron, 2001). Stretcher and Barron's study indicated that teachers' instructional practices emphasized AYP indicator subjects (English and math) at the expense of other non-AYP subjects. Findings confirmed that test-based accountability policies (making English and math as AYP) have helped focus instruction for increased student achievement level in English and math (Jackson, 2008). Jackson's study showed that the accountability factor protecting the AYP subjects helped to increase student achievement in English and math contents of the graduation test. The graduation test statistics indicated that on average, about 94% of students pass in these two AYP indicator subjects (GDOE, 2007). According to the data revealed by National Assessment of Educational Progress (NAEP), math is one academic area where notable improvement was evident in student performance on the GHSGT, but students' science achievement remained stagnant over the years (Barton, 2002; Gonzales et al., 2008).

The shortcoming of the federal NCLB program focusing only on English and math was highlighted as the reason for overall student failure. The schools exclusively focus on basic skills in English and math while ignoring competence in subjects such as science, which is essential to a good education (Rothstein, Jacobsen, & Wilder, 2008). In another study the limitations of NCLB-mandated AYP requirements were reinforced as schools narrow down the curriculum of non-AYP determinant subjects and ignore the long-term benefits of these subjects (Gunzenhauser, 2003). Erickson et al. (2007) observed that a teacher or a school engaged in teaching to the test (emphasis only on English and math subjects) will only be focused on improving the AYP determinant subject test scores and may not help to improve student performance in other subjects of the exit exams. A report by the Center on Education Policy (CEP) provided details of funding to develop programs especially in English and math subjects. The CEP report highlighted that more than half of the funds and technical assistance by States was "specifically targeted to close the achievement gap in math and in English/reading" (2007, p. 2). Science courses need equal emphasis on learning and funding to develop strategic programs for student achievement. While continuing the emphasis on English and literacy, intervention programs should be applied with equal emphasis to subjects across the curriculum, particularly in math and science (Benton & White, 2007). Carpenter, Ramirez, and Severn (2006, as cited in Downey, English, Steffy, & Poston, 2008) warned that achievement gaps between races may not be the most serious compared to multiple forms of achievement gaps that exist in student performance between subjects. Identifying and addressing different forms of achievement gaps are required to improve student achievement in the graduation test.

Literacy and numeric skills are essential educational and social components (Damon & Lerner, 2006). Literacy skills are associated with the economic growth of a nation (Murray, 2005). The lack of literacy and numeric skills among the school age population is a concern that needs to be addressed, and the emphasis placed on English and math subjects is justified to a certain extent (Kirsch, Braun, Yamsmoto & Sum, 2007).

U.N. Secretary Moon's message for international literacy day emphasized that literacy is not just about reading (Department of Public Information, 2009). It is imperative for an individual to be scientifically literate to be successful in a technologically empowered era (Holbrook & Rannikmae, 2007). Improving academic achievement in science is essential to because of the prediction that the future jobs will go to those with education in science and engineering and U.S firms are in need of "scientifically and mathematically literate employees" (U.S. Department of Education 2006, p. 11). Former President George W. Bush and the 50 state governors in 1989 set a goal for the United States to be "the first in the world in math and science achievement" and visualized the importance of these subjects in the previous decade (Cannon, 2000, ¶ 2). The achievement in science is considered as an index of success in the workplace.

In addition to the known reasons for having the low graduation rates (gender, race, and socioeconomic status), another underlying component is students' unequal performance among the core subjects on the GHSGT. Test statistics revealed that the percentage of students failing in the science content is the highest (about 30%) in several years (GDOE, 2007). This failure rate is connected to the low graduation pass percentage as the failing scores in any one of the content areas ultimately affect the overall graduation pass percentage of the test. Hence, it appears that "enhancing the achievement level in the science content may lead to advance student's performance, resulting in improving the graduation rate" (Bottoms, 2003, p. 26). The challenging question pertaining to this situation is: why do students underachieve in the science content of the GHSGT? It is interesting to note students' varied performance between AYP (English and math) and non-AYP subjects (specifically science) on the graduation test. Students' low performance in the science content of the graduation test raises many questions on educational policies. A large-scale cohort study by Uerz, Dekkers, and Bquin (2004) presented a commonness in an achievement gap report on account of student choice of science subject in secondary education relating it to the growing shortage of science graduates regardless of race, gender, and socioeconomic status of students. Despite the necessity of scientific literacy in this technological world, scientific literacy does not seem to be a priority for many students. Using the Simpson-Troost Attitude instrument, Atwater, Wiggins, and Gardner (2006) collected demographic data and data about intentions and attitudes of students' engagement in science to reveal students' uncertain attitude towards science courses. Dimitrov (1999) conducted a study to determine patterns of gender and ethnic differences in science achievement on the Ohio Off-Grade Proficiency Test and did not find any gender or ethnic differences in science achievement. Student attitude towards science courses was not encouraging regardless of gender or ethnicity.

Examining teacher perceptions on reasons for students' underachievement in science was the strategy used in the current study. In the review of literature examining teacher perception is recommended as a tool to investigate reasons for student science underachievement.

Analyzing Teacher Perceptions

Teachers are practitioners who deal with curriculum, strategies, policies, students, and parents. Teachers' insights, opinions, and perceptions on educational issues are vital in determining the strategies that work well as they strive toward helping students succeed. Teachers' input to resolve the achievement gap crisis has leverage, as their judgments are based on their expertise and knowledge in the field of education. Assessing teacher perception to find solutions to educational problems can be a very effective strategy.

There are numerous studies that examine teachers' perceptions on pressing educational issues with the intent of finding solutions to these problems. Measuring teacher perceptions to diagnose the problems and initiatives to adopt strategies has become a common procedure. Teacher perceptions and beliefs are explored by mapping them with varied problems in the field of education. A research study by Machado (2008) examined teacher attitudes on student achievement using poverty as a covariate. Machado's study revealed that poverty does not dictate academic achievement, instead the teacher quality and leadership quality determines academic achievement. Findings from another research study by Foster focused on teacher perceptions of low-income and minority students in schools undergoing comprehensive school reform. Foster (2008) concluded that positive school contexts will foster positive teacher perceptions of students resulting in enhanced student achievement. A qualitative study examining teacher attitudes found that teachers played a significant role in developing resiliency in secondary students; the study also suggested that teachers can have a positive influence on their students' affective development (Miller, 2008). The effect of teacher attitude was related to professional development program, resulting in a significant increase of teacher self-esteem. Smith (2008) confirmed that enhanced self-esteem improved the ability to teach better and improved student achievement. Yet another study analyzed teacher beliefs on bridging the language gap in a science classroom for English language learners (Arnold, 2007). Arnold recommended appropriate professional development courses for teachers to enable them to play the dual role of teaching science content and English literacy skills and make their students successful in a science class.

Studies have confirmed that teachers' beliefs and attitudes are generally congruent with their instructional practices (Fuchs, 2008). Pass (2007) focused on teacher perceptions of their instructional practices and found that teachers perceived and practiced a notion of using a one-size-fits-all approach to teaching the state-mandated content in an English class with a diverse population, instead of adopting a differentiated curriculum to fit the needs of individual students. The outcome of Pass's research study on teacher perceptions may be used to identify the hidden facts and underlying issues related to student achievement. Teacher perceptions are also employed in research studies to measure the effectiveness of a specific program. For instance, Eberle (2003) adopted an inductive approach to investigate the relationship between teachers' beliefs on their content with their classroom practices and confirmed a positive correlation between these two variables. Eberle also concluded that the teaching practices depend on the teacher's ability to organize the science concepts and the curriculum. A research study (Gorski, 2008) explored teacher perceptions on the effect of problem-based learning in a social studies class. The findings reflected that both teachers and students liked the flexibility, enhanced engagement level, and level of interaction, which helped to enhance student achievement. Teachers' contextual beliefs about science teaching environment were assessed and disclosed that the context beliefs complemented teachers' self-efficacy measures (Lumpe, 2000). Further, Lew (2001) was able to identify from his gathered teacher perceptions that new science teachers were early constructivist teachers and preferred to use a student-centered approach to enhance student achievement.

An ex-post-facto-designed study by Carter explored the effects of the GHSGT test on the morale and teacher self-efficacy of eleventh grade teachers. Carter, in his study illustrated that stress and changes to instructional strategies significantly predict teacher morale and self-efficacy and also confirmed that morale and self-efficacy are independent of teachers' teaching experience (2008). Another investigative study on teacher perceptions correlated academic optimism to organization citizenship behaviors and to student achievement at Virginia high schools and found a significant positive relationship between academic optimism and citizen behaviors which ultimately led to enhanced student achievement in exit exam (Wagner, 2008).

Spaulding (2007) compared pre-service and in-service teachers' attitudes and perceived abilities to integrate technology into the classroom and confirmed the need to continue with an initiative to prepare pre-service teachers to effectively integrate technology into the classroom for student success. Contrary to Spaulding's (2007) study, Macdonald's (2003) study, which examined the impact of computer technology implementation in social studies content of the graduation test from teachers' perspectives, did not find any significant variation in the test scores of the treatment group.

Another study on pre-service teacher attitude toward special education-general education collaboration affirmed that although research participants generally had a positive attitude prior to the intervention program, the intervention increased knowledge about the inclusion program and enhanced positive attitude (Yamamoto, 2007). According to Otway (2007), teachers opined that collaborative teaching integrated with multiple instructional models are required to enhance student achievement.

Tucker (2009) determined teacher perceptions on difficulties associated with teaching high-stakes subjects (i.e., English, math, science, and social studies). Tucker compared the burnout factor for public high school teachers teaching high-stake subjects with teachers teaching low-stakes subjects (elective subjects). Although teachers reported greater burnout, statistically significant difference was not found across subject areas they taught. It was also revealed that teachers do share pressure because of the responsibility of making students pass the high-stakes tests. Studies have also shown that teacher attitudes about school climate and program are positively correlated with student achievement (Meyers, 1984).

Taylor, Jones, Broadwell, and Oppewal (2008) mapped scientist's views with that of science teachers' views to explore the influencing factors on science learning. The documented perceptions of both scientists and teachers matched with two common themes: (a) too much variability of science education programs and instructional quality, and (b) a need to enhance students' desire to learn science and cultivate critical thinking skills. The study also confirmed the positive relationship between students' motivation level to learn science subject with their science achievement.

In addition to emphasizing teacher perceptions, it is equally important to examine the validity of teacher perceptions and to determine if teachers' perceptions are correct. Cadwalader (2008) conducted a study to determine the level of accuracy of teachers' ability to identify students' strengths and weakness to understand their learning needs. The results revealed that teachers were less than 50% accurate in their judgment. In another similar study, Gannon (2004) found that teacher perceptions of students' multiple intelligences were less than 50% accurate. Research studies reviewed teacher thinking and decision making factors revealed that insufficient attention was given to the content of teachers' beliefs and principles leading to flawed assumptions. Hence, it was recommended to adapt Kelly's Repertory Grid Technique as an alternative method to measure teacher perceptions (Fransella, Bell, & Bannister, 2004; Munby, 1982, 2004).

A teacher perception was used in the current study to measure students' proficiency and cognitive abilities based on the learning model, Bloom's taxonomy. The following section of the literature review describes the specifics and the nature of learning models related to cognitive abilities.

The Learning Models

According to Krathwohl (2002), Bloom's (Bloom et al., 1956) taxonomy provides a framework to measure whether students attain and reach the expected level of learning according to teachers' classroom instructions. The taxonomy framework was conceived to facilitate the educational goals and to measure outcomes. Bloom's taxonomy model will be used in the current study to measure teacher perceptions on student ability and proficiency level to understand why student performance varies between science and the other three core subjects of the GHSGT. Bloom’s taxonomy can be used as an important diagnostic tool to understand and assess students’ learning process at different cognitive levels. Most of the other learning theories are built upon different cognitive levels of Bloom’s taxonomy (Martinez-Pons, 2001).

Conceptual Framework Based on Bloom’s Taxonomy Model

Benjamin Bloom (1956) advocated that his taxonomy will define the educational objectives and the curriculum, in addition to assessing the outcome (Bloom’s Taxonomy of Learning, 2008). Bloom's taxonomy provided a common language for teachers, linking the level of difficulty of subject matter and information about pupil achievement (Bloom’s Taxonomy of Learning, 2008). Table 3 illustrates the sub-categories under each domain:

Table 3

Categories and Sub-categories of Bloom's Taxonomy

Cognitive domain	Affective domain	Psychomotor domain
1. Knowledge	1. Receiving phenomena	1. Perception
2. Comprehension	2. Responding phenomena	2. Set
3. Application	3. Valuing	3. Guided response
4. Analysis	4. Organization	4. Mechanism
5. Synthesis	5. Internalizing values	5. Complex overt response
6. Evaluation		6. Adaptation
		7. Origination

Note. From "Instructional System Design Concept Map" by D. R. Clark, 2004, Bloom's Taxonomy of Learning domains: The Three Types of Learning. Retrieved from http://nwlink.com/. Adapted with permission of the author.

The cognitive domain in Bloom's taxonomy (Bloom's Taxonomy of Learning, 2008) was organized from simplest to complex hierarchical order. Bloom identified three domains of learning: (a) cognitive skill related to knowledge, (b) affective related to attitude, and (c) psychomotor or physical skills. In the present study, the curriculum, the curricular objectives, and all test items, including the GHSGT test descriptors, will be aligned to this taxonomy to show the breadth and depth of the items across the spectrum of categories. In Larson's (2003) research study the nature and extent of alignment between science content standards and standardized assessments were determined. The major findings indicated that there was an acceptable categorical concurrence with more than half of the assessment items categorized beyond knowledge level or depth level of Bloom's taxonomy.

Bloom (1956) emphasized the intellectual outcomes in the cognitive domain and identified six levels in a hierarchical order, starting with knowledge, comprehension, application, analysis, synthesis, and evaluation (Figure 1).

Figure 1. The Cognitive levels of Bloom’s taxonomy.

Evaluation	judges the value of information
Synthesis	builds a pattern from diverse elements
Analysis	separates information into part for better understanding
Application	applying knowledge to a new situation
Comprehension	understanding information
Knowledge	recall of data

Figure 1. The cognitive levels of Bloom’s taxonomy organized in a hierarchical order. Adapted with permission from “Bloom's Learning Domains” by B. Hoffman (Ed.), *Encyclopedia of Educational*

Technology, 2008. Retrieved from http://www.scribd.com/doc/13442504/Blooms-Digital-Taxonomy-v30

The objectives that involve the understanding and knowledge category at the lower level of cognition are equally important as the classification moves towards comprehension, application, and synthesis aspects of cognition. The International Center for Leadership in education built upon Bloom's taxonomy and recommended applying the lowest cognitive level-knowledge within a course subject across the subjects of curriculum to real-world situations and to real-world unpredictable situations (Shanklin, 2008). Shanklin recommended integrating all the cognitive levels of taxonomy in a sequential manner to improve student achievement.

Anderson and Krathwohl's Revised Bloom's Original Taxonomy

Anderson and Krathwohl's (2001) revised Bloom's original taxonomy by combining the cognitive dimensions of knowledge and process to enable instructors and teachers to efficiently align standard-based learning objectives to teacher assessment techniques. Although the main features of the original taxonomy were unaltered, the nouns were replaced by verbs to make it more specific to the cognitive function. The knowledge domain was replaced with recognizing, recalling; the understand domain was replaced with interpreting, comparing; the application domain was replaced with implementing, executing; the analysis domain was replaced with differentiating, organizing; the synthesis domain was replaced with develop, create; and the evaluation domain was replaced with judgment, critiquing (Huitt, 2004).

The taxonomy is applicable to a broader range of learning situations. Webb (2007) provided evidence to support the application of Bloom’s taxonomy (2008) to pedagogic methods to illustrate improvement in student achievement levels. Fullan (2005) applied the taxonomy by admitting that students learn by drawing knowledge from a range of information to attain greater depths of understanding to apply themselves in new situations. Noble (2004) advocated the integration of principles of the revised Bloom’s taxonomy (Bloom, 1956) with Gardner’s multiple intelligences (Gardner, 1983) to provide an effective tool for curriculum differentiation and to enhance student achievement.

The alignment of policy with curriculum standards is important in the evaluation of standard-based assessments. To be able to evaluate whether students have understood the standards, the assessment should focus on curriculum standards. Bloom’s taxonomy (1956) is considered the most appropriate model to verify cognitive complexities (Nasstrom & Henriksson, 2008). Elseer and Rule (2008) successfully adopted the Bloom’s taxonomy model to evaluate the wide range of academic performance, abilities, and interests of upper elementary children. Corso (2008) recommended that instructors use Bloom’s taxonomy to understand students’ range of cognitive complexities in varied academic learning situations. Manthey (2006) analyzed the adaptation of revised Bloom’s taxonomy to assess the achievement gap between what students bring with them and what they should know based on California’s content standards.

Marzano’s taxonomy, a revised version of Bloom’s taxonomy, was aligned to standards-based education to provide a curriculum framework and to elevate thinking skills (Marzano & Kendall, 2006). Marzano's taxonomy is based on three domains of knowledge: information, mental procedures, and psychomotor procedures. Christie and Alkin (2008) examined various evaluation prescriptive theories and advocated the use of cognitive evaluation to improve performance and support policy decision making.

Students retain little understanding of the information in science courses. Even though the factual content in science is taught in a detailed manner, assessments are based on student ability to recall the information. Students spend little time practicing application and analysis, the much needed higher cognitive levels of thinking. To correct this problem, a study recommended that teachers apply the upper levels of Bloom's taxonomy (1956) by formulating more questions (Lord & Baviskar, 2007). Crowe, Dirks, and Wenderoth (2008) successfully developed the Blooming Biology Tool (BBT), which is based on Bloom's taxonomy, to identify learning difficulties and to design questions at higher cognitive skill levels to enhance mastery of the content.

Bloom's model (1956) was successfully adopted to evaluate the different levels of cognitive difficulties in an information technology course (Oliver & Dobele, 2007) and in international marketing courses (Manton, English, & Kernek, 2008). Cochran and Conklin (2007) advocated the paradigm developed by Anderson and Krathwohl (2001), based on the original Bloom's taxonomy (1956), to evaluate the technology-enhanced activities in more powerful and critical ways. The importance of vocabulary achievement in science and science-related engineering courses is repeatedly emphasized. A study based on Bloom's taxonomy (1956) recommended relating the cognitive domain with content vocabulary to achieve specialized knowledge (Lynch, Russell, Evans, & Sutterer, 2009). Memory plays an important role in student achievement. Bloom's taxonomy, which addresses various cognitive characteristics in a broad range of understanding to application, is the best fit.

Contrary to recommendations made by other researchers, Amer (2006) compared the classical Bloom's taxonomy (1956) with the revised taxonomy (Anderson & Krathwohl, 2001) to reveal weaknesses and practical limitations of the original taxonomy while giving credit to the underlying philosophy and potential pedagogic uses. Booker (2007) questioned the intent of Bloom's taxonomy, stating that it is more appropriate for higher education and misapplied to K-12 education, resulting in a serious distortion of purpose. Booker also blamed overreliance on Bloom's taxonomy for rendering American children incompetent at the international level. Shaw (2006) investigated the effectiveness of a strategy in which students exposed to designing higher order thinking (based on Bloom's cognitive taxonomy) multiple choice questions in science would be able to achieve better on a standardized test (California Critical Thinking Skills Test). Results revealed that students did not show any improved ability to answer critical thinking multiple choice questions because of their practice task of creating such questions.

According to Gewertz (2007), the Texas education system is revamping the assessment method for graduating high school students. Instead of testing the accumulated knowledge over the years, the state will test the mastery of the knowledge at the end of the course. This proposal was an important shift in thinking and is gaining momentum.

Research Methodologies

There is a vast body of literature available on using different methodologies in a research study. Qualitative research relies on an "inductive logic of inquiry" (Seale, Gobo, Silverman, & Gurbium, 2007) where a researcher is involved in understanding the nature and reasons for human behavior and focuses on a smaller sample by using a case study, interviews, focus groups, or observation. A drawback to qualitative study, however, is that the rich description makes it difficult to determine the generalizable themes (Trochim, 2008) and "lacks quantitative research's power to generalize" (Seale, Gobo, Silverman, & Gurbium, 2007, p. 283). Qualitative research crosses disciplines, fields, and subject matter and has an "interconnected family of terms, concepts" (Denzin & Lincoln, 2000, p. 2) surrounded by assumptions. According to Thomas (2003), the qualitative approach describes the characteristics of people using an interpretive naturalistic approach, such as case studies, interviews, or observations.

A quantitative approach, characterized by numerical measurements, is easily replicable by other researchers and can be generalized to other persons and places (Thomas, 2003). Quantitative research summarizes large amounts of data to enhance the applicability and generalizations of findings (Trochim, 2008). Additionally, a quantitative approach based on the numerical data and scientific approach leads to scientific predictions (Black, 2002). The quantitative approach using SPSS in educational research is advocated even to non-mathematical students (Muijs, 2004) because of its adaptability. Trochim (2008) favored the quantitative research method because of its confirmatory and deductive nature.

It is also argued that there is a very narrow distinct between qualitative and quantitative due to their overarching characteristics. Qualitative data is always quantitatively coded, and, similarly, qualitative measures such as perception, beliefs, and attitudes are quantified, “opening for new possibilities for interpretation and all quantitative data is based on qualitative judgment” (Trochim, 2008, ¶ 9). Thomas (2003) recommended blending qualitative with quantitative research methods in dissertations, arguing that both the methods complement one another. Creswell (2009) noted that in a mixed method approach, the researcher brings together the best of both the approaches.

In this current descriptive research study, quantitative methodology was used to answer the descriptive research question. Statistics in the quantitative method is a powerful tool for a descriptive study or to find answers to the research questions (Williams, & Monge, 2001). The survey approach is preferred as it is an “easier, quicker, less expensive, or more accurate way for getting accurate, reliable, and valid” needed information to answer important questions (Alreck & Settle, 2004, p. 3). Schuman and Presser (1996) justified the continued used of the survey method because researchers can obtain information efficiently and because the survey method allows the sampling procedure to represent a relatively small number to a much larger population. Thomas (2003) recommended a quantitative study and the use of a grounded theory in it “to extract theory out of the collected information itself (p. 3).

There are several studies conducted using a non-experimental survey method to investigate teacher beliefs and perceptions. For instance, Brady and Woolfson examined teacher beliefs on teaching children with learning difficulties (2008). Another study estimated the impact of collective leadership on student achievement from teachers' point of view (Leithwood & Mascall, 2009). Yet another comparative study investigated teacher and principal perspectives on reasons why some schools to do better than other schools under similar conditions (EdSource, 2007). A study by Wasilewski, Gifford, and Bonneau (2008) confirmed a positive correlation between student positive behavior and their enhanced educational attainment, after verifying the school-wide positive behavioral support with its educational outcomes based on teachers' responses. Leatherwood (2006) examined teacher attitude on the academic performance of pregnant and parenting students and found that teachers will be more sympathetic to them. The gathered teacher perception data in a study measured the effectiveness of Success-for-All, a school reform model and confirmed the positive impact of the reform model on students' standardized test reading scores (Munoz, Dossett, & Judy-Gullans, 2003). A federally funded research study with the intent of enhancing student achievement conducted a nation-wide survey to gather teacher perceptions on school improvement and created the School Review Process Guide, a school improvement plan. Teacher perceptions collected by administering a survey provided the data for this large-scale study (The Center for Comprehensive School Reform and Improvement, 2008).

Section 3 of this study further describes the use of the quantitative, nonexperimental approach in this study. This approach enables to gather and assess teacher perceptions on reasons for students' science underachievement on the GHSGT.

Summary

Several forms of achievement gaps account for the low graduation rate in the state of Georgia. There are various strategies in place to narrow down these academic achievement gaps associated with ethnicity, socioeconomic status, and gender. However, there is insufficient research about the achievement gap in students' performance on the core subjects of the GHGST. The GHSGT statistics on the Department of Education (GDOE) website reflects disparity in students' performance in the core subjects of the test. The objective of GDOE (n.d., ¶ 2) that "*ALL* students can learn" and student success can be accomplished by narrowing down the achievement gaps, is the basis for this research.

The current study identified a pattern in which students' underachievement in the science content of the GHSGT compared to their achievement level in other three core subjects of the graduation test (English, math, and social studies). The percentage of failure in the science content is about 40% (for the academic years 2000-01 to 2006-07) for the school district under study (GDOE, 2007). Students' low performance in the science content of the GHSGT is also causing concern about the low graduation rate.

The current study intended to explore reasons for students' science underachievement from teachers' perspectives. A survey approach was used in this study to gather teacher perceptions on reasons for the low graduation rates. Bloom's taxonomy model (1956) provided the theoretical framework to explore teacher perceptions. The research literature confirmed the use of teacher perception to identify and address educational issues. In the current study, reasons for students' science underachievement on the GHSGT will be determined from teachers' perceptions. The nature and importance of the state-mandated the GHSGT was also discussed in the literature review. The related guidelines and policies of the GHSGT are aligned with the federal mandated NCLB to strengthen the test.

In Section 3 the methodology of the study, including the statistical tools and data analysis, was detailed. The analyzed results were reported in Section 4. Section 5 concluded with recommendations.

SECTION 3: RESEARCH METHODS

Introduction

The first part of this section describes a non-experimental, quantitative study. The research design, based on Bloom's (1956) taxonomy, was used to examine teacher perceptions on reasons for student science underachievement in the GHSGT. The research design, research question, variables, instrumentation, setting, and participants are discussed in this section.

Students' science underachievement in the graduation test is considered as one of the reasons for a low high school graduation rate. There is an abundance of research literature available describing reasons for the low graduation rates from various perspectives, such as the achievement gap between gender, race, and socioeconomic status. However, little research has examined the reasons for student science underachievement on the GHSGT, which affects the graduation rate.

The empirical data on the GHSGT, published by the GDOE (2007) for the academic years 2000-2001 to 2006-2007, were analyzed to identify student science underachievement compared with achievement in three core subjects—English, math, and social studies—for the school district under study. The longitudinal study conducted on individual pass percentage on the graduation test confirmed that a major percentage of students (about 40%) fail in the science content of the GHSGT compared with English (about 4%), math (about 6%), and social studies (about 15%). The objective of the current study is to analyze reasons for students' low achievement in science, from teachers' perspectives.

In this study, a survey approach was employed to gain insight into teacher perceptions on reasons for student science underachievement. The purpose of the survey approach was to quantify teacher perceptions. Quantification of perceptions will allow the adoption of a quantitative paradigm because quantitative research helps to establish the relationship between variables (Creswell, 2003). According to Mulder (2006), objectivity stands for “reality, truth, and reliability” (¶ 1); this study will provide objectivity and reliability to the measured variables. It is critical to understand student achievement from teachers’ perspectives because these perceptions may lead to the development of strategies needed for student success (Learning Point Associates, 2004).

Bloom’s taxonomy (1956) provided a framework to understand student academic proficiency in the content areas of the GHSGT from teachers’ perspectives. Reyes (2004) recommended developing a framework to identify the “measurable variables and their relationships” (p. 3). A self-developed questionnaire, the Achievement Gap and Science Underachievement Questionnaire (AGSUQ), was used as a diagnostic tool to measure teacher perceptions. Results of this study will help formulate intervention strategies to improve students’ science achievement and, consequently, improve the overall graduation rate.

Research Design

This study is deductive, descriptive, and quantitative. The quantitative approach was selected over other methods because the choice of research approach depends on “research problem, personal experiences, and audience” (Creswell, p. 23). To address the research problem, the quantitative study allows a relatively larger sample population (compared with a qualitative study). This quantitative study will incorporate an empirical study (GHSGT statistics) with a cross-sectional survey (teacher perceptions) to mediate the variables of interest. Malmberg (2008) noted that a key approach for the success of the study is to develop an accurately designed research model.

This nonexperimental research method was designed to be carried out in two phases. The initial phase included a longitudinal study to disaggregate the GHSGT scores and to identify students' science achievement compared with other three core subjects of the GHSGT over a 7-year period. Meyers (1984) favored disaggregating of standardized test data to unmask indicators and reveal underlying characteristics. The segregation of empirical GHSGT data is expected to reveal students' level of science achievement, an indicator to understand the characteristic nature of the study. "It is not until the data are disaggregated that patterns, trends, and other important information are uncovered" (Administration Manual. n. d., p. 1). The GHSGT data were disaggregated based on the individual core subject pass percentage for (a) the school district under study (b) eight different randomly-selected school districts representing urban, suburban, and rural and city school districts, and (c) for the state of Georgia. The pass percentage statistics indicated students' underperformance in science compared with English, math, and social studies, the core subjects of the GHSGT. This longitudinal study served as a first step for a theoretical explanation for science underachievement and the achievement gap between science and other three core subjects of the graduation test.

The second phase was carried out by administering an anonymous survey to high school core subject teachers to gather perception data on reasons for students' science underachievement in the graduation test. A survey method was adopted to cover a large population in a relatively short time-frame. The survey method is an appropriate choice when the goal of the research and researcher is to "apply the findings beyond research participants and to influence policymakers" (Hesse-Biber & Leavy, 2006). Although interviews help to elicit individuals' perception and opinion, surveys provide the needed time for reflection before answering the questions (Backstrom & Hursh-Cesar, 1981). A two-dimensional study culminating both survey and longitudinal studies was undertaken by Johnson (2001) to explore the relationship between variables. Johnson adopted a two-dimensional study to realize the benefits of both approaches for the success of his study. The present research study will follow Johnson's guidelines for adopting the survey and the longitudinal study. The current research is designed for a paper-pencil survey methodology to collect the primary data (Appendix C).

Studies where participants are anonymous have been conducted successfully to gather information on diverse topics. In their study of bullying behavior with the intent of minimizing bullying through behavioral intervention and instruction, Drosopoulos, Heald, and McCue (2008) protected the anonymity of participants. Smyth, Davis, and Kroncke (2009) collected anonymous survey data on students' assessments of questionable academic situations on varying ethical situations and statistically analyzed the data. In another anonymous survey, the author explored the prevalence of primary school teachers' and principals' burnout by examining their perception data (Tomic & Tomic, 2008). Brew (2008) investigated students' willingness to provide detailed feedback if given the opportunity to complete an anonymous survey and confirmed the participants' willingness to provide complete information. Brew concluded that the anonymous survey is an effective tool to gather perceptions. To meet the NCLB mandate, the California Department of Education conducted an anonymous survey to measure teacher attitudes on student achievement in the context of drug and school violence (Austin & Duerr, 2005). An extended study on teacher perceptions compared the benefits of an anonymous questionnaire with a confidential survey and concluded that an anonymous survey procedure is as valid as a confidential survey procedure (Van de Looji-Jansen, Goldschmeding, & DeWilde, 2006). A paper-pencil questionnaire can have an added benefit of giving participants anonymity to elicit honest responses beyond what they would disclose in the presence of an interviewer (Hoyle, Harris, & Judd, 2002). Hence, a paper-pencil procedure was adopted in the present study to collect the data.

In this study, a self-developed questionnaire was used to gather teacher perceptions on reasons for student science underachievement on the GHSGT. The previous research studies have justified the use of questionnaire and inventories as an effective statistical tool to gather perceptions and attitudes. For example, Bliss (2007) noted that student developmental skills were assessed using a standardized assessment inventory such as Battelle Developmental inventory (BDI-2) to measure functional abilities of young children. The second edition of Test Memory and Learning (TOMAL-2) instrument was recommended by Schmitt and Decker (2009) to measure broadband verbal and nonverbal memory functions across the age span of 5 to 59 years. Enochs and Riggs (1990) developed the Science Teaching Efficacy Belief Instrument (STEBI) to provide insight into elementary science teachers' efficacy and beliefs in science teaching.

Enochs and Riggs also recommended administering the STEBI survey twice, at the beginning and also at the end of the semester, to compare the participants' responses and beliefs in science teaching. There were studies were undertaken to measure teacher perceptions on reasons for students' lack of motivation (Hardre, Davis, & Sullivan, 2008), and teacher perception of diagnostic indicators and intervention strategies to motivate high school students for their academic achievement (Hadre, 2008).

The previous research studies have also confirmed the influence of teachers' experience and the subject taught on the outcome of the study. Howe (2000) conducted an international study (British Columbia, Canada, and Japan) to compare and contrast secondary school teachers' belief on critical thinking with respect to gender, age, teaching experience, and subject taught. The outcome of Howe's study indicated that the significant difference on teachers' belief was confined to subjects taught and teaching experience. However, there were no significant differences in teachers' belief based on participants' gender or age. In a longitudinal study about improving instructional practices to meet NCLB objectives, a weak correlation between teacher qualifications and a teacher training program on student achievement was found (Palardy & Rumberger, 2008). A national-level survey was administered to measure science teacher perceptions on nature of science based on years of teaching experience, teacher training program, and qualification (Dogan & Abd-El-Khalick, 2008). The outcome of this study indicated a positive correlation based only on years of teaching experience

Teachers' experience is a critical factor in improving school culture because experience provides stability and enhances student achievement (Harper, 2009; Zwicky, 2008). In a National Science Board (2004) report the efficiency of experienced teachers with inexperienced teachers was compared. The report concluded that "inexperienced teachers are generally less effective than senior teachers" (p. 5). To prevent an exodus of most experienced teachers, Njuguna recommended revising the retirement policy so that experienced teachers can be retained to collaborate with new teachers by sharing their effective classroom expertise (2009). The importance of experienced teachers in the success of reform efforts in a school was advocated by Gohn (2004). According to Gohn, a teacher's teaching experience is believed to have a direct impact on student achievement. The personal resources and effectiveness brought in by experienced teachers is reflected in their day-to-day performance (Kennedy, 2008). Experienced teachers are believed to have rich personal resources in terms of content knowledge and effective instructional practices.

The two covariates used in the AGSUQ survey instrument based on the recommended literature review were: (a) subject taught by teacher, and (b) number of years of teaching experience. These two covariates are believed to reveal teacher perceptions on reasons for student science underachievement.

Setting and Sample

The population for this non-experimental, quantitative study was drawn from seven suburban public high schools located in southern Georgia. All seven schools to be included in this study are part of a single public school district. The population comprised high school teachers (including special education and collaborative teachers) teaching English, math, social studies and science, the core subjects of the GHSGT. GHSGT results published by the GDOE treat both regular and students with disabilities as one single group for the purpose of compiling and publishing students' pass percentage data. The subjects taught by the teachers will be the criteria for selecting study participants. The school system under study has seven high schools and there are approximately 10 teachers in each of the four core subjects. Thus, the estimated population size was about 280.

The sample consisted of participants from four different schools of the same school district who agreed to participate in this study. The target sample is independent of gender, ethnicity, and socioeconomic demographic characteristics. The sample size, based on a sample size calculator (American Research Group, Inc., 2000), recommended the size of the sample to be about 160, at a confidence level of 95%, for a population size of 280.

Instrumentation

A psychometric test is generally used to identify a particular ability based upon the selected response, from a range of alternatives. The psychometric approach is advocated as an effective tool for cognitive assessment (Gallagher, 2000; Robinson, 2005). There are no instruments available to assess student proficiency integrating psychometric properties with Bloom's taxonomy model (Bloom, 1956) to examine teacher perceptions on reasons for student science underachievement. Therefore, a multidimensional instrument, the Achievement Gap and Science Underachievement Questionnaire (AGSUQ), was developed to measure teacher perceptions on reasons for students' science underachievement (Appendix C). This self-developed, validated questionnaire was used as a statistical tool to collect the data and to measure the teacher perception variable. An anonymous, cross-sectional was administered to high school teachers teaching the four core subjects of the GHSGT.

The AGSUQ is similar to a psychometric test, which can be used to assess abilities and effectiveness of policies (Parkinson, 2008). The questions on the questionnaire (Appendix C, Domain 1) were organized by level of cognitive behavior, such as found in the Bloom's (1956) taxonomy. Participants were asked for basic demographic information on subjects taught and years of teaching experience, because these two covariates appeared to make a significant impact on student achievement according to the reviewed literature.

Instrument Development

A list of teacher perception descriptors on student proficiency level and related policy factors were derived primarily from the literature review, psychometric tests, Bloom's taxonomy (1956) and the researcher's personal experience as a science teacher. These descriptors were classified into three domains, based on their relative strength and correlation with each of the domains. The development of the questionnaire involved several specific stages:

1. Conducting a review of the literature on other questionnaires and psychometric scales.
2. Identifying cognitive levels as a measure of achievement based on Bloom's taxonomy.
3. Listing a pool of descriptors based on multidimensional aspects of the study.

4. Reviewing items by experts and practitioners in the educational field for precision and relevance.
5. Rephrasing and re-writing some of the statements to facilitate and to express the view points of different subject teachers.
6. Classifying and mapping the items under three major domains.
7. Choosing a common 5-point Likert scale of measurement for all items.
8. Making the questionnaire compatible with a paper-pencil mode of administration to maintain anonymity of the participants.
9. Conducting a pilot study to determine the reliability and validity of the questions and statements.

McCall (2001) recommended having a panel of experts to identify the descriptors that would help to address the research question. According to Bailey (2006), "frequent discussions with a colleague, or an expert in the topic" (p. 188) is a part of a research process. This peer debriefing is necessary for the development of an instrument. Lincoln and Guba (1985) advocated peer debriefing for the "purpose of exploring aspects of the inquiry that might otherwise remain only implicit with the inquirer's mind" (p. 308). Spillett (2003) reinforced peer debriefing to enhance credibility of the instrument. The current study used a panel of six educators to review the range of representation of concepts from all the four content areas and obtain their input and perception on relevancy, clarity, and content of the questionnaire. The panel of experts included core subject teachers and special education teachers preparing students for the GHSGT.

Initially more than 40 items were constructed while transforming the theoretical framework into statements while developing the questionnaire. Many of them were eliminated either because of their ambiguity or for their similarity with other items. Fowler (2008) recommended framing the questions on survey items as reliable as possible by wording appropriately to ensure that they mean the same to all respondents. There are three domains in the AGSUQ instrument, within which several measurable constructs are listed. Finally, the instrument was revised to 33 items in addition to a teacher profile item under the demographic domain. The demographic domain addressed participants' information on subject taught and number of years of teaching experience. The emerged transitional inventory was categorized into three domains to describe teacher perceptions on student proficiency, reasons for science underachievement, and policy factors to enhance science achievement.

Domain 1. To measure teacher peceptions on students' proficiency level in the respective content areas, the dependent variables will be: (a) students' ability in reading, writing, comprehension, application, math skill, and lab skill in accordance with Bloom's higherarchical cognitive levels; (b) learning characteristics, including interest in the subject, learning and retaining content with ease, and getting high scores with little effort; and (c) attitude characteristics comprised of curiosity, questioning, objectivity, and critical thinking (Appendix C).

Domain 2. Teacher perceptions on reasons for student science underachievement was measured as a three category question comprised of multiple variables: (a) teacher expectations of student ability in reading, writing, comprehension, application, math skill, and lab skill; (b) lack of equal emphasis and lack of continuity in curriculum; (c) more emphasis on English and math subjects, as English and math are AYP indicators, and AYP factor drives greater performance; (d) difficulty of comprehending and remembering science concepts due to math integration, unfamiliar vocabulary, and demand of higher order thinking skills (Appendix C).

Domain 3. Teacher perception responses on policy factors to improve science achievement included: (a) making science an AYP indicator, (b) making all core subjects AYP indicators, and (c) replacing the GHSGT with End-Of-Course Test (Appendix C). The reponses obtained from all the three domains of the questionnaire will be analyzed to answer the research question.

Reliability and Validity of the Instrumentation

ASGUQ is a new statistical tool that warrants confirmation of its reliability and validity. A pilot study needs to be conducted prior to the administration of the survey to gather data for the purpose of estimating the reliability of the instrument. Cronbach's alpha is an appropriate technique for measuring reliability of a multi-point formatted questionnaire and is described as an "index of reliability" (Santos, 1999, ¶6). Cronbach's alpha confirms the internal consistency between the items and scales. Cronbach's alpha uses the "mean of all the inter-item correlations to assess the stability of the instrument" (Warner, 2007, p. 854). The coefficient value ranges between zero and one; 0.6-0.7 alpha coefficient value indicates an acceptable reliability and 0.8 or higher indicates a good reliability.

For the purpose of conducting the pilot study, the survey was administered to 20 high school teachers to ensure equal representation from each of the four core subjects of the GHSGT. Teachers' responses to the questionnaire were used to generate statistics required to determine its internal consistency. Teachers' responses to specific items were expected to vary based on their subject curriculum context and years of experience.

According to Salkind (2006), there are three types of validity tests: content validity, criterion validity, and construct validity. The content validity of the AGSUQ instrument was confirmed with a panel of experts in the field during the debriefing session. The participant teachers were asked to indicate any experienced difficulties while responding to the items, as recommended by Hua, Williams, and Hoi (2004). It was necessary to ascertain participants' feedback and "the way participants' experience" (Cochen, Manion, & Morrison, 2003, p. 110) to confirm the content validity. Criterion validity of the used AGSUQ tool was verified after mapping teacher responses of the pilot study with the standardized scores of GHSGT. A positive correlation was confirmed between teachers' perceptions on reasons for student science underachievement and the GHSGT pass percentage in science. According to Gravetter and Wallnau (2005), the validity of a new statistical tool can be demonstrated using "a common correlation technique" (p. 420). Finally, construct validity was confirmed by rooting the construct items with a wide literature search for the meaning and relevance of the construct.

Data Collection and Analysis Procedures

Data Collection

The AGSUQ questionnaire is similar to a psychometric test on a 5-point Likert scale was employed to measure teacher peerceptions. The participants were asked to rate each of the statements serving as a variable on a 1-to-5 response scale (5 = *strongly agree*; 4 = *agree*; 3 = *neutral*; 2 = *disagree*; 1 = *strongly disagree*). According to McCall (2001), a properly developed Likert scale is a useful tool in “addressing the need to consider opinions and attitudes towards potential policy decisions” (p.1). The nature of the scale is expected to enable the teachers to rate each of the variables in this study with a degree of certainty, as perceived by them.

A pilot study was carried out using the AGSUQ tool during the month of March 2010, after the completion of the IRB protocol (IRB approval No. 03-12-10-0355267). The rationale for choosing this schedule was to provide sufficient time for teachers to assess the proficiency of their students.

Data Analysis

After collecting the completed questionnaires from the participants, the questionnaires were segregated based on the subjects taught and years of experience. Frequency distribution was calculated for each demographic attribute of the entire sample population based on subjects taught and years of experience. Creswell (2003) noted that counting the number of times the same responses occur enables the “quantification of qualitative data” (p. 221). Also, this procedure transforms qualitative data into quantitative data. The responses will be coded from the collected data was entered into

Statistical Program for Social Sciences (SPSS) software to generate a spreadsheet indicating subjects taught and years of teaching experience. The rationale behind the classification is novice teachers are likely to have different perceptions than veteran teachers, in addition to subject (taught) characteristics.

The statistical analyses of the data were carried out using analysis of variance (ANOVA), Pearson's chi-square test, and *t* test. The square root transformation procedure was used to transform the non-normal dataset into a normally distributed dataset to ensure the kurtosis and skewness values within the acceptable limits. The parametric test ANOVA is the recommended data analysis method because of its flexibility to evaluate mean differences between multiple samples of datasets (Gravetter & Wallnau, 2005). The rationale for the Pearson chi-square test was to determine the strength of the correlation between the variables as it predicts the degree and direction of the variables (Gravetter & Wallnau, 2005). The nonparametric chi-square test for independence, which does not require normal population distributions and homogeneity of variance, was used to determine the strength of correlation between the variables. The *t* test for independent samples was employed to compare the responses between two groups of teaching experiences: (0-10 years of experience and 11 years or more of experience) for each of the subjects.

The AGSUQ instrument consisted of 33 items construct were grouped under three domains. The first domain was to assess teacher perceptions on students' proficiency and their preparedness to take the GHSGT. Because of the commonness and the degree of internal consistency between the items, the average proficiency percentage was analyzed using ANOVA. The ANOVA test compared the mean proficiency percentage for each of the four teachers group (English, math, science, and social studies) to determine the statistically significant difference between teacher perceptions. Further, the pair-wise comparison of the mean proficiency percentage between different groups was performed using Tukey's post-hoc test (for equal variances, significant value > 0.05) and Games-Howell (for unequal variances, significant value < 0.05).

Thus, the ANOVA statistical procedure was used to compare teacher perceptions based on subject taught and *t* test was used to compare teacher perceptions based on years of experience. The *t* test compared the mean proficiency score for novice teachers (0-10 years of experience) with veteran teachers (11 years and more) to compute any statistically significant difference in perceptions. The *t* test was conducted to determine the equality of variances between the groups.

The remaining two domains of the questionnaire, reasons for science underachievement and policy factors (AYP and EOCT), were comprised of statements representing categorical variables. Contingency tables were the preferred method to record and analyze the relationship between two or more categorical variables. The contingency table tabulated the variables based on their pair-wise frequency of occurrence. Further, based on the cross tabulation of variables, Pearson's chi-square statistic (test of independence) was calculated to determine the strength of correlation between variables. The cross tabulation is suitable for categorical variables because it does not have any underlying assumptions like the ANOVA and *t* test do.

Descriptive data from domain 2 was used to analyze teacher perception on students' science underachievement (Appendix C). The contingency table analyzed teacher perceptions on reasons for achievement gap on account of: (a) lack of equal emphasis on all the four core subjects, (b) lack of continuity in curriculum, and (c) lack of cumulative knowledge. Further, the reasons for students' disparate performance between the core subjects will be analyzed by comparing students' performance between AYP subjects (English and math) and non-AYP subject (science), and between two non-AYP subjects (science and social studies). The cross-tabulation results were used to reflect teacher perceptions on reasons for students to perform better in English and math compared with science. The cross-tabulation statistics compared science with social studies to analyze teacher perceptions on students' underachievement in science.

Finally, teacher perceptions about AYP and EOCT policy factors to enhance science achievement were analyzed using the descriptive data obtained from domain 3 of the questionnaire. The cross-tabulation method reflected teacher perceptions on (a) making science an AYP indicator, (b) making all core subjects AYP indicators, and (c) replacing graduation with end-of-course test.

I coordinated with the person in charge of Secondary Coordinator Leadership Services of the school district to obtain permission to conduct the study and for administering the survey. I was granted permission by the superintendent of the school district to conduct the research. The IRB protocols were in place prior to the administration of the survey. The survey was designed to be administered in a paper-pencil mode to conceal the identity of the participants and to assure privacy and confidentiality of the participants. This anonymous survey did not necessitate obtaining consent from potential participants, as the completed survey was an indication of participants' willingness to participate in the survey. Anonymity was assured, as neither the name of the school or the school district was used in any written reports that stem from the collected data by me. Since teacher demographic details did not include the participant's name, gender, age, qualification, and race information, the nature of the survey helped to maintain the required anonymity and confidentiality of the participants. The survey package included a cover letter to invite the participants to take part in the study. The cover letter contained a brief overview of the survey, intent, procedure, and will highlighting the involved risks and benefits of voluntary participation (Appendix D).

I personally delivered the survey package to the central office of the school district. The survey package consisted of a note to administrators of each of the participating schools, letter of invitation to participants, and the questionnaire. The survey package from the central office was delivered to the administrators of the participating schools and then distributed to the core subject teachers in their respective schools. Three days time was allotted for teachers to complete the 25-minute survey; participants could complete the survey before or after school hours without being disturbed during instructional hours. Teachers were instructed to return the completed survey to the administrator as identified by the respective principals. I collected back the completed questionnaires from the central office after the central office obtained the completed questionnaires from all of the participating schools. Teachers who were absent or unavailable during the planned survey time-frame were excluded from this study.

To eliminate the biased outcome, I conducted my research study in a school district where I am not an employee. I neither have any professional or personal association with any of the participants nor have any identifying information about any of the participants. The authenticity of each teacher's survey responses were respected and protected. The participants did not receive any compensation for participating in the study. My researcher's role was limited to delivering the survey package to the central office of the school district and collecting the completed questionnaires from the central office.

Summary

The research was designed to investigate teacher perceptions on students' science underachievement on the GHSGT. The two covariates in the study were limited to subjects taught by teachers and years of teaching experience, as recommended by researchers in the review of literature. The demographic variables such as gender, race or ethnicity, and qualification were controlled in the study. A self-developed AGSUQ questionnaire was used as a diagnostic, statistical tool for identifying reasons for students' science underachievement and related achievement gaps in the content areas of the GHSGT from teachers' perspectives. The analysis of GHSGT data identified three themes related to the teacher perceived factors influencing students' science underachievement on the graduation test: (a) student proficiency in the content area, (b) reasons for science underachievement, and (c) policy factors that may enhance science achievement.

Section 3 detailed the research procedures including statistical tool, statistical analyses, characteristics of the sample relative to the research question, and the variables, with the intention of uncovering the patterns and relationships of the data. This description also justified having a new instrument, the AGSUQ, and the variables, based on abundant literature resources. In section 4, the research results are reported. In section 5, interpretations are made and conclusions are drawn.

SECTION 4: RESULTS

Introduction

The purpose of this deductive, non-experimental quantitative study was to investigate reasons for students' science underachievement on the Georgia High School Graduation Test (GHSGT) from the teachers' perspective. An empirical study comparing students' pass percentages in core subjects (English, math, social studies, and science) of the GHSGT (for 2000-2001 to 2006-2007 academic years) confirmed two common themes: (a) disparate student performance has led to an achievement gap between science and the other core subjects, and (b) students consistently underachieved in science. This pattern led to the emergence of an achievement gap and science underachievement theory (AGSU). Disparate student performance is considered one of the significant reasons for the low graduation rate. The Department of Education (GDOE, 2008a) statistics indicated that a relatively higher percentage of students fail the science content section of the graduation test compared with the other three core subjects. Sikes (2008) advocated the importance of adopting teacher perceptions to derive data-driven decisions for the enhancement of student achievement. This study sought to answer the research question: What are teacher perceptions of reasons for students' underachievement in science compared with other core subjects of the GHSGT? This chapter presents an overview of the study's purpose, descriptive analyses of the gathered data, major findings and the results, as well as a summary.

Research Tool and Research Question

A self-designed questionnaire was administered to gather teacher perceptions on reasons for an achievement gap between science and the other core subjects of the GHSGT. The questionnaire consisted of closed-ended questions with predetermined options to obtain teacher appraisal on the concern related to the science underachievement. Bloom's taxonomy (1956) model was used to develop the AGSUQ. Teacher perceptions were measured based on two parameters: subject taught by the teachers and years of experience.

Population and Demographics

The research population consisted of about 280 public high school teachers teaching English, math, science, and social studies courses to 11^{th}-grade first-time test takers from a school district located in southern suburban Georgia. Data collection took place at four different high schools of a single school district. The targeted sample had only one inclusion criterion—teachers teaching the core subjects for 9^{th} to 11^{th}- grade students─ including special education and collaborative teachers teaching these subjects.

Data Collection

The collected data was disaggregated by coding the responses obtained from participant teachers. I entered the coded quantitative data on an Excel spreadsheet and transferred the data to the statistical program, Statistical Package for the Social Sciences (SPSS 16.0) for Windows. Data segregation included several steps to classify the data based on the subject taught by the teacher and number of years of experience.

Survey Findings

Teacher Characteristics

The AGSUQ, using a 5-point Likert scale, explored teacher perception on reasons for the disparate student performance between science and other core subjects of the graduation test. A total of 121 teachers participated in the study during the 2009-2010 school year. Of the 220 surveys distributed, 121 were returned, resulting in a response return rate of 55%. The useable survey response rate was 95%, as 6 of the 121 survey responses were incomplete and were treated as incomplete and invalid. Data were analyzed for a sample of 115 (*n* = 115) useable responses.

Table 4 illustrates the response rate achieved from each of the core subject areas for the total received responses (*n* = 121) and valid responses (n= 115), respectively.

Table 4

Number of Completed Responses From Each of the Core Subjects

Subject taught	Returned responses	%	Valid returned responses	%
English	39	33.0%	37	22.0%
Math	26	21.5%	25	17.0%
Science	27	22.5%	26	24.0%
Social studies	29	23.0%	27	23.0%
Total	121	100.0%	115	85.0%

The participated teacher demographics revealed that out of 115 core subject teachers, including special education and collaborative teachers, 22% were English teachers, 17.0% math teachers, 24% science teachers, and 23% social studies teachers.

The covariate, number of years taught, was categorized into: (a) novice teachers with 0-10 years experience and (b) experienced teachers with 11 years or more of experience to analyze the data. Table 5 shows the participation percentage of these two groups of teachers in the study. Novice teachers accounted for 40% of the participated sample and experienced teachers accounted for a larger portion of the sample, with 60% participation.

Table 5

Teaching Experience

Years of experience	*N*	Cumulative %	*n*	Valid responses %
0-10 years	48	39.7%	47	41%
11 years or more	73	60.3%	68	59%
Total	121	100.00%	115	100.00%

Note. All participants including special education and collaborate teachers irrespective of the subject they teach are considered as one sample group to determine the years of experience.

Pilot Study

The pilot study was conducted during March 2010, after the completion of the IRB protocol. Six experts from all the four core subjects were consulted about the content, relevance, and focus of the questions on the AGSUQ. The feedback data confirmed the reliability and validity of the tool and met all the expected methodology procedures as well. Randomly selected 20 teachers, five from each of the four core subjects participated in the pilot study. The determined Cronbach's alpha by statistical analysis, 0.8844 confirmed the reliability value of the used tool (see Appendix D), which is an acceptable numerical $\alpha-$value above the critical value 0.7 (Fink, 2007; Gravetter & Wallnau, 2005). Hence, it was concluded that the research tool is a reliable measure to assess teacher perceptions.

Data Analysis

Descriptive statistics are more suitable to obtain the comparative outcomes between the four sets of data gathered in this study (Gravetter & Wallnau, 2005). The descriptive statistics included the determination of mean and standard deviation for each of the categories of subject taught. Analysis of Variance (ANOVA) determined the variance between the responses of each of the categories and *t* test determined the correlation between the responses of teachers having 0-10 years of experience and teachers having 11 and more years of experience. The bias in the ANOVA and *t* test due to unequal group size was addressed by taking the inequality of variances into account. The research question was addressed after discussing the responses to the three domains (students' proficiency, reasons for the achievement gap, and policy factors) of the AGSUQ tool.

Domain 1: *Teacher Perceptions on Students' Proficiency Level*

The data to measure students' proficiency based on teacher perceptions were derived from 13 statements of the first domain of the questionnaire. Student proficiency was measured in terms of (a) learning ability in reading, writing, comprehension, application, math skill, and lab skill; (b) learning characteristics such as interest in the subject, learning and retaining the content with ease, and ability to do well on the graduation test; and (c) attitude characteristics included curiosity, questioning, objectivity, and critical thinking.

The average percentage proficiency is a scale variable adopted to analyze a parametric test having a symmetrical data distribution. A non-parametric test is recommended for the skewed distribution of the data (Gravetter & Wallnau, 2005). Since the dataset in the current study was negatively skewed, square root transformation was adopted (see Table 6) as a corrective measure prior to the analyses of the data.

Table 6

Descriptive Statistics for Average Proficiency Percentage

Statistics	Original dataset	Square root transformed dataset
Mean	82.41	0.41
Median	88.57	0.39
Skewness	-1.07	0.00
Kurtosis	-0.21	-0.35

The transformed dataset statistics in Table 6 suggested the normally distributed dataset where the mean and median are very close and the kurtosis and skewed values are under limit (-3 to 3 & -1 to 1), respectively.

Table 7 summarizes the means and standard deviation of students' proficiency rating perceptions for each of the core subjects separately.

Table 7

Teacher Perception on Student Proficiency

Subjects taught	*N*	*M*	*SD*
English	37	92.36	6.82
Math	25	87.36	6.73
Social studies	26	90.86	4.46
Science	27	55.60	8.04

A comparison between the core subject teachers' perceptions (n = 115) on students' proficiency showed a remarkable difference. English teachers indicated an excellent proficiency level in English content of the graduation test (M = 92.36) whereas science teachers indicated a poor proficiency level in their subject (M = 55.60). Social studies (M = 90.86) and math teachers (M = 87.36) gave an intermediate rating to their students' proficiency level. Further, the ANOVA test results ($p < 0.05$) reinforced the statistically significant differences in teachers' perceptions on students' proficiency level.

The data were further disaggregated to carry out the posthoc analysis of teacher perception on student proficiency. Table 8 shows the result of posthoc analysis with significance values.

Table 8

Posthoc Test Comparison of Teacher Perception on Student Proficiency

Subjects(I)	Subject taught (J)	Mean difference (I-J)	Significance
English	Math	-0.12	0.000
	Social studies	-0.07	0.021
	Science	-0.43	0.000
Math	English	0.12	0.000
	Social studies	0.05	0.222
	Science	-0.31	0.000
Social Studies	English	0.07	0.021
	Math	-0.05	0.222
	Science	-0.36	0.000
Science	English	0.43	0.000
	Math	0.31	0.000
	Social studies	0.36	0.000

The results demonstrated that the teacher perceptions on students' proficiency differed significantly from each other. The results of posthoc test indicated that the perception of English teachers on the proficiency of their students was significantly higher than the perception of other three core subject teachers, $p < 0.05$. In contrast, the perception of science teachers on the proficiency of their student was significantly lower than the perception of other three core subject teachers, $p < 0.05$. The posthoc test results also indicated that the perception of math and social studies teachers did not differ significantly and the observed difference was only due to chance, $p > 0.05$.

Table 9 highlights teacher perceptions on student proficiency based on years of experience. An alpha level of 0.05 was applied to *t* test to verify the correlation between the two independent samples (Gravetter & Wallnau).

Table 9

Teacher Perceptions on Student Proficiency Based on Years of Experience

Teaching experience*	*N*	*M*	*SD*
0-10 years	47	84.02	15.81
11 or more years	68	80.59	16.72

Note. *Teaching experience is a covariate in this study. Zero-10 years of experienced teachers are novice teachers and 11 or more years of experience are experienced teachers.

Teachers having different years of work experience ($n = 115$) perceived their students' proficiency level with different measures. The descriptive statistics indicated that the teachers with 0-10 years of work experience (novice teachers) rated the proficiency level of students slightly higher ($M = 84.02$) than teachers having 11 or more years of work experience (*M* = 80.59). However, the *t* test results obtained from the transformed dataset suggested that this observed difference in perception of experienced teachers and novice teachers on student proficiency was only due to chance and had no statistical significance, $t\ (113) = -1.204$, $p > 0.05$.

Domain 2: Reasons for Achievement Gap Between the Core Subjects

Table 10 summarizes teacher perceptions on expected level of learning ability in all the core subjects of the graduation test.

Table 10

Perceptions on Required Student Ability Skills to be Successful on the Graduation Test

Ability required to be successful	Subject taught	% of teachers strongly agree
Reading	English	100.0%
	Math	100.0%
	Science	100.0%
	Social studies	100.0%
Writing	English	100.0%
	Math	100.0%
	Science	100.0%
	Social studies	100.0%

(table continues)

Comprehension	English	100.0%
	Math	100.0%
	Science	100.0%
	Social studies	100.0%
Application	English	100.0%
	Math	100.0%
	Science	100.0%
	Social studies	100.0%
Math skill	English	100.0%
	Math	100.0%
	Science	100.0%
	Social studies	100.0%
Lab skill	English	100.0%
	Math	100.0%
	Science	100.0%
	Social studies	100.0%

All participant teachers expected that students should have ability skills (reading, writing, comprehension, application, math, and lab skill) to be successful in the graduation test. There was a total concurrence in their perceptions. The comparative analyses between teacher perceptions on expected learning ability (see Table 10) and the actual learning ability (see Table 7) is an indicator of an achievement gap between the core subjects. Interpretations of these findings are discussed in Section 5.

Table 11

Perceptions Based on Teacher Experience: *Required Student Ability Skills to be Successful on the Graduation Test*

Teacher perception on students' ability skills	Teaching experience	% of teachers strongly agree*
Reading	0-10 years	100.0%
	11 or more	100.0%
Writing	0-10 years	100.0%
	11 or more	100.0%
Comprehension	0-10 years	100.0%
	11 or more	100.0%
Application	0-10 years	100.0%
	11 or more	100.0%
Math skill	0-10 years	100.0%
	11 or more	100.0%
Lab skill	0-10 years	100.0%
	11 or more	100.0%

Note. *Percentages of teachers who disagree, strongly disagree, neutral, and agree are not listed as they have zero numeric values.

Table 11 reflected a unanimous agreement (1005) on teacher perceptions based on their years of experience. All participated teachers perceived that reading, writing, comprehension, application, math skills and lab skills are very important for a student to be successful in all the core subjects of the graduation test. The reported result was independent of the subject taught by teachers and their years of experience.

Table 12 shows teacher perception on reasons for an achievement gap between science and other three core subjects of the GHSGT. Science teachers perceived that lack of equal emphasis (97.67%), lack of continuity in curriculum (97.67%), and lack of cumulative knowledge (96.40%) were the reasons for students' science underachievement. Statistically, all the participant teachers (n = 115) held a common perception that lack of equal emphasis, lack of continuity in curriculum, and lack of cumulative knowledge in the content area were reasons for an achievement gap between the core subjects of the graduation test. However, the Pearson's chi-square test indicated that science teachers held significantly a stronger perception than the perception of other core subject teachers, $\chi 2\,(3, n = 115) = 16.197, p < 0.05$. Again, the Pearson's chi-square test indicated that science teachers' perception of lack of continuity in the curriculum was significantly stronger than the other three core subject teachers, $\chi 2\,(3, n = 115) = 37.805$, $p < 0.05$. Finally, all the participant teachers perceived that lack of cumulative knowledge was an additional reason for an achievement gap in student performance between the core subjects. Pearson's chi-square test indicated a significantly stronger science teachers perception compared with other core subject teachers, $\chi 2\,(3, \mathrm{n} = 115) = 24.794, \mathrm{p} < 0.05$. Thus, science teachers strongly perceived that lack of equal emphasis, lack of continuity in curriculum, and lack of cumulative knowledge were the main reasons for an achievement gap between science and the other three core subjects of the GHSGT.

Table 12

Teacher Perception of Reasons for an Achievement Gap: *Science vs. English, Math, and Social Studies*

Reasons for achievement gap	Subject taught	% of teachers disagree	% of teachers agree	% of strongly agree	$\chi2$*
Lack of equal emphasis on all the four core subjects	English	0.00%	25.00%	75.00%	0.001
	Math	0.00%	16.67%	83.33%	
	Science	0.00%	2.33%	97.67%	
	Social studies	0.00%	36.59%	63.41%	
Lack of continuity in curriculum	English	5.00%	32.50%	62.50%	<0.001
	Math	0.00%	63.33%	36.67%	
	Science	0.00%	2.33%	97.67%	
	Social Studies	2.44%	46.34%	51.22%	

(table continues)

Lack of cumulative knowledge	English	0.00%	40.00%	60.00%	<0.001
	Math	0.00%	43.33%	56.67%	
	Science	0.00%	3.60%	96.40%	
	Social studies	0.00%	39.02%	60.98%	

χ^{2*} = Pearson's' chi-square significance

Table 13 shows teacher perceptions on the reasons for an achievement gap between science and other core subjects, based on teachers' years of experience. Both, novice and experienced teachers equally perceived that lack of equal emphasis on all the four core subjects, $\chi2$ (1, n = 115) = 0.755, $p > 0.05$; lack of continuity in curriculum, $\chi2$ (1, n = 115) = 1.670, $p > 0.05$, and lack of cumulative knowledge were the reasons for an achievement gap between science and other subjects. However, the experienced teachers perceived this reason more strongly compared with the perceptions of novice teachers, $\chi2$ (1, n = 115) = 6.456, $p < 0.05$.

Table 13

Teacher Perceptions on Reasons for Achievement Gap based on Teaching Experience

Reason for achievement gap due to lack of:	Teaching experience	% of teachers disagree	% of teachers agree	% of strongly agree	χ^2
Equal emphasis on all core subjects	0-10 years	0.00%	22.22%	77.78%	
	11 or more	0.00%	16.36%	83.64%	0.385
Continuity in curriculum	0-10 years	2.08%	37.50%	60.42%	0.434
	11 or more	1.72%	27.59%	70.69%	
Cumulative knowledge	0-10 years	0.00%	36.46%	63.54%	0.011
	11 or more	0.00%	17.24%	82.76%	

Note. Strongly disagree and neutral ratings have zero value and are not listed in the table.

Reasons for an Achievement Gap: Non-AYP vs. AYP Subjects

The cross-tabulation results in Table 14 summarize teacher perception on reasons for students to perform better in AYP subjects (English and math) compared with a non-AYP subject, science.

Table 14

Teachers' comparative perception on reasons for the achievement gap between non-AYP and AYP subjects

Reasons for achievement gap	Subject taught	% of teachers agree	% of teachers strongly agree	χ2
More emphasis	English	12.82%	87.18%	0.36
on math and	Math	10.00%	90.00%	
English	Science	2.33%	97.67%	
	Social studies	9.76%	90.24%	
English and	English	0.00%	100.0%	0.054
Math are AYP	Math	13.33%	86.67%	
indicator	Science	1.33%	98.67%	
Subjects	Social studies	9.76%	90.24%	
AYP nature	English	7.69%	92.31%	0.076
drives greater	Math	5.80%	94.20%	
performance	Science	2.75%	97.25%	
	Social studies	9.76%	90.24%	

Note. Percentage of teachers who disagree, strongly agree and neutral responses have zero values are not included in the Table.

All participant teachers *(n* = 115) perceived that more emphasis on math and English was one of the influencing reasons for students to perform better in these subjects compared with science. The Pearson's chi-square test confirmed that this assertion, χ2 (3, *n* = 115) = 3.215, $p > 0.05$. Another attributed reason for student disparate performance was that English and math are AYP indicator subjects. The Pearson's chi-square test reinforced this assertion, $\chi 2$ (3, *n* = 115) = 7.648, $p > 0.05$. Finally, all teachers agreed that the AYP status of English and math drove better performance compared with the non-AYP status of science. The Pearson's chi-square test indicated that all of the teachers equally perceived that the AYP status of a subject is also a contributing for the better performance in English and math compared with science, $\chi 2$ (3, *n* = 115) = 6.889, $p > 0.05$. However, science teachers strongly agreed with all the three statements: more emphasis on math and English (97.67%), English and math are AYP indicator subjects (98.67%), and AYP status drives greater performance (97.25%).

Table 15 details teacher perceptions based on their years of experience for students to perform better in English and math than in science.

Table 15

AYP vs. Non-AYP Subjects: Teachers' Perceptions based on Teaching Experience

Reasons for achievement gap	Teaching Experience	% of teachers agree	% of teachers strongly agree	χ^2
More emphasis on	0-10 years	10.53%	89.47%	0.249
English and math	11 and more	5.17%	94.83%	
English and math are	0-10 years	9.38%	90.63%	0.016
AYP indicators	11 and more	4.88%	95.12%	
AYP nature drives	0-10 years	5.26%	94.74%	0.602
greater performance	11 and more	3.45%	96.55%	

Note. Disagree, strongly disagree and neutral values (zero values) are not shown in the table.

χ^2 = Pearson's chi-square significance

The two groups of participant teachers equally perceived that student performance was better in English and math because of more emphasis being placed on English and math, $\chi2$ (1, n = 115) = 1.328, $p > 0.05$. Further, the chi- square test also indicated that senior teachers perceived more strongly that better performance in English and math was because they are AYP indicators, $\chi2$ (1, n = 115) = 5.775, $p < 0.05$. However, the chi-square test indicated that both the groups perceived equally that the better performance in English and math was because of their AYP status, $\chi 2$ (1, n = 115) = 0.272, $p > 0.05$.

Reasons for an Achievement Gap between Non-AYP Subjects

The teacher perception data was disaggregated to compare teacher perceptions on student performance between science and social studies (see Table 16).

Table 16

Teachers' Comparative Perception on Reasons for an Achievement Gap Between the Two Non-AYP Subjects

Science compared with social studies is:	Subject taught	% of teachers agree	% of teachers 2 strongly agree	χ
Relatively difficult to comprehend and remember	English	5.00%	95.00%	0.015
	Math	13.33%	86.67%	
	Science	2.33%	97.67%	
	Social studies	21.95%	78.05%	
Contains abstract concepts	English	5.00%	95.00%	0.077
	Math	0.00%	100.00%	
	Science	0.00%	100.00%	
	Social studies	9.76%	90.24%	

(*table continues*)

Is math based course	English	7.66%	92.34%	0.065
	Math	5.83%	94.17%	
	Science	3.21%	96.79%	
	Social studies	4.38%	95.62%	
Contains unfamiliar vocabulary	English	2.50%	97.50%	0.054
	Math	0.00%	100.00%	
	Science	0.00%	100.00%	
	Social studies	2.44%	97.56%	
Demands higher order thinking skills	English	12.50%	87.50%	0.034
	Math	16.67%	83.33%	
	Science	0.00%	100.00%	
	Social studies	4.88%	95.12%	

Comparing perception results (See Table 16) between two non-AYP subjects indicated that student performance in social studies is relatively better than in science. The collective responses from teachers (*n* = 115) showed that students perform better in social studies because science is a relatively difficult subject to comprehend and remember. The Pearson's chi-square test suggested that science and English core subject teachers strongly perceived this reason compared with other two core subject teachers, χ2

(3, $n = 115$) = 10.417, $p < 0.05$. Another reason perceived by teachers is that science content contains abstract concepts. The Pearson's chi-square test suggested that all the core subject teachers equally perceived this as the reason for the disparate performance between these two subjects, $\chi 2$ (3, $n = 115$) = 6.850, $p > 0.05$. Further, all teachers equally perceived that science is a math-based subject; as a result there was a significant difference in student performance between these two subjects, $\chi 2$ (3, $n = 115$) = 2.021, $p > 0.05$. Science content containing unfamiliar vocabulary was another reason perceived by the teachers for the disparate performance; the Pearson's chi-square result was $\chi 2$ (3, $n = 115$) = 2.125, $p > 0.05$. All the core subject teachers also perceived that science demands higher order thinking skills compared with social studies, with a Pearson's chi-square test value, $\chi 2$ (3) = 6.641, $p < 0.05$.

The years of teaching experience was used as a covariate to compare student performance between the two non-AYP subjects from teachers' view point (see Table 17).

Table 17

Teacher Perceptions Based on Teaching Experience: *Science vs. Social Studies*

Reason for achievement gap	Teaching experience	% of teachers agree	% of teachers strongly agree	χ2
Relatively difficult to comprehend and remember	0-10 years	12.50%	87.50%	0.269
	11 and more	6.90%	93.10%	
Contain abstract concepts	0-10 years	6.25%	93.75%	0.052
	11 and more	0.00%	100.0%	
Is a math based course	0-10 years	1.20%	98.80%	0.735
	11 and more	2.05%	97.95%	
Contain unfamiliar vocabulary	0-10 years	0.97%	99.03%	0.724
	11 and more	1.59%	98.41%	
Demands higher order thinking skills	0-10 years	0.09%	90.91%	0.42
	11 and more	5.45%	94.55%	

Teacher perceptions based on their experience revealed that novice and experienced teachers equally perceived that science is a difficult subject because: (a) science is a relatively difficult subject to comprehend and remember when compared to social studies, $\chi 2\,(1, n = 115) = 1.219, p > 0.05$; (b) science content contains abstract concepts, $\chi2$ (1, n = 115) = 3.772, $p > 0.05$; (c) science is a math-based course, $\chi2$ (1, n = 115) = 1.019, $p > 0.05$; (d) science content has unfamiliar vocabulary, $\chi2$ (1, n = 115) = 0.125, $p > 0.05$, and (e) science as a subject demands higher order thinking skills, $\chi2$ (1, n = 115) = 0.651, $p > 0.05$, respectively.

Domain 3: *Teacher Perceptions on AYP and EOCT Policy Factors*

The cross-tabulation in Table 18 shows teachers' perceptions on policy factors, which may be helpful in closing the achievement gap between science and the three core subjects of the GHSGT.

Table 18

Teacher Perceptions on AYP and EOCT Policy Factors to Optimize Students' Science Performance

Recommendations	Subjects	% of teachers strongly disagree	% of teachers disagree	% of teachers Neutral	% of teachers agree	% of teachers strongly agree	$\chi 2$
By making Science an AYP Indicator	English	0.00%	5.00%	0.00%	12.50%	82.50%	0.279
	Math	0.00%	0.00%	0.00%	6.67%	93.33%	
	Science	0.00%	0.00%	0.00%	2.33%	97.67%	
	Social studies	0.00%	2.44%	0.00%	4.88%	92.68%	
By making all core subjects AYP indicators	English	5.00%	7.50%	0.00%	40.00%	47.50%	0.003
	Math	0.00%	30.00%	0.00%	43.33%	26.67%	
	Science	0.00%	29.55%	0.00%	25.00%	45.45%	
	Social studies	14.63%	29.27%	0.00%	34.15%	21.95%	
Replacing graduation test with end-of-course-test	English	10.26%	5.13%	15.38%	10.26%	58.97%	
	Math	3.33%	16.67%	3.33%	10.00%	66.67%	<0.001
	Science	0.00%	4.76%	0.00%	0.00%	95.24%	
	Social studies	24.39%	31.71%	0.00%	9.76%	34.15%	

Table 18 reflected that all four core subject teachers (n = 115) equally perceived that by making science an AYP indicator subject, the achievement gap between science and the other three core subjects of the GHSGT can be closed, $\chi 2\,(6, n = 115) = 7.474$, $p > 0.05$. However, perceptions of teachers differed significantly for making all subjects to be AYP indicators of the GHSGT. The Pearson's chi-square test indicated that the English teachers had the strongest perception and social studies teachers had weakest perception that this measure will help close the achievement gap between science and other subjects of GHSGT, $\chi 2\,(9, n = 115) = 25.291$, $p < 0.05$. Further, the science teachers held a significantly strong perception compared with other core subject teachers on replacing the graduation test with an end-of-course-test (EOCT) to help close the achievement gap between science and other three subjects of the GHSGT, $\chi 2\,(12, n = 115) = 63.522$, $p < 0.05$.

The cross-tabulation of teacher perceptions on the policy factors to close the achievement gap between science and the other three core subjects based on years of teaching experience is summarized in Table 19.

Table 19

Teacher Perceptions on AYP and EOCT Policy Factors to Optimize the Science Performance Based on Teaching Experience

	Teaching experience	% of teachers strongly disagree	% of teachers disagree	% of teachers neutral	% of teachers agree	% of teachers strongly agree	χ2
By making science an AYP indicator	0-10 years	0.00%	2.08%	0.00%	6.25%	91.67%	0.977
	11 or more	0.00%	1.72%	0.00%	6.90%	91.38%	
By making all core subjects AYP indicators	0-10 years	2.06%	25.77%	0.00%	41.24%	30.93%	0.017
	11 or more	10.34%	20.69%	0.00%	24.14%	44.83%	
Replacing graduation test with EOCT	0-10 years	6.90%	13.79%	1.72%	3.45%	74.14%	0.200
	11 or more	11.70%	14.89%	6.38%	9.57%	57.45%	

The outcome of the analyses indicated that there was no difference between novice and experienced teachers' perceptions on making science an AYP indicator, despite of variation in years of teaching experience. Both groups strongly agreed that science should be an AYP indicator to improve student science performance. The perception on replacing the GHSGT graduation test with the EOCT reflected a mixed response. About 27% of experienced teachers disagreed with this idea, indicating that it may not help to improve science scores on GHSGT. However, there was relatively a significant difference in teachers' perceptions on making all core subjects AYP indicators. Among experienced teachers, about 30% of the teachers disagreed with this proposal.

Conclusions

The research question was addressed based on the cumulative responses of all of the three domains of the AGSUQ tool. Both the descriptive and inferential statistics were obtained by measuring teacher perceptions under three domains: (a) proficiency level of students, (b) reasons for achievement gap between science and other core subjects of GHSGT, and (c) policy factors to optimize science performance.

Teacher Perceptions on Student Proficiency

The comparative teacher perception data on student proficiency indicated students' highest proficiency rating in English subject compared with other three subjects of the GHSGT ($p < 0.05$). In contrast, the proficiency rating of the students by the science teachers was significantly lower compared with students' proficiency rating by the other three core subject teachers ($p < 0.05$). However, the proficiency rating between math and social studies teachers did not differ significantly from one another ($p > 0.05$). The statistics also indicated that the teachers with 0-10 years of work experience (novice teachers) rated the proficiency level of students slightly higher ($M = 84.02$) than teachers having 11 or more years of work experience [experienced teachers] ($M = 80.59$) in this study.

Teacher Perceptions on Reasons for an Achievement Gap Between Science and Other Three Core Subjects of the Graduation Test

All the participant teachers (n = 115), irrespective of the subject they teach, unanimously perceived that reading, writing, comprehension, application, math skills, and lab skills are very important for a student to be successful on the graduation test.

Further, the teachers perceived that the important reasons for an achievement gap in the GHSGT were lack of equal emphasis on all the four core subjects [$\chi2\,(1, n = 115) = 0.755$, $p > 0.05$] and lack of continuity in curriculum [$\chi2\,(1, n = 115) = 1.670$, $p > 0.05$]. The majority of science teachers (96%) also perceived that lack of cumulative knowledge led to an achievement gap in performance between science and other three core subjects of the GHSGT.

Teachers' comparative perception data between non-AYP subjects (science) and AYP subjects (English and math) reflected the reasons for better student performance in English and math compared with science is because: (a) there is more emphasis on English and math, [$\chi2\,(3, n = 115) = 3.215$, $p > 0.05$], (b) English and math are AYP indicator subjects [$\chi2\,(3, n = 115) = 7.648$, $p > 0.05$] and, (c) the AYP nature drives better performance, [$\chi2\,(3, n = 115) = 6.889$, $p > 0.05$].

Further, teachers' comparative perception data between two non-AYP subjects (science and social studies) reflected the reasons for students to perform better in social studies compared with science: (a) science is relatively difficult to comprehend and remember compared to social studies, ($\chi2\,(1, n = 115) = 1.219$, $p > 0.05$), (b) science contains abstract concepts, ($\chi2$ (1, n = 115) = 3.772, $p > 0.05$), (c) science is a math-based course, (d) science contains unfamiliar vocabulary, ($\chi2$ (1, n = 115) = 0.125, $p > 0.05$), and finally (e) science as a subject demands higher order of thinking skills ($\chi2$ (1, n = 115) = 0.651, $p > 0.05$). However, the Pearson's chi-square indicated that science teachers held a strong perception on these reasons as factors for an achievement gap between science and other core subjects of the graduation test.

Both novice and senior teachers expressed that the math-based content of the course (100.0%) is one of the reasons for students to underachieve in science subjects. However, the senior teachers perceived the reasons for the achievement gap more strongly than the novice teachers.

Policy factors

The important policy factors perceived by the teachers to close the achievement gap between science and other three core subjects of the GHSGT are: (a) to make science an AYP indicator subject [$\chi2$ (2, n = 115) = 0.048, $p > 0.05$] and, (b) to replace the graduation test with end-of-course-test [$\chi2$ (4, n = 115) = 6.047, $p > 0.05$]. The perception data also indicated that science teachers held significantly a strong perception compared with other core subject teachers' perception on replacement of the graduation test with the EOCT, [$\chi2$ (12, n = 115) = 63.522, $p < 0.05$]. Novice and experienced teachers' perceptions did not indicate any significant difference on policy factors. Chapter 5 will discuss and interpret these findings.

SECTION 5:

CONCLUSIONS AND RECOMMENDATIONS

Overview

This study was initiated as a result of this researchers' concern about the low graduation rate on the Georgia High School Graduation Test (GHSGT). One of the reasons for the low graduation rate is the maximum percentage of students failing in science content of the GHSGT. Students are required to pass all the core subjects (English, math, social studies, and science) of the GHSGT to be eligible to graduate. The maximum percentage of students failing in any single content area of the graduation test will negatively affect the overall graduation rate. This study was undertaken to determine teacher perceptions on reasons for student underachievement in science and reasons for an achievement gap in student performance between science and other core subjects of the GHSGT.

The available scholarly literatures have addressed the low graduation rate concern and achievement gaps from different perspectives. Section 2 of this study detailed achievement gaps in terms of race, gender, and socioeconomic status on the graduation test. However, to fill the deficiency in scholarly literature, this study focused on identifying reasons for an achievement gap in students' performance between science and other three core subjects of the graduation test. The disparity in student performance between science and the other core subjects on the graduation test has added a new dimension to the graduation rate concern in the light of data-driven accountability of the educational system.

Purpose of Study

The current study addressed the research question: What are teacher perceptions on reasons for students' underachievement in science compared with other core subjects of the Georgia High School Graduation Test? This descriptive research question was answered from the perspectives of teachers teaching these core subjects. The study focused on three major domains: (a) student proficiency level, (b) reasons for student science underachievement including reasons for student disparate performance between science and other three core subjects of the test, (c) and policy factors that may help to improve science achievement.

The current research study was executed in two phases. Initially, a longitudinal study was conducted to gather an empirical data on the graduation pass percentage of 11th grade first-time test takers in each of the core subjects. In the second phase, a science underachievement theory was developed based on the reviewed literature. Adopting Bloom's (1956) taxonomy as a model, a statistical tool, AGSUQ was constructed to measure teacher perceptions on student cognitive levels. A reliable and valid statistical tool was required to provide schools with valuable feedback on student achievement (Corbell, Reiman & Nietfeld, 2008). The AGSUQ statistical tool was developed with the assumption that teacher judgment can adequately ascertain student achievement (Fuller, 2000; Guskey, 1996; Marzano, 1999; & Stiggins, 2001). Hence, teacher perceptions were used in this study to identify reasons for the science underachievement.

Interpretation of Findings

The first domain of the AGSUQ tool explored teacher perceptions on students' proficiency level in the core subjects tested on the Georgia High School Graduation Test (GHSGT). The data findings from the 13 constructs under proficiency domain of the questionnaire demonstrated that: (a) student reading, writing, comprehension, application skills in English, math, and social studies subjects were relatively better than students' learning ability in science; (b) the learning characteristics such as interest in the subject, ability to learn and retain the content with ease, and ability to perform well in the graduation test responses were confirmed from teachers teaching English, math, and social studies, but not by science teachers; and (c) the evidence of attitude characteristics such as curiosity, questioning ability, objectivity, and critical thinking characteristics were endorsed again by English, math, and social studies teachers but not by science teachers. English teachers gave highest proficiency rating (*M* = 92.36), science teachers gave lowest proficiency rating (*M* = 55.60) where as math (*M* = 87.36) and social studies (*M* = 90.86) teachers rated the proficiency level to be in the intermediate range. According to teacher perception data, the attainment of student proficiency was not same in all the core subjects of the GHSGT.

Ruddell (2001) in his study argued that students must be proficient in the language of the subject to think deeply in that area and read and write fluently in the language of the subject area. Snyder, Dillow, and Hoffman (2008) identified disparate student performance between the academic subjects in one of their research reports. The disparity in student proficiency could be correlated with student GHSGT pass percentage statistics across the subjects (GDOE, 2007). Teacher perception data on students' below average proficiency in science supported students' science pass percentage statistics on GHSGT.

Teacher perception data analyses and findings to address the reasons for student science underachievment suggested that students are not applying the learned skills and abilities from other content areas to science content. English, math and social studies teachers perceived that the same groups of students have adequate proficiency in terms of learning abilities (reading, writing, comprehension and application), learning characteristics (interest in the subject, retaining the learned content, doing well on the graduation test) and attitude characteristics (curiosity, questioning, objectivity, and critical thinking) in their respective subjects. Science content incorporates all the learning skills and characteristics found in English, math, and social studies contents. Students are unable to effectively transfer their learned information across the different content areas. Additionally, the required cumulative science learning aspect incorporates all the cognitive characteristics found in the upper levels of Bloom's taxonomy. Hence, science learning demands higher cognitive skills from students. This also explains the reason for students to have below average proficiency the science content.

To address this concern, an interdisciplinary approach needs to be adopted. The mastered proficiency in other subject disciplines will help to improve students' science proficiency as students see science as a discipline having connections with other subjects (Bardeen, 2000). It was asserted that academic achievement and proficiency can be enhanced by making students apply the information learned in other content areas to a science class (Dollinger, Matyja, & Huber, 2007). Promoting varied learning approaches to connect the subjects will help ease the transition of learned skills from one content area to another (Premuzic & Furnham, 2008). The transition of reading and comprehension skills from English content and problem solving skills from math content to science will help to enhance student science achievement.

Shwartz, Weizman, Fortus, Krajcik, and Reiser (2008) argued for coherent curricula to help students develop multidisciplinary connections and dependencies, connecting science literacy with general literacy to improve student science performance. Cromley's (2009) study mapped the international data set from the Program on International Student Assessment (PISA) to determine the correlation between scientific literacy and reading literacy and confirmed that general literacy skills will help to drive higher science achievement. Wei (2009) recommended a model of integration of curricular subjects beyond science, for enhancing student science achievement. Science curricula were integrated with nonscience curricula to improve student science achievement in Canada, because of having a low science literacy rate despite rated good on the international tests (Kennepohl, 2009). To strengthen science and literacy skills, Howes, Lim, and Campos (2009) suggested using science as a vehicle to develop literacy skills.

The attitudes and interests cultivated from early childhood helps to develop lifelong science literacy. Research studies advocated the use of trade books for improving reading habits and to develop science literacy; Science concepts introduced at an early age was expected to help for the academic achievement at a later stage (Atkinson, Matusevich, & Huber, 2009; Schroeder, Mckeough, Graham, Stock, & Bisanz, 2009; Zales & Unger, 2008). To emphasize the science-literacy connection for the enhancement of student achievement, researchers recommended adopting an interdisciplinary approach of using literature as a component of the science curriculum (Barclay, Benelli, & Schoon, 1999; Bybee, 2002; Buxton, 2001). It was advocated to align interdisciplinary course assignments with critical thinking skills to challenge a “wide range of cognitive skills and intellectual dispositions” (Bassham, Irwin, Nardone, & Wallace, 2005, p. 1). To address this concern application of information technology as a tool was recommended by Ching (2009), to integrate the academic subjects in a thematic and interdisciplinary manner. Bae (2009) authenticated in his study the importance of interdisciplinary education because it is not merely science, but the society is also in need of interdisciplinary education. Dyehouse et al.’s (2009) study confirmed the value of interdisciplinary projects by modeling the participant groups to examine the influence and dependencies between the subject components to affirm its benefits. At a different level, Martens-Baker (2009) envisioned a cross-school interdisciplinary project to improve teachers’ skills for insisting upon the interdependency of skills. Adoptions of these recommendations are needed to enhance higher levels of thinking found in Bloom’s (1956) taxonomy.

The second domain of the AGSUQ tool addressed teacher perceptions on reasons for science underachievment, including reasons for the disparate performance between science and other core subjects tested on the GHSGT. Irrespective of the subjects being taught, all the participated teachers were unanimous (100%) in their opinion that reading, writing, comprehension, application, math skills, and lab skills are very important for a student to be successful on the graduation test. The existing gap between science teachers expectations on students' proficiency level (see table 10) and the students' actual contained proficiency level (see Table 7) based on teacher perceptions supported the student science underachievement theory.

The teacher perception data was further disaggregated to understand the reasons for student science underachievement. The results indicated 98% of the participated science teachers supported that lack of equal emphasis on all subjects and lack of continuity in curriculum are the reasons for student science underachievement compared with the divided opinion of other three core subject teachers' perceptions. Similarly, 96% of science teachers suggested that lack of cumulative knowledge in the science content is another reason for students to underachieve in science. This is in comparison with 58% of other core subject teachers' perceptions. Evidently, the perception of science teachers were relatively stronger compared with perceptions of other core subjects teachers.

There is an empirically-demonstrated correlation between the allocation of time and student learning; the allotment of time makes a substantial difference in the learning outcome. "The more time allotted to one content area, the higher will be the academic achievement" (Fisher et al., 1980, p.16). More academic achievement is seen in subjects where more emphasis is placed by allotting more time. The pass percentage statistics by GDOE (2007) supported this fact that students are performing better in English and math compared with science.

It is important to understand the way the science curriculum is structured to analyze the teachers' perceptions on lack of continuity as one of the reasons for science underachievement. The science course curriculum from freshman year (9^{th} grade) to the junior year (11^{th} grade) of high school is not cumulative. The contents of the courses are not built upon the information learned in the previous years. Each year, different science courses are taught in a fragmented manner, indicating a lack of continuity in the course curriculum. Students complete biology in their freshman year, physical science in the 10^{th} grade, and can choose between environmental science, anatomy, astronomy, chemistry, physics, or any of the science advanced placement (AP) courses in their junior year. Students taking the GHSGT in the 11^{th} grade for the first time find it difficult to remember and recollect all the content information learned in their previous courses. This is because the GHSGT science test descriptors encompass all science courses from 9^{th} to 11^{th} grades to be tested as one integrated science subject. Repeaters extending the anticipated graduation period more than the required 4 years are unable to retain the content from year to year and fail to make connections between different science courses. In the context of accelerating changes, a report stated that the thinking is guided by intellectual standards "--- such as relevance, accuracy, precision, clarity, depth, and breadth" (Foundation of Critical Thinking, 2004, ¶ 22). Without these intellectual standards in science education, excellence cannot be achieved. According to a report on the range of high school science curriculum, students benefit from depth of the curriculum rather than breadth (Tai, Schwartz, Sadler, & Sonnert, 2009). The call for standardized assessment by NCLB (2001) and the implementation of new sets of content standards (Barth, 2006) represent some of the undertaken efforts to improve the graduation rate. The content standards are expected to raise student achievement in the graduation test by specifying “what students should be learning and what teachers should be teaching in schools” (Vohs, Landau, & Romano, 1999, ¶ 2). Hence, lack of continuity and lack of building up cumulative content are some of the reasons for students to underachieve in science, as reflected by teacher responses in the current study.

When the math curriculum pattern is observed, it is found that the fundamentals learned in one math class are continuously used and applied in another math class as students move through different grade levels. Use of the fundamental mathematical operations along with new information throughout the high school math courses leads to a continuous and progressive accumulation of knowledge. Only a small portion of math teachers in the current study supported that lack of continuity can be an issue for an achievement gap.

The analyzed teacher perception data comparing reasons for students to perform better in AYP subjects (English and math) than in a non-AYP (science) subject reflected: (a) a common agreement on teachers’ perception that more emphasis on math and English is one of the influencing reasons for students to perform better in these subjects. (b) a unanimous perception of English teachers (100%) that students perform better in English and math compared with science as these are the only two AYP indicator subjects. (c) the majority of the participated teachers agreed upon the fact students performed better in English and math because of the AYP factor associated with these two subjects. However, science teachers indicated relatively stronger perceptions (97%) compared with other subject teachers' perceptions.

NCLB in its efforts to standardize the educational system mandated English and math to be the AYP-determining courses of the graduation test. AYP, a part of the NCLB Act of 2001 helps measure the progress schools are making. Failure to meet AYP will result in sanctions against the schools (Barth, 2006). This has led to more than 71% of schools devote more time only on English and math subjects by reducing time spent on other subjects, at the expense of AYP indicator subjects (Toppo, 2007). It is important to understand that the increased level of emphasis increases the proficiency in a narrow range (Wilde, 2004). The graduation rate statistics (GDOE, 2007) in individual subjects have reflected that students' proficiency in AYP indicator subjects, English, and math are relatively higher than science, a non-AYP indicator subject.

The reasons for an achievement gap in student performance between science and social studies (both non-AYP subjects) were disaggregated to compare teacher perception under five constructs. Teacher perception data analysis revealed that all the four core subject teachers perceived that students perform better in social studies than in science because science content is relatively difficult to comprehend and remember. The results of Pearson's chi-square test suggested that all the core subject teachers' equally perceived that abstract concepts, math-based content, unfamiliar vocabulary, and demand of higher order thinking skills in science content are the reasons for students to underperform in science compared with social studies subject. These results demonstrated that students find science a difficult subject because of the nature of its content (math based, abstract concepts, unfamiliar vocabulary, and need for higher order skills).

Another prominent barrier in science achievement—that science is a math-based course—was corroborated by all four core subject teachers. All science problems are word problems, which demands skills such as reading, comprehension, and applying vocabulary in context. The ability to solve word problems is strongly related to reading skills, vocabulary, and comprehension ability (Fuchs et al., 2008; Vilenius-Tuohimaa, Aunola, Nurmi, 2008). The features of word problems warrant varied mathematical cognition abilities (Powell et al., 2009) and involve multiple cognitive phases (Lee, Ng, & Ng, 2009). This amounts to more cognitive load because of interacting sources of information found in a word problem (Berends & Van Lieshout, 2009). In Singapore, students were successfully taught to solve word problems applying arithmetic and pre-algebraic strategies (Ng & Lee, 2009). Diagrams were used as a tool to represent key information in the problem (Ng & Lee, 2009). Drawing diagrams was further incorporated as a part of the procedure while solving word problems (Van Garderen, 2007). Linares and Roig (2008) advocated constructing and using mathematical models as conceptual tools to solve word problems. Teachers were also advised to utilize science literacy to strengthen the concept connections between science and math disciplines (Richardson, Matthews, & Thompson, 2008). It is necessary to incorporate the research based strategies in science teaching to resolve the concern on word problems.

The concern of unfamiliar vocabulary as perceived by participated teachers in this study needs to be resolved as well. Brown and Spang (2008) advocated synthesizing science language in everyday classroom with vernacular language, whereas Nienkamp (2008) favored combining humanities and sciences with practical skills. Marzano (2005) developed a six-step process to teach new words to all students to be more conversant with unfamiliar terms. Marzano emphasized on the strategies such as description, usage to interact, use of activities, and games to introduce the new and unfamiliar words, to improve upon the understanding of the content.

The third domain of the AGSUQ tool addressed teacher perceptions on AYP and EOCT policy factors to optimize science pass percentage on the GHSGT. There were three constructs to elicit teacher perceptions on policy factors. All the four core subject teachers equally perceived that by making science an AYP indicator subject the achievement gap between science and other core subjects could be narrowed down. However, teacher perceptions were divided and differed significantly for making all core subjects AYP indicators. Further, the science teachers hold significantly a strong perception (95.24%) compared with other core subject teachers on replacement of graduation test with the EOCT as a means to improve science scores. This also explains the reasons for majority of science teachers to favor replacement of the graduation test with the EOCT, which is a test administered at the end of a specific academic year. The EOCT is expected to resolve the problem of students forgetting the learned information in their previous years.

The data analysis on policy factors indicated that making science an AYP indicator will help in closing the achievement gap between science and the core subjects. Science teachers in this study strongly favored this idea to improve science achievement.

Findings confirmed that educators feel that test-based accountability policies have definitely helped to focus instruction and raise expectations for student learning. This was confirmed by increased student achievement level in English and math (Jackson, 2008).

Exclusion of science in AYP leads to less emphasis on teaching and funding for science. Even though science is tested under NCLB law, is not counted to assess AYP. As a result, science is not getting the emphasis and attention that it should. Accountability policies outlined in NCLB are based exclusively on math and reading test scores have narrowed the emphasis on other curricula (Rothstein, Jacobsen, & Wilder, 2008). The Education Commission of the States (2008), while reauthorizing NCLB, suggested adding science to the AYP indicator list. Including science in AYP would compel the schools to concentrate on student achievement in science (NSTS, 2008). The majority of math, science and social studies teachers in the present study favored the idea of making science an AYP indicator subject. Instead of making all core subjects AYP indicators, it may be more feasible to make science an AYP indicator in addition to English and math. Because the achievement gap in student performance was evident only between science and other core subjects of the GHSGT.

It was distinctly apparent from the results that replacement of the graduation test with the EOCT was supported only by science teachers, but disapproved by and disagreed on other core subject teachers. This can be interpreted in relationship to the science teachers’ responses to lack of continuity statement. Science teachers believed that the EOCT will help students to perform better as they are tested on what they have learned during that academic year. They also believed that the ECOT reduces the vastness of the content, as students will be tested in one science discipline compared to the present procedure in which all the three disciplines (biology, physics, and chemistry) taught in different years are tested together.

There are several initiatives to strengthen EOCT and to make it a comprehensive assessment system (NGA Center for Best Practices Issue Brief, 2008). Studies contended that instead of testing knowledge that students accumulate over several years, students should be assessed on what they learn at the end of each course year (Gewertz, 2007). Lambert (2002) examined the correlation and validity between end-of-course reading grades and state test (Texas Assessment of Academic Skills [TAKS]) and confirmed a moderate positive relationship between the scores. The results did not find evidence of consensus opinion by all the participated teachers to replace the GHSGT by EOCT.

The analysis of results also indicated that teachers with 0-10 years of work experience (novice teachers) and teachers having 11 or more years of work experience (experienced) did indicate variations in their perceptions. However, the *t* test results with an applied alpha level of 0.05 obtained from the transformed dataset suggested that this observed difference in perception data between experienced and novice teachers was only due to chance and has no statistical significance. Hence, it is concluded that the findings are independent of teachers' years of experience. The subject taught by teachers is the only covariate that influenced teacher perceptions. The findings in this study validated the opinion of educational practitioners and most of the illustrated information in the literature.

Implications for Social Change

This study is important in helping to understand and identify the reasons for student science underachievement and its impact on the graduation rate. The current study added a body of literature to the existing research work on issues related to the enhancement of the graduation rate. This study has the potential to bring positive social change by reducing the number of students failing in the science content of the graduation test and increasing the overall graduation rate. Improving the graduation rate indirectly helps an individual to be a productive citizen rather than a liability to the community.

The challenges faced by the education system and the public schools throughout the U.S. are crucial. Global challenges, a more diverse population, ever changing demands for a skilled workforce, and economic instability are some of the forces that constantly shape and reshape the education system (Karoly & Panis, 2004). In this context completing high school graduation is not a choice but, an imperative. Science and technology are considered as principal drivers for a country's economy (Easton, Harris & Schmitt, 2005). Education in science has become a mandatory prerequisite for sustainable economic performance (Habermeier, 2007). The disconnect between science learning, science achievement, and potential career choice (Jones, 2007) is one of the reasons for science underachievement. Scores on science tests have a particularly strong positive relationship with economic growth (Barro, 2001). Facione (2006) observed that students have not mastered the fundamental thinking skills even after earning college degrees. Accordingly, such skills should have been mastered at the high school level.

Recommendations for Action

The key findings of this study can be effectively employed by administrators and educational practitioners to resolve the achievement gap between science and other three core subjects of the GHSGT and to improve the graduation rate. To accelerate the science pass percentage, teachers are encouraged to integrate interdisciplinary projects and reading assignments to help students use the information learned in one content area to put into practice in other content areas. Interdisciplinary teaching strategy should be practiced by teachers to incorporate more science facts, such as scientists' autobiographies as reading assignments in literature, science problems in math, and the history of science and technology development in social studies subjects. It is also important to connect the various afterschool club activities, sports, and field trips as cumulative projects. Thus, proficiency gained in one subject area can be beneficially applied and used in other content areas to enhance students' cumulative proficiency knowledge.

The findings also revealed that students are required to have critical thinking and application knowledge and not just basic cognitive level knowledge to be successful in demanding subjects like science. The North Central Regional Education Laboratory (2004) advocated implementing strategies to help students attain high levels of academic achievement and "intellectual competence" (p. 2). This indirectly implies improving teacher quality so that teachers can integrate and impart higher order thinking skills as recommended by Bloom (1956).

To narrow the achievement gap between science and other core subjects, science literacy must be made an integral part of general literacy to overcome the barrier in comprehending scientific concepts and vocabulary. It is important to bring in this change throughout K-12 level education instead of focusing only on high school curriculum. Appropriate professional development initiatives are required to train teachers to adopt an interdisciplinary approach in their classrooms. The curriculum, textbooks, classroom assignments, activities, projects and the graduation test questions need to be aligned to promote cumulative knowledge proficiency.

Making science an additional AYP indicator will help obtain the needed emphasis and funding to improve science education. The importance of reasoning, scientific thinking, and application of knowledge to real-world science are as important as basic literacy (reading and math) in an individual’s learning. The majority of teachers in this study strongly agreed that science as an AYP subject does not get enough emphasis from teachers, administrators, and school districts. Hence, making science an AYP indicator is an immediate requirement for policy makers to improve science achievement.

The problem of science underachievement is not confined to the high school graduation test alone, but can be traced back to the science performance of eighth graders in their Criterion-Referenced Competency Test (CRCT). CRCT is a state mandated exit exam for the middle school students. The AYP status depends on student performance in English and math subjects of CRCT just as the way English and math scores determine the AYP status of the GHSGT. The performance of students in CRCT exam reflected student science underachievement similar to the GHSGT. The GDOE statistical data

(2007) indicated that students underperform in the science content of CRCT relative to their performance in other core subjects. According to the Governor's Office of Student Achievement, which publishes CRCT results, about 40% of the students fail in the science content of CRCT exam (GDOE, 2007). A bottom-up strategy is required to improve the science achievement at the middle school and high school exit-exams (CRCT and GHSGT), respectively.

Recommendations for Future Study

This study provides a foundation for future research to improve the graduation rate by optimizing science achievement. This study is of interest to researchers, teachers, administrators, and policy holders. The outcome of this study is limited to high schools across the nation with similar curriculum structure and subjects offerings. It is suggested that a future study can be performed on a larger population comprising of different school districts across the nation. Further research conducted on a large scale will provide greater insight into identifying and addressing the science underachievement problem in multiple dimensions. Additional studies can investigate the subgroups (by race, gender, disability, and socio-economic status) having the highest achievement gap between science and other core subjects of the graduation test.

Students find it difficult to solve science problems as they are all word problems. It is a challenge for students to read, comprehend, take out extraneous information, and choose the appropriate operation while solving problems. Future research focusing on problem solving ability in science is recommended to enhance student science performance.

The results of this study implied the need for further research into the perception of teachers on replacement of the GHSGT with the EOCT. Even though, the majority of science teachers favored this change, the other three core subject teachers had mixed responses, and social studies teachers did not favor a change in exam procedures.

Conclusions

This study addressed strategies to close the academic achievement gap between science and other core subjects of the GHSGT and to optimize student science achievement. The analysis derived from teacher perception data provided greater explanation for student underachievement in science. Teachers' judgment and insight are crucial in investigating reasons for student underachievement in science from various perspectives. The key findings from this research were (a) the AYP factor drives greater student performance, (b) science is a more demanding subject because it incorporates all other skills learned in other content areas, and (c) science should be made an AYP indicator to enhance science achievement.

This study proposed a new paradigm to promote graduation rate by enhancing the science achievement. The findings and recommendations of this study will provide a basis for developing strategies to improve student science achievement and to enhance the graduation rate. The improved graduation rate is expected to make a positive impact on the community by facilitating the personal success of an individual. Thus, educational practitioners, administrators, and policy makers should take into account the recommendations made in this study while developing curricula, content standards, and standardized tests.

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APPENDIX A: COMPARATIVE PERFORMANCE BETWEEN GHSGT CORE SUBJECTS FOR 8 RANDOMLY SELECTED SCHOOL DISTRICTS

Table A4.

Comparative Performance in Core subjects of GHSGT by 11th-grade, First-time Test Takers of Gwinnett County School District

	Academic years						
Subjects	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
English	96	96	96	95	96	97	97
Math	96	96	96	96	96	96	95
S Studies	86	89	89	89	91	92	92
Science	76	79	79	78	79	83	84

Source: Statistics from Georgia Department of Education, K-12 Public Schools Annual Report Card (2007)

Table A5.

Comparative Performance in Core subjects of GHSGT by 11th-grade, First-time Test Takers of Cobb County School District

Core	Academic Years						
subjects	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
English	95	97	97	96	96	96	98
Math	93	94	94	94	96	95	95
S Studies	87	90	88	87	91	88	92
Science	79	85	79	75	79	77	79

Source: Statistics from Georgia Department of Education, K-12 Public Schools Annual Report Card (2007)

Table A6. *Comparative Performance in Core subjects of GHSGT by 11th-grade, First-Time test Takers of Fulton County School District*

Core subjects	Academic Years						
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
English	95	96	95	95	97	97	98
Math	94	93	92	94	95	95	94
S Studies	90	90	88	88	88	91	92
Science	79	78	77	73	76	80	79

Source: Statistics from Georgia Department of Education, K-12 Public Schools Annual Report Card (2007)

Table A7. *Comparative Performance in Core subjects of GHSGT by 11th-grade, First-Time test Takers of Atlanta Public school System*

Core Subjects	Academic Years						
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
English	89	90	92	89	92	93	94
Math	84	81	83	84	85	84	81
S Studies	70	75	74	71	77	79	78
Science	55	63	57	59	61	61	63

Source: Statistics from Georgia Department of Education, K-12 Public Schools Annual 84Report Card (2007)

Table A8. *Comparative Performance in Core subjects of GHSGT by 11th-grade, First-time Test Takers of Butt County School District*

Core Subjects	Academic Years						
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
English	95	96	90	90	93	99	98
Math	88	87	77	85	93	95	94
S Studies	77	80	71	79	80	84	90
Science	56	63	57	59	67	72	75

Source: Statistics from Georgia Department of Education, K-12 Public Schools Annual Report Card (2007)

Table A9. *Comparative Performance in Core subjects of GHSGT by 11th-grade, First-time Test Takers of Dekalb County School District*

Core Subjects	Academic Years						
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
English	93	95	94	92	93	93	94
Math	90	89	88	88	96	86	86
S Studies	78	82	80	80	77	90	83
Science	65	70	63	60	57	62	66

Source: Statistics from Georgia Department of Education, K-12 Public Schools Annual Report Card (2007)

Table A10. *Comparative Performance in Core subjects of GHSGT by 11th-grade, First-time Test Takers of Troup County School District*

Core Subjects	Academic Years						
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
English	91	94	94	94	95	97	97
Math	88	90	91	91	92	93	94
S Studies	73	78	80	80	77	81	85
Science	61	66	66	66	62	66	74

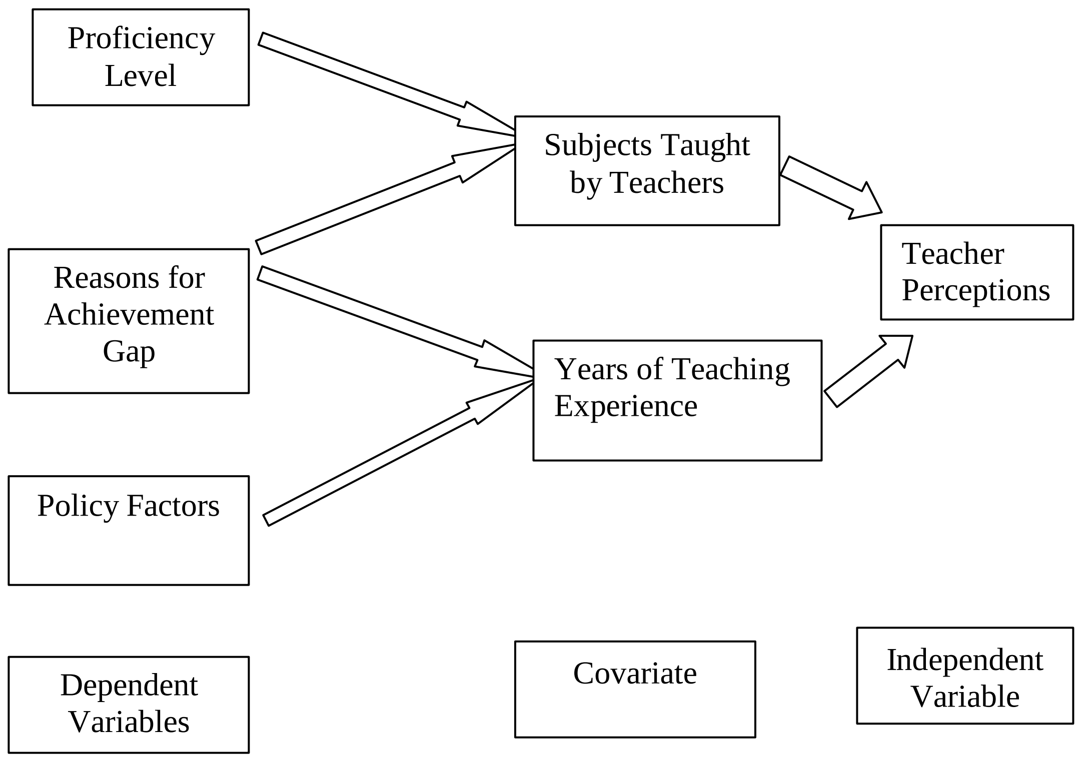
Source: Statistics from Georgia Department of Education, K-12 Public Schools Annual Report Card (2007)

Table A11. *Comparative Performance in Core subjects of GHSGT by 11th-grade, First-time Test Takers of Clayton County School District*

Core Subjects	Academic Years						
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
English	93	95	94	93	95	95	97
Math	91	90	90	90	90	89	90
S Studies	79	82	80	81	79	84	86
Science	61	66	61	57	57	60	62

Source: Statistics from Georgia Department of Education, K-12 Public Schools Annual Report Card (2007)

APPENDIX B: A VISUAL MODEL OF INTERACTIONS BETWEEN VARIABLES



Source: From Creswell (2003, p. 122), modified visual model of variables

APPENDIX C: ACHIEVEMENT GAP AND SCIENCE UNDERACHIEVEMENT (AGSU) QUESTIONNAIRE

Background: The Georgia High School Graduation Test (GHSGT) results of XXXX School System reflect that students are not performing at the same proficient level in all the core subjects (English, mathematics, social studies, and science) of the graduation test. The results also indicate a pattern of students' disparity performance between the core subjects and relatively a large percentage of students failing the science content of the graduation test affecting the overall graduation pass percentage
Purpose: This study will examine teachers' insight and opinion on the achievement gap in the graduation test core subjects, keeping the focus on science underachievement in the graduation test. This information will be used to set strategies to close the achievement gap in students' graduation test performance as teachers' judgment and commendation may prove to be an effective tool to improve students' science achievement in the graduation test. I request you answer all sections of this survey and complete it within a week. Your participation is highly appreciated.
Permission: I have the Superintendent's permission to conduct the survey at XXXX Schools.

Demographic Domain: Teacher Profile

Identify the core subject you teach and total years of teaching experience.

i. Core subject taught	**ii. Teaching experience**
☐ English	☐ 0-10 Years
☐ Mathematics	☐ 11 years or more
☐ Social studies	
☐ Science	

Domain 1: Students' Proficiency Level

Q. 1. **My students demonstrate adequate learning abilities in the following areas, necessary to be successful in my content area of the graduation test:**

Note: Answer item number e and f (Lab/math skill) of this question, if only applicable to your content area that you teach.

Learning ability	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
a. Reading ability	☐	☐	☐	☐	☐
b. Writing	☐	☐	☐	☐	☐
c. Comprehension of content	☐	☐	☐	☐	☐
d. Application skills	☐	☐	☐	☐	☐
e. Math skills	☐	☐	☐	☐	☐
f. Lab skills	☐	☐	☐	☐	☐

Q. 2. My students demonstrate adequate learning characteristics in the following areas, necessary to be successful in my content area of the graduation test:

Learning Characteristics	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
a. Show an interest in the subject	☐	☐	☐	☐	☐
b. Learn and retain the content with ease.	☐	☐	☐	☐	☐
c. Do well on the graduation test.	☐	☐	☐	☐	☐

Q. 3. **My students demonstrate adequate learning attitudes in the following areas, necessary to be successful in my content area of the graduation test:**

Attitude Characteristics	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
a. Curiosity	☐	☐	☐	☐	☐
b. Questioning	☐	☐	☐	☐	☐
c. Objectivity	☐	☐	☐	☐	☐
d. Critical thinking	☐	☐	☐	☐	☐

<u>Domain 2: Reasons for the Achievement Gap</u>

Q. 4. Identify the level of agreement or disagreement on the importance of the following ability skills students must have in order to be successful, in all the core subjects of the graduation test:

Importance	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
a. Reading	☐	☐	☐	☐	☐
b. Writing	☐	☐	☐	☐	☐
c. Comprehension	☐	☐	☐	☐	☐
d. Application	☐	☐	☐	☐	☐
e. Math Skill	☐	☐	☐	☐	☐
f. Lab Skill	☐	☐	☐	☐	☐

Q. 5. The reason for achievement gap between the core subjects on the graduation test is:

Reasons	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. Lack of equal emphasis on all four core subjects.	☐	☐	☐	☐	☐
b. Lack of continuity in the curriculum.	☐	☐	☐	☐	☐
b. Lack of cumulative content knowledge.	☐	☐	☐	☐	☐

Q. 6. Students perform better in English and mathematics subjects of the graduation test compared to science because:

Sc Vs. English & Math	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. More emphasis is placed on English and math courses.	☐	☐	☐	☐	☐
b. English and math are AYP indicator subjects.	☐	☐	☐	☐	☐
c. AYP factor drives greater performance.	☐	☐	☐	☐	☐

Q. 7. Science and social studies are the non-AYP subjects of the graduation test. Students' pass percentage is higher in social studies than in science because science:

Science vs. Social Studies	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. Is relatively difficult to comprehend and remember.	☐	☐	☐	☐	☐
b. Contains abstract concepts.	☐	☐	☐	☐	☐
c. Is a math based course	☐	☐	☐	☐	☐
d. Contains unfamiliar vocabulary.	☐	☐	☐	☐	☐
e. Demands higher order thinking skills.	☐	☐	☐	☐	☐

Domain 4: Policy Factor

Q. 8. Identify your degree of agreement: Closing the achievement gap between core subjects will help in enhancing the overall graduation pass percentage:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. By making science an AYP indicator.	☐	☐	☐	☐	☐
b. By making all core subjects AYP indicators.	☐	☐	☐	☐	☐
c. Replacing graduation test with End-Of-Course-Test (EOCT).	☐	☐	☐	☐	☐

Thank You!

APPENDIX D:

LETTER OF INVITATION TO PARTICPATE IN THE SURVEY

Note: The following invitation along with the survey package was delivered to the Central Office of the school district to be delivered to potential participants, in their respective schools.

The research study to investigate teachers' perceptions on *Achievement Gap between core Subjects of the Graduation Test and Science Underachievement is* being conducted by Bhagyalakshmi Gopalsingh, a doctoral student at the university. Ms. Gopalsingh is being supervised by Dr. Michael Brophy, professor at the University and chairman of the dissertation committee. Ms. Gopalsingh has received permission from XXXX Public School system to conduct this research study. You are being requested to take part in this research study.

Purpose

The purpose of this research is to:

1. To analyze teacher perceptions on achievement gap due to students' disparate performance between the core subjects of the graduation test (English, mathematics, science, and social studies) and in particular, science underachievement to identify strategies to close this achievement gap,

2. To identify and to recommend strategies to improve students' science performance of the graduation test to narrow down the achievement gap and to enhance the overall graduation rate.

Participation in the Study

You have been asked to participate in this research study between the dates of March 22, 2010 to March 24, 2010 (3days). You have been asked to complete the survey because you are in a position to provide an insight into this critical issue to recommend strategies to close this achievement gap existing between the core subjects of the graduation test. The information provided will help the researcher to identify and address the areas of concern as identified by the participating teachers in the study. You are being invited to complete a fifteen minutes anonymous survey as your perceptions and insights are valuable and critical in determining factors such as: (a) students' proficiency level (b) reasons for achievement gap and science underachievement, and (c) policy factors influencing to widen this achievement gap.

Participation in this study is voluntary and will not affect your performance evaluation. If you have read and understood the information above and agree to voluntarily complete the survey please continue below. Your participation is greatly appreciated. There will be no compensation provided by the researcher for participating in the study. The participants have a choice not to participate in this study is the alternative

Risks and Discomfort

There are no anticipated risks as a result of your participation. There will be no cost to you except for your time required to complete the questionnaire.

Confidentiality

All survey information will be kept confidential and will only be used for research purposes. Anonymity is assured as neither your name nor the name of the participating school will appear in any written reports that stem from the data collected by the researcher.

Benefits

The anticipated benefits to the participants: Identifying the reasons for the achievement gap will help to identify the strategies to close this achievement gap. This identification will enable the teacher to select the right practices to be used in the classroom during instructional time and also during remediation program. These research based and data-driven practices help to enhance the achievement level, especially, in science content of the graduation test, and to improve the overall graduation pass percentage. The students' success in the graduation test increases the self-confidence, morale of an individual teacher and helps psychologically, to derive the job satisfaction. As a participant in this research study, the researcher believes that the information produced will improve the quality of instruction and types of services it provides for all graduating students in Public Schools.

More Information

If you have questions or concerns about this study, please contact faculty adviser Dr. Michael Brophy, Walden University/ student researcher Gopalsingh at (253) 720-0078 / (770) 507 6127. If you have any questions about the human rights as a research participant, contact Dr. Leilani Endicott, and the contact information is 800-925-3368, ext. 1210 or irb@waldenu.edu .

You are requested to read the Consent Form and retain the copy with you for any future reference or clarifications. Returning the completed survey is appreciated. .

Thank you for participating.