Predictive Model for Student Performance on the Science Georgia High School Graduation Test

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ABSTRACT

Georgia has one of the lowest high school graduation rates in the United States with approximately 60% of students graduating within four years of entry into the ninth grade. A 28% failure rate on the Science Georgia High School Graduation Test (GHSGT) may contribute to low graduation rates. This study developed a statistical model to predict performance on the Science GHSGT. Nine learner characteristics were selected for evaluation as predictors of Science GHSGT performance, and the research was guided by the following questions: (a) Can performance on the Science GHSGT (i.e., Pass or Fail) be accurately predicted from gender, ethnicity, performance in previous high school science classes, previous grade retention, performance on eighth-grade Reading Criterion-Referenced Competency Test (CRCT), performance on eighth-grade Mathematics CRCT, performance on eighth-grade Science CRCT, performance on high school Physical Science End of Course Test (EOCT), or performance on high school Biology EOCT?; (b) What is the accuracy and reliability of the developed prediction model?; and (c) Does cross-validation of the data confirm the accuracy and reliability of the analytical model? Data were extracted from 712 permanent student records in a southern Georgia high school. Selected predictors were evaluated via logistic regression for correlation with performance on the Science GHSGT. Statistical analysis revealed that performance on the Physical Science EOCT, performance on the Biology EOCT, and gender are statistically significant predictors of performance on the Science GHSGT. Research using the developed prediction model and a broader sample of student data is recommended. Analysis of predictive correlations between eighth-grade Science CRCT and performance on Physical Science EOCT and Biology EOCT is also recommended.

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DEDICATION

This volume is dedicated to the memory of my youngest sister, Gayle Fay Dowler, who left this life too soon. You are always in my thoughts. You would have been proud!

Chapter I

INTRODUCTION

Statement of the Problem

In an increasingly competitive global economy, earning a high school diploma is critical in gaining successful employment and building a productive career (Southern Regional Educational Board [SREB], 2005). Although experts debate the moral responsibility of the nation in ensuring that each child earns a high school diploma, civic leaders recognize the economic and social benefits that high school graduates offer to society (Amos, 2008). These same leaders also realize the negative economic, social, and personal consequences that result when increasing numbers of dropouts settle in their communities.

High school graduates are likely to find steady, long-term, higher-paying employment, and are far less likely to rely on government-funded health care, food stamps, housing assistance, or other taxpayer supported benefits than those who do not graduate (Garfinkel, Kelly, & Waldfogel, 2005). High school graduates also tend to live longer (Muennig, 2005) and become engaged in their communities by voting, volunteering, and paying taxes (Junn, 2005). Moreover, they are less likely to become parents at an early age (Haveman, Wolfe, & Wilson, 2001) or become involved in criminal activity (Raphael, 2004).

High school dropouts, on the other hand, tend to live a starkly different existence. Due to the serious consequences on both a personal and public level for those who drop

out of high school, the U.S. high school dropout rate is a source of concern to community leaders (Neild & Balfanz, 2006). Fifty years ago, a high school dropout could find a good paying job that would adequately support a family (Amos, 2008). However, the types of occupations that paid living wages and benefits to the dropouts of the 1950s have essentially disappeared (Christenson & Thurlow, 2004). Since these occupations are now automated or outsourced to overseas locations, dropouts have more difficulty finding adequate employment (Balfanz, 2007). Teenagers, who leave high school without having earned a diploma, face a difficult financial, educational, and social future that has consequences for the communities in which they live (Rouse, 2005).

As students who do not complete high school are increasingly becoming a drain on the local economies in which they settle, the high school graduation rate has become the focus of much attention among civic leaders (Balfanz, 2007). Rouse (2005) explained that civic leaders are concerned that these dropouts lack the skills and knowledge necessary to make them eligible for consistent, high-quality, long-term employment. Rouse found that only about half of the nation's high school dropouts maintain regular jobs, as compared with 69% of high school graduates and 74% of college graduates. As a consequence, the average annual earnings of dropouts range from approximately $12,000 (Levin, 2005) to $19,000 annually (Alliance for Excellent Education, 2005). Compared to annual average wages of $33,000 for high school graduates, Levin noted that dropouts contribute less than half of the city, state, and federal taxes of their more highly educated counterparts.

Local economies also suffer when their residents have a low level of education. A lack of educated workers deters potential employers from moving into these

communities, leaving community leaders to experience difficulty in attracting new business investment. These communities are often forced to allocate more funding for social programs at the same time that they are collecting lower tax revenues from dropouts, who are likely to be unemployed or working fewer hours at low-paying jobs (Alliance for Excellent Education, 2007; Rouse, 2005). Moreover, communities must often bear the additional financial burden of providing health care for an uneducated populace that is typically less healthy (Levin, 2005), less productive (Bailey, 2005), more likely to become parents at a young age (Amos, 2008), and more likely to be involved in criminal activity (Moretti, 2005).

On a national level in 2005, employment opportunities lost due to inadequate education cost the United States approximately $158 billion in lost wages and up to $36 billion in federal and state tax revenues for each class of students who failed to graduate (Levin, 2005). Over the course of a lifetime, each high school dropout costs the nation approximately $260,000 in lost earnings, taxes, and productivity (Amos, 2008). According to Amos, the nation's economy would have benefited from an additional $319 billion in income had all of the students who dropped out of high school in 2008 completed their education.

Technological advances in the workplace continue to demand a more highly educated labor force (U.S. Department of Education [USDOE], 2001). In 1950, only 34% of American workers between the ages of 25 and 29 had earned a high school diploma, and only 5% of American workers over the age of 25 had earned a college diploma (U.S. Department of Labor [USDOL], 2006). However, many jobs at that time required only basic literacy skills, with other skills demanded by the job acquired through

workplace experience [USDOL]. In contrast, by 1970 14% of the labor force had completed four years of college, and this figure more than doubled to 32% by 2005, primarily due to increased educational demands placed on the economy through growth in the technology and medical sectors.

At the same time that experts estimate that 85% of the nation's future jobs will require some form of post-secondary education, they also estimate that approximately 30% of America's high school students will leave school each year without a diploma (Pinkus, 2006). Without the benefit of a high school diploma, dropouts will have little or no opportunity to obtain the post-secondary training needed within a job market that demands some form of higher education (Amos, 2008).

Growth in the education, medical, and technology sectors of the economy over the past 50 years primarily accounts for the increased need for higher education among the American work force (USDOL, 2006). According to the USDOE (2001), the high school completion rate among 25 to 29 year-olds increased to 55% in 1970. After reaching approximately 78% in 1978, this rate remained relatively steady throughout the 1990s (National Center for Educational Statistics [NCES], 2007).

In southeastern states, the percentage of high school students graduating within four years of entry into the ninth grade has declined since 1980 (SREB, 2005). Among these states, Georgia has one of the lowest graduation rates (NCES, 2007). More specifically, the NCES reported that in 1998, only 54% of Georgia's high school students earned a diploma within four years of entering the ninth grade, and that between 2000 and 2005, only approximately 60% of Georgia students graduated within the expected 4-year period after entry into the ninth grade.

According to Georgia law O.C.G.A §20-2-281, high school students must successfully complete all mandated courses and pass all graduation tests in order to receive a high school diploma (Georgia Department of Education [GADOE], 2008c). Although this law continues to be enforced today, the GADOE has made some modifications regarding the required courses for graduation and the number of credits awarded for these courses.

Prior to 2007, the GADOE allowed students to select different academic diploma tracks, such as college preparatory, college preparatory with distinction, technology/career, and technology/career with distinction, and awarded different numbers of credit hours to students who participated in these different programs (Georgia Department of Education, 2008c). Consequently, some programs offered more courses and/or more challenging content than did other programs.

To resolve the academic inequities between different diploma programs, the GADOE revised the law to require that all high school students complete at least 23 Carnegie units, a standard of measurement representing units for the completion of year-long courses. Further, the content of all courses was revised to be similar in terms of content and rigor (GADOE, 2008c). Specifically, the GADOE now requires that students complete: (a) four units of English/language arts; (b) four units of mathematics; (c) four units of science; (d) three units of social studies; (e) one unit of health; (f) one unit of physical education; (g) three units of foreign languages and/or fine arts, career, technical or agricultural education; and (h) four units of elective courses.

After the completion of most required courses, high school students take the Georgia High School Graduation Tests (GHSGTs) to measure their knowledge and skills

in writing, English/language arts, mathematics, science, and social studies (GADOE, 1999). Students first take the writing test during the fall semester of the 11th grade, and all other content area tests at the end of that year. Students who do not pass one or more of the tests with a minimum scale score of 500 are afforded multiple opportunities to review and retake the test(s) during the senior year.

Statewide student performance on the GHSGTs varies among different content areas. The GaDOE (2008d) reported that the average student failure rates of three test administrations in 2005, 2006, and 2007 for writing, English/language arts, mathematics, social studies, and science were 9%, 4%, 8%, 14%, and 28%, respectively. As these data show, science is the content area test with the highest percentage of student failure.

The Science GHSGT is an 80-item multiple choice instrument that focuses on content and skills in the areas of: cells and heredity (25% of test items); ecology (17% of test items); the structure and properties of matter (26% of test items); energy transformations (16% of test items); and forces, waves, and electricity (16% of test items). According to GADOE statewide data for 2006 to 2008, students obtained the lowest scores on the structure and properties of matter domain and the highest scores on the ecology domain (GADOE, 2008d). Overall student performance on each domain was roughly equivalent, with students answering 70% to 78% of the items correctly for each domain.

The content of the test items within the Science GHSGT are based on state-mandated standards termed the Georgia Performance Standards (GPS) (GADOE, 2008e). The science standards are the basis for the content and skills taught in the science curricula for students in kindergarten through Grade 12. Whereas the science curricula at

each elementary grade level focuses on life science, earth science, and physical science, the science curricula at the middle grade level addresses only one science area each school year: earth science in the sixth grade, life science in the seventh grade, and physical science in the eighth grade.

Based on state standards throughout the elementary, middle, and high school years, the Georgia science curriculum prepares students for the Science GHSGT, with the science knowledge and skills acquired during the elementary and middle grades providing the foundation for more advanced learning during the high school years. At the high school level, students are required to take biology and physical science courses as part of four science courses needed to fulfill science requirements for high school graduation.

All Georgia school systems administer the Georgia Criterion-Referenced Competency Tests (CRCTs) to students in grades one through eight to measure student understanding of the science content presented during the early and middle grades (GADOE, 2008a). School systems also administer the CRCTs to student in grades one to eight to measure student understanding of reading, English/language arts, social studies, and mathematics (GADOE, 2008a). Criterion-referenced tests, such as the CRCTs, are designed to measure how well students learn the knowledge and skills presented in a specific curriculum with student scores reflecting whether the student meets, does not meet, or exceeds the standard (GADOE, 2008a, 2008e). School systems typically administer the tests over three to five consecutive days with students being tested on one subject per day.

The A+ Educational Reform Act of 2000, O.C.G.A. §20-2-281, describes the

Georgia State Board of Education requirement for adoption of end-of-course assessments in grades nine through twelve (GADOE, 2008b). The assessments, which are mandated in core subjects specified by the State Board of Education (2008b), are currently composed of eight content areas: mathematics (algebra/geometry/statistics); social studies (U.S. History and Economics/Business/Free Enterprise); science (biology and physical science; and English/Language Arts (Ninth Grade Literature and Composition, and American Literature and Composition). The Georgia End of Course Tests (EOCT) align with the Georgia curriculum standards and include assessments of specific content knowledge and skills. The assessments provide diagnostic information to help students identify strengths and areas in need of attention, therefore improving performance in all high school courses and on other assessments, such as the GHSGT. The EOCT also provide data to evaluate the effectiveness of classroom instruction at the school and system levels (GADOE, 2008b, 2008e).

Although the delivery of science curricula at each grade level is important for student performance on the Science GHSGT, educators must consider other factors related to student performance on high-stakes tests. Specific risk factors such as low attendance and consistently poor grades may predict poor performance on standardized tests (Jerald, 2006). Coley (1995) recognized school-related problems such as student dislike of school, inability to keep up with school work, and inability to get along with teachers as primary factors in poor performance and school dropout. Researchers have found that other factors including gender, ethnicity, grade point average (GPA), and performance on achievement tests in early grades predict future academic achievement (Engerman & Bailey, 2006).

Purpose of the Study

The purpose of this study is to identify which characteristics of students at a high school in south Georgia predict performance on the Science GHSGT. Through examination of multiple factors including gender, ethnicity, performance in science classes, CRCT scores in science, mathematics, and reading, End of Course Test (EOCT) scores in biology and physical science, and grade retention will be used to develop a statistical model to identify students at risk of failing the Science GHSGT. This model may prove beneficial for developing and implementing appropriate interventions to improve students' Science GHSGT scores, thus helping increase the graduation rate.

Research Questions

To increase high school graduation rates in Georgia, it is essential to identify which student characteristics predict student performance on the Science GHSGT. In order to gain an understanding of these characteristics among the students investigated in this study, the researcher will address the following research questions:

1. Can performance on the Science GHSGT (i.e., Pass or Fail) be accurately predicted from gender, ethnicity, performance in previous high school science classes, previous grade retention, performance on eighth-grade Reading CRCT, performance on eighth-grade Mathematics CRCT, performance on eighth-grade Science CRCT, performance on high school Physical Science EOCT, or performance on high school Biology EOCT?
2. What is the accuracy and reliability of the developed prediction model?
3. Does cross-validation of the data confirm the accuracy and reliability of the analytical model?

Significance of the Study

For educational leaders concerned with student achievement and overall school performance, identifying the predictors of performance on high-stakes tests is an important task. Early identification of students at-risk of failure on the Science GHSGT is the first step in developing and implementing appropriate interventions to improve student Science GHSGT scores and hopefully increasing high school graduation rates. To contribute to the research conducted on the academic, behavioral, motivational, and cultural predictors of student performance in school, the study will focus on the identification of several specific, measureable factors that may predict student performance on the Science GHSGT. The factors include student gender, ethnicity, performance in mandatory science classes, eighth-grade CRCT scores, ninth- and tenth-grade Physical Science EOCT scores and Biology EOCT scores, and grade retention. The researcher's ultimate goal is to develop a simple model that can be easily implemented by school counselors, teachers, and administrators.

The GHSGT is one of the last hurdles to graduation that each student must negotiate. Failure on any segment of the GHSGT puts students at risk of failing to earn a high school diploma, which may impact their future standard of living. The data collected and the prediction model developed by the researcher will help school counselors, teachers, and administrators develop a focused interventional strategy, and modify the science curricula in a manner that will lead to improved scores on the Science GHSGT. By gaining a better understanding of the characteristics of students at risk of failure, educators will be able to provide students with the support and resources they require to earn their high school diplomas. Educators will thereby help achieve society's

ultimate goal for students to become productive citizens who contribute to their communities by gaining meaningful employment within an increasingly demanding job market.

Chapter II

REVIEW OF LITERATURE

The task of preparing teenagers for an increasingly demanding job market presents a unique set of challenges for public high schools. An estimated 85% of jobs now require at least a high school diploma and some postsecondary education (Alliance for Excellent Education, 2008). High school graduates must be prepared for the rigors of a demanding workplace and further education (Achieve, Inc. & National Governors Association, 2005).

According to the *Action Agenda for Improving America's High Schools (*Achieve, Inc. & National Governor's Association, 2005*)*, business leaders and college presidents report that high schools are failing to prepare many students for work and higher education. Leaders in business and academia spend billions of dollars each year to provide employees and high school graduates with additional instruction on basic skills that they should have attained in high school.

Another concern regarding the academic preparedness of students involves high school graduation rates. Students, who do not graduate from high school, often lack the knowledge and skills needed for advanced career opportunities and higher learning (Achieve, Inc., 2005).

This review of literature examines influences in students' academic and personal lives, which affect student achievement and high school graduation rates. Influences include the use of high-stakes tests in schools, social interactions with family members

and school communities, and personal characteristics of students.

To address the aforementioned topics, the following questions are posed:

1. What is the impact of high-stakes tests on student learning and classroom instruction?

2. How do social interactions of students with family members and school communities influence student learning and high school graduation rates?

3. What characteristics are common among students who are at risk of not completing high school?

Impact of High-Stakes Tests on Student Learning and Classroom Instruction

In an effort to ensure the readiness of high school graduates for employment and for advanced education, approximately half of U.S. public school systems have implemented the high school requirement for students to pass exit examinations of selected academic content prior to graduating from high school (Center on Education Policy, 2007). According to proponents of high school exit examinations, students, who pass examinations, demonstrate proficiency of basic academic content and skills, which are needed before entering the labor force or higher education (Amrein & Berliner, 2002; Dorn, 2003; Thurlow & Esler, 2000).

Exit examinations carry serious consequences for students, such as the inability to graduate from high school or to be promoted to an advanced grade level, and are commonly referred to as high-stakes tests (American Educational Research Association, 2000). High-stakes tests in public schools are used to measure student mastery of course content (Abrams & Madaus, 2003). For most states in the U.S., the content of those tests reflect the academic standards as established by individual states (Center on Education

Policy, 2007). Content disciplines from which the standards are derived include: reading, writing, mathematics, science, and English (Cross & Joftus, 1997; Hymes, 1991; Marzano & Kendall, 1997). Although failing a high-stakes test may result in detrimental consequences for the student, the rationale for using high-stakes tests is based on the belief that high-stakes tests improve student learning and classroom instruction (Hanushek & Raymond, 2005).

Rationale for Using High-Stakes Tests

Proponents of high-stakes testing posit that, in theory, standardized tests, such as benchmark measures or exit examinations, influence student motivation and increase parental involvement (McDonnell, 2005; Raymond & Hanushek, 2003). In addition, proponents believe that such tests prompt teachers to work harder and more effectively through either monetary incentives or punitive threats (Hanushek & Raymond, 2005). In essence, some educational leaders believe that pressure to succeed on high-stakes tests pushes teachers and students to perform at a higher level, thus improving America's public schools (Heartel & Herman, 2005; Peterson & West, 2003; Phelps, 2005).

The requirement that students must pass a test in order to advance academically is not a new concept. Indeed, as many states adopted the use of minimum-competency tests throughout the 1970s (Erickson, Kleinhammer-Tramill, & Thurlow, 2007). However, the popularity of competency tests faded in the early 1980s and the use of those tests was nearly eliminated until the release of the 1983 report, *A Nation at Risk: The Full Account* (National Commission on Excellence in Education, 1983). The content of *A Nation at Risk* raised concerns among educational leaders that U.S. public schools were falling behind academically to their international counterparts, falling short of providing equal

opportunities for all students, and not producing youth ready for the labor force.

Because of the recommendations of the *Nation at Risk* report and other documents related to international comparisons of student achievement, such as the Program for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS), high school exit examinations began to gain popularity. The aim of educational policy makers was to ensure that students who received a high school diploma had mastered fundamental skills in reading, writing, and mathematics (Amrein & Berliner, 2002; Dorn, 2003; Thurlow & Esler, 2000).

Effectiveness of Using High-Stakes Tests in Public Schools

Although the initial intent of high-stakes tests was to improve student learning, research shows that exit examinations fail to improve academic achievement, increase graduation rates, or produce graduates who are prepared for work (Jacob, 2001; Marchant & Paulson, 2005; Warren & Grodsky, 2009). After evaluating 30 years of national data, Marchant and Paulson concluded that exit examinations were just challenging enough to reduce the graduation rate, but not challenging enough to have a positive impact on how much students learn. Between 1973 and 2000, when high school exit examinations were first developed and administered, the annual high school graduation rate decreased by 2.1% nationally (Warren, Jenkins, & Kulick, 2006). This figure represented 42,000 students who otherwise would have graduated if exit examinations had not been in place.

One final concern detailed by Marchant and Paulson (2005) was whether high-stakes tests measured the types of knowledge and skills required for success beyond high school. A discrepancy between what was learned in school and what was needed for the workplace appeared to be evident.

Influence of High-Stakes Tests on Specialized Groups of Students

Despite the concerns expressed by researchers regarding the use of high-stakes tests, many states continue to use standardized tests for making decisions regarding students' grade-level placements and graduation eligibility. As of 2006, 22 states had implemented the use of high school exit examinations with three additional states making plans to add exit examinations by 2012 (Center on Education Policy, 2007). With the exceptions of Minnesota, Indiana, Ohio, New York, and Rhode Island, states requiring exit examinations were located among the southern tier of states within the United States.

In 2002, nearly half of all public school students and more than half of all minority students lived in states requiring students to pass a graduation exit examination (Chudowsky, Kober, Gayler, & Hamilton, 2002). Those states had higher rates of poverty as well as lower per-pupil spending than the national average.

Graduation rates for minority students appear to be disproportionately lower than for many groups of students (Albrecht & Joles, 2003; Orfield, Losen, Wald, & Swanson, 2004). Another group of students identified as having a low graduation rate are students with disabilities.

Minority Students. The disparity in high school graduation rates between White and minority students is well documented. In 2003, for example, the national graduation rate for White students was 78%, compared with 72% for Asian students, 55% for African American students, and 53% for Hispanic students (Greene & Winters, 2006). In some states the difference between White and minority graduation rates was 40 or 50 percentage points (Editorial Projects in Education [EPE], 2007).

Students who fail to graduate from high school often drop out of school prior to

taking high school exit examinations and graduation. Minority students tend to have greater high school dropout rates than non-minority students. According to a study over a 7-year period involving students from Texas, one of the states that requires high school exit examinations, McNeil, Coppola, Radigan, and Vasquez (2008) found that more than 135,000 students dropped out of high school each year. More than 60% of those students were identified as Black and Latino youth.

The level of difficulty of high school exit examinations appears to influence the dropout rate of minority students. In states with easy exit examinations, Black male students are 5.2% more likely to drop out of high school than their counterparts in states with no exit examinations. In states with more rigorous exit examinations, Black males are 7.3% more likely to drop out than are their counterparts in states with no exit examinations (Glenn, 2006).

Students with Disabilities. Since the 2004 reauthorization of the *Individuals With Disabilities Education Act* (IDEA), students with disabilities have been expected to participate in annual state-mandated testing. Assessment results for those students are required to be included in schools' Annual Yearly Progress (AYP), an indicator of overall student achievement on standardized tests. Although each student with disabilities has an Individualized Education Program (IEP) to address his or her special needs, all students are required to participate in state testing. Furthermore, since the passage of No Child Left Behind Act (NCLB) (2001), students with disabilities have been expected to meet the same academic requirements as regular education students (Schwartzbeck, 2003).

Conflicts between the requirements for testing and graduation for students with disabilities have existed among federal, state, and local agencies. Allbritten, Mainzer,

and Ziegler (2004) suggested that certain elements of NCLB conflicted with federal and state requirements for those students. In addition, at the local level parents and teachers of students with disabilities have had the freedom to establish learning outcomes based on individual student needs, which may or may not have been aligned with standardized grade-level assessments.

Albrecht and Joles (2003) outlined a variety of conflicts that arose because disabled students were included in high-stakes testing. One of those conflicts was located in *The Use of Tests as Part of High-Stakes Decision-Making for Students: A Resource Guide for Educators and Policy Makers* (U.S. Department of Education, 2000b, p. 55), which indicated that if a statistical analysis of assessments from a group of students was found to be significantly lower than assessments from a random distribution, then the test was considered inappropriate for the particular group of students. Based on that information, the researchers believed the expectations of NCLB for students with disabilities were in direct conflict with IEP programs for students with special needs. According to the researchers, the expectations of NCLB requiring students to achieve a specified level of performance on generic assessments was in direct conflict with individualized education programs for students with special needs.

Practices for including students with disabilities in high-stakes testing programs have varied from state to state. Testing accommodations for students with physical or sensory disabilities have been typically approved, while those students with cognitive or behavioral difficulties have not been approved (Fitzsimmons, 1998). Additionally, inconsistencies in test monitoring and data reporting have often resulted between school systems (Ysseldyke, Algozzine, & Thurlow, 2000).

High-Stakes Tests and Classroom Instruction

The use of high-stakes tests in K-12 schools has impacted classroom instruction by causing modifications in curricula content, teaching strategies, and time allotments for instruction. Some of those changes have resulted in unintended consequences for teaching and learning (Abrams & Madaus, 2003; Clarke et al., 2003; Goldberg, 2004; Shepard & Dougherty, 1991).

According to a study conducted by Abrams and Madaus (2003), several unintended consequences were identified when examining the effects of high-stakes tests on teachers and students. One of those consequences pertained to the influence of high-stakes tests on the selection of curricular content and instructional practices for classroom teaching. When high-stakes tests were considered important to teachers and school administrators, curricular content began to resemble the content of the tests, and classroom instruction became focused on the delivery of that content.

In a related study conducted by Clarke et al. (2003), 360 educators from elementary schools, middle schools, and high schools were interviewed to determine the influence of state-level standardized tests on teaching and learning. According to the results of the study, 40% of the participants reported that the use of high-stakes tests influenced the substance of curricular content. Content, not related to the tests, was often removed from instruction, and additional, test-related content was added to the curricula.

Some educators argue that most standardized tests do not measure the full range of material that any good teacher would normally include in his or her curriculum (Goldberg, 2004). According to survey data involving 360 teachers in 100 schools, 79% of the teachers indicated they felt pressured by administrators to improve test scores

(Shepard & Dougherty, 1991). As a result of that perceived pressure, the teachers provided instruction to students that focused on the delivery of test content at the expense of teaching deeper subject matter.

Another influence of high-stakes tests has been the loss of instructional time in the classroom due to the use of time to prepare students for tests and to administer tests to students (Shepard & Dougherty, 1991). According to Shepard and Dougherty, teachers reported that they spent an average of four weeks per year preparing students for high-stakes tests, and lost an additional five to ten days of class time to administer the tests.

Influence of Students' Social Interactions on Learning and Graduation Rates

Educational leaders and psychologists have intently explored the relationship between social behavior and academic achievement since the early 20th century (Malecki & Elliott, 2002). Social behavior refers to the process of communicating with others, according to Malecki and Elliott, and children's social behavior typically involves communications or interactions with family, peers, and teachers. Research regarding the influence of children's social interactions with family and school members on student academic achievement and high school graduation rates is examined.

Social Interactions: The Family

Parents are identified as the primary influence in students' educational experiences (Trotman, 2001; Yan & Lin, 2005). Children's ability to learn is affected by: parental support, parental involvement, and parenting styles.

Parental Support. Domagala-Zysk (2006) studied the importance of social support from those with whom students share a significant relationship. One hundred teenage students in danger of school failure and 100 teenage students with no risk of

failure comprised the study population. Results of the study show that teenage students need to feel supported by family. Nearly all students specifically identified their mothers as being the most significant relationship. Domagala-Zysk (2006) found that 42% of boys and 20% of girls who failed school perceived a lack of support from their fathers. Additionally, 65% of boys and 30% of girls who failed school believed that they did not receive adequate support from their mothers. Among girls in the Domagala-Zysk study, those at risk of failure were less likely to view their mothers as significant role models in their lives, while girls not in danger of failure viewed their mothers as a significant and positive influence.

Parental Involvement. Using a nationally representative data set, Menning (2006) investigated the relationship between involvement of nonresident fathers and student failure in school. The study revealed that students benefit academically if nonresident fathers are consistently involved in their children's lives. Conversely, students whose nonresident fathers are only sporadically involved in their lives seem to struggle more in school and they are less likely to be successful academically.

Students' academic success is also impacted by the mothers' educational accomplishments. Suh, Suh, and Houston (2007) found that the level of educational attainment of the biological mother of an at-risk student had a significant impact on whether that student would drop out of school. At-risk students whose mothers did not finish high school were less likely to succeed academically and more likely to drop out of high school themselves.

Parenting Styles. Adolescence is a critical period in the development of a child. Research shows that relationships with parents during adolescence correlate strongly to

academic achievement (Berk, 2000; Rothstein, 2004). Baumrind (1991) formulated a model describing parenting styles and family types as authoritative (high control and high warmth), authoritarian (high control and low warmth), permissive (low control and high warmth), or rejecting (low control, low warmth). Baumrind's parenting styles are found to be strong predictors of academic achievement among adolescents (Berk, 2000). Berk determined that children from authoritative and authoritarian homes were more likely to exhibit high academic achievement. By contrast, adolescents with permissive parents achieved at a lower level academically.

Engerman and Bailey (2006) conducted a study of African-American students which focused on the parenting styles of the students' parents. According to data from that study, African-American families were found to be primarily authoritarian with a parent-oriented decision making style. African-American adolescents from homes, where permissive parental practice prevailed, earned significantly lower grades than students living in authoritarian homes.

Social Interactions: The School

Students' social interactions in the school environment refer to their relationships with teachers and peers. According to a 1-year study conducted by Malecki and Elliott (2002), which consisted of 139 third- and fourth-grade students and their teachers, students' positive social interactions were found to correlate with academic achievement. Results of the study revealed that good social skills were predictors of positive academic achievement, while poor student behavior was predictive of negative academic achievement.

In a longitudinal study of 576 at-risk 10th graders, Fleming et al. (2005) examined

students' social interactions with members of the school community and academic achievement. According to the results of the study, levels of students' bonding with peers and teachers were correlated with course grades. Students, who bonded well with peers and teachers, were found to have high grades; while, students, who displayed negative interactions with peers and teachers, were identified as having lower grades.

In a study of 810 seventh-grade students, Fortin, Marcotte, Potvin, Royer, and Joly (2006) identified an at-risk subgroup of students who showed satisfactory academic performance despite negative interactions with others. Although students in the at-risk subgroup were involved in antisocial behaviors such as covert minor misdemeanors (lying or shoplifting), property damage (setting fires or vandalism), and delinquent acts (joyriding, illegal use of checks or credit cards, stealing cars, selling drugs, or breaking and entering residences), the antisocial behaviors were displayed in the students' local communities, not in the school environment. Teachers were unaware of students' negative behaviors outside of the school, and teacher-student relationships were not negatively affected by the students' antisocial behaviors. At-risk students, who developed positive relationships with teachers, were found to have had satisfactory grades for coursework.

Fortin et al. (2006) also found that students, who had difficulty adjusting socially with peers in the classroom, had low grades. Students, having socially maladjusted behaviors, were identified by teachers as being unstable, agitated, stubborn, disobedient, immature, and uncooperative. In addition to low grades, the students were more likely to drop out of school.

According to Hamre and Pianta (2005), instructional support and emotional support

of students by teachers are important for ensuring student academic achievement. Instructional support refers to the use of teaching aids or strategies by educators to assist students in the learning process. Examples include re-teaching of academic lessons to reinforce course content, providing relevant feedback on student work, and engaging students in discussions of course topics. Emotional support pertains to the ways in which teachers encourage students to assume responsibility for academic achievement. Teacher use of both types of supports have been found to moderate the risk of early school failure more than small class size or low teacher-student ratio.

In a research study in which interviews were conducted with 17 students at risk of dropping out of school, Knesting and Waldron (2006) found that teachers who supported students, academically and emotionally, played a major role in the students' decisions to stay in school and to pursue graduation. Through the instructional and emotional supports from teachers, students were able to identify behaviors that hindered their educational progress, and they learned how to succeed academically.

Characteristics of Students Who Do Not Graduate From High School

Although characteristics of school dropouts are numerous and vary according to research studies, three traits appear repeatedly throughout the literature. They include students' socioeconomic status, gender, and academic performance in school (Fang & Sen, 2006; Masten, 2000; Pomerantz, et al., 2002; Gestdottir, 2007).

Socioeconomic Status

According to a study conducted by Fang and Sen (2006), family socioeconomic status was found to be the most powerful predictor of academic success. Students from lower socioeconomic status households consistently achieved lower academically. Fang

and Sen also established evidence that the presence of multiple adult family members in the household may bolster feelings of support and stability in the children of the household, thus offsetting some of the disadvantages inherent in low socioeconomic situations.

Students, who live in poverty, often face situations related to crime and violence in their homes and neighborhoods. Despite those conditions, however, some students manage to achieve at high academic levels even though they face multiple challenges in their personal lives (Masten, 2000). Resilience in these students results from self-protective factors such as flexible coping strategies, a sense of responsibility, and solid social support in the form of structure, supervision, and a caring home environment (Egeland, Carlson, & Sroufe, 1993).

Solberg, Caristrom, Howard, and Jones (2007) found that students exposed to high levels of both direct and indirect violence might not enter high school with the resilience needed to manage challenges faced in school. This lack of resilience, paired with low intrinsic motivation and an absence of personal connections with teachers, ultimately leads to lower grades and a higher probability for being retained in school.

Gender

A large collection of research has documented differences in the academic achievement of girls and boys (American Association of University Women, 1999; American College Testing Program, 1997; Dwyer & Johnson, 1997; Entwisle, Alexander, & Olson, 1997; Pomerantz, et al., 2002). According to those studies, girls typically receive higher grades than boys for reading, spelling, and writing. Also, girls receive equal or higher grades than boys in math and science.

A different picture emerges when one examines the performance of girls and boys on achievement tests. Although girls perform better than boys on achievement tests of reading, spelling, and writing, boys perform better than girls on achievement tests of mathematics and science (U.S. Department of Education, 2000a, 2003). Observing that girls outperform boys in terms of their grades in math but not on achievement test scores, Kenny-Benson, Pomerantz, Ryan, and Patrick (2006) explored the extent to which the effects of children's approaches to schoolwork generalized to performance on achievement tests. The researchers found that the superior performance of girls in the math or science classrooms did not appear to extend to achievement tests in those subjects. The difference was attributed to possible lower self-efficacy among girls when faced with testing situations.

In more recent years, researchers of gender in science education have examined subgroups typically underrepresented in science, such as rural, urban, economically disadvantaged, and minority students. In urban schools, African-American girls tend to outperform their male peers on achievement tests in science (Guo, 2007). Performance on science examinations among female African-American students may be due to school contextual factors that limit learning opportunities for all African-American students, but especially affect male students (Seiler, 2001). Compared to their female counterparts, African-American males have a disproportionate number of school suspensions, expulsions, and absences, which have subsequently impacted their ability to learn science subject matter.

Academic Performance in School

Academic performance in school refers to students' levels of achievement as

measured by grades for coursework and grade-level promotions or retentions. Another indicator of students' academic performance is achievement on standardized tests.

Academic difficulties, such as poor grades for coursework and grade-level retentions, have been recognized as primary reasons for students to drop out of school (Christenson et al., 2001; Gestdottir, 2007; Stearns & Glennie, 2006). Christenson et al. noted that academic difficulties are often accompanied by poor school attendance and they frequently begin in elementary school. Lan and Lanthier (2003) identified poor academic achievement as the earliest potential indicator for dropout status, and the researchers found that poor grades and course retentions of dropouts often began prior to eighth grade. After eighth grade, students' poor academic performances led to a deterioration of other personal attributes, such as attitudes toward school and relationships with peers, which contributed to eventual withdrawal from school.

Student achievement on standardized tests also foreshadows students' academic performance in school. In a research study of 16,489 African American high school students, Engerman and Bailey (2006) found that students who were in the lowest achievement quartile as 10^{th} graders were 12-times more likely to be low achievers in the 12^{th} grade.

In addition to foreshadowing students' academic success, standardized tests can literally impede students from graduating from high school (Engerman & Bailey, 2006). When students are required to take high school graduation examinations, passing scores on the tests are necessary before students are eligible to graduate from high school. In the state of Georgia, failure to pass the GHSGTs has affected high school graduation rates. Science has been identified as the content area on the GHSGT with the highest

student failure rate – an average of 28% of Georgia students each year from 2005 to 2007 failed the science portion of the GHSGT (Georgia Department of Education, 2008d).

Summary

This literature review focused on three factors related to graduation rates among high school students. The use of high-stakes tests in schools, students' social interactions with family members and school communities, and personal student characteristics were described in relationship to student achievement and high school graduation rates.

The implementation of high-stakes tests was originally intended to improve classroom instruction and student learning; however, use of the tests has not had a positive effect on teaching and learning as expected. Some adverse results of using high-stakes examinations include: (a) classroom instruction that is focused on didactic delivery of test-related content, rather than on inquiry and the development of in-depth student knowledge in a well-balanced curricula program (Abrams & Madaus, 2003; Clarke et al., 2003; Goldberg, 2004); (b) high drop-out rate of minority students, specifically, African-American students and Hispanic students (Albrecht & Joles, 2003; Orfield, Losen, Wald, & Swanson, 2004), and students with disabilities (Allbritten, Mainzer, & Ziegler, 2004); and (c) lower high school graduation rates for schools in which high school exit examinations are required (Jacob, 2001; Marchant & Paulson, 2005; Warren & Grodsky, 2009). All of those results influence students' opportunities for future careers and extended education.

The social interactions of students are a strong predictor of high school graduation rates. The social factors that most notably affect high school graduation rates are: (a) parental support and involvement, including strong support from both parents

(Domagala-Zysk, 2006; Suh et al., 2007); (b) firm parenting styles (Berk, 2000; Engerman & Bailey, 2006); (c) a high degree of perceived support from teachers, school administrators, and peers (Fleming et al., 2005; Fortin, et al., 2006); and (d) strong instructional support via teachers who use a variety of teaching methods (Hamre & Pianta, 2005). Each of the factors impacts the chances that a student would graduate from high school.

Finally, specific characteristics of students who fail to graduate from high school include: (a) low socioeconomic status (Fang & Sen, 2006: Masten, 2000; Solberg et al., 2007); (b) female gender (Kenny-Benson, Pomerantz, Ryan, & Patrick, 2006; Pomerantz, et al., 2002); and (c) poor academic performance in coursework (Christenson et al., 2001; Gestdottir, 2007; Stearns & Glennie, 2006). All of those factors have been found to impede student success on exit examinations, therefore increasing the likelihood of students dropping out of school before graduation.

Chapter III

RESEARCH DESIGN AND METHODOLOGY

This study assessed the relationship between GHSGT scores in science and selected academic and non-academic indicators such as gender, ethnicity, prior performance in science classes, any form of previous grade retention, Georgia End of Course Test (EOCT) scores in physical science and biology, and CRCT scores in reading, mathematics, and science. The ultimate purpose of the study was to identify predictors of performance on the Science GHSGT.

All Georgia public schools are required to administer the GHSGT, which measures student mastery of academic standards in English/language arts, mathematics, social studies, and science. The GHSGT is a criterion-referenced assessment based on state academic standards. Findings in the study that support a positive correlation between Science GHSGT scores and the potential predictors studied will provide a model for early identification of students at risk of failure on the science portion of the GHSGT. Early identification of at-risk students will allow for implementation of instructional programs and strategies to remediate students in need of extra academic support in science.

Description of Participant School

The participant school serves approximately 2,000 inner-city students attending grades nine through twelve in a south-central Georgia city of 50,000 residents. School curriculum offerings include college preparatory and honors-level courses in all academic

disciplines to include Advanced Placement courses in mathematics, science, English/language arts, social studies, and art. Additionally, an International Baccalaureate (IB) Programme, which offers students the opportunity to earn an IB diploma as well as a Georgia High School diploma, was fully implemented. The IB Programme is an advanced curriculum with an international focus that requires study of the major academic disciplines, Theory of Knowledge, Extended Essay, and successful completion of comprehensive examinations to earn the diploma.

Examination of the 2007-2008 Georgia Public Education Report Card (GADOE, 2008d) revealed an ethnic distribution in the study school of 19% Caucasian, 75% African American, and 6% other ethnicities (i.e., Hispanic, Asian, American Indian, and Multiracial). The gender ratio among the student body was 46.5% male and 53.5% female (Table 1).

Students eligible to receive free and reduced price meals comprised 56% of the school population (Georgia Department of Education, 2008d). This school also participated in the Title I program, a federally funded program providing financial assistance to schools with high percentages of financially disadvantaged children to help ensure that all children meet challenging state academic standards (U.S. Department of Education, 2008). Students with disabilities comprised 10.3% of the population, Remedial Education 2.7%, and English to Speakers of Other Languages (ESOL) 0.8% (Georgia Department of Education, 2008d).

Further examination of the 2007-2008 Report Card (Georgia Department of Education, 2008d) for this school describes the school staff as consisting of eight Full-Time Equivalent (FTE) support personnel, 15 FTE administrators (i.e., school-based

administrators), and 121 FTE teachers. The administrators were equally divided between male and female (53.7% male), while support personnel were predominantly female (75%). The teaching staff was predominantly female (64.5%) averaging thirteen years teaching experience. The ethnicity of the teaching staff was primarily Caucasian (69.4%). Educationally, the majority of the teaching staff held one of the following degrees: master's degree (47.1%), bachelor's degree (38.8%), or educational specialist's degree (12.4%).

Table 1: *Demographics of Study School, School System, and State*

	High School		School System		State of Georgia	
	Percent					
	2007	2008	2007	2008	2007	2008
Caucasian	21	19	19	18	47	46
African American	74	75	75	76	38	38
Other (Asian, Hispanic)	2	4	4	5	12	13
Students with Disabilities	12	12	15	13	12	11
Eligible Free/Reduced Meals	56	55	68	68	50	51

Research Questions

Selection of an appropriate research design, data collection method, and data analysis procedure was based on compatibility with the research questions (Kerlinger &

Lee, 2000). Data for the study were collected from permanent cumulative school records. Nine indicators of student performance on high stakes tests were used to build a statistical model for predicting student performance on the GHSGT in science. Ethnicity, gender, eighth-grade CRCT results in mathematics, science, and reading, history of retention in any previous grade, academic performance in prior science classes, and EOCT results in physical science and biology were selected because these variables represent important indicators in a variety of school and academic issues, including dropout and graduation rates (Lee & Burkam, 2001).

In order to gain an understanding of these characteristics among the students investigated in this study, the following research questions served as a guide for this study:

1. Can performance on the Science GHSGT (i.e., Pass or Fail) be accurately predicted from gender, ethnicity, performance in previous high school science classes, previous grade retention, performance on eighth-grade Reading CRCT, performance on eighth-grade Mathematics CRCT, performance on eighth-grade Science CRCT, performance on high school Physical Science EOCT, or performance on high school Biology EOCT?
2. What is the accuracy and reliability of the developed model?
3. Does cross-validation of the data confirm the reliability of the analytical model?

Dependent Variable

Performance on the Science GHSGT served as the dependent variable in the study. A category for the dependent variable was created to distinguish students who

passed the test from those who did not pass. Using SPSS statistical processing software, a database was designed for statistical processing of the study data. In the database, passing test scores on the GHSGT in science of 500 or better were assigned a code of one (1), and failing scores of less than 500 were assigned a code of zero (0).

Predictor Variables

Nine variables representing measurable characteristics that may predict performance on the Science GHSGT were selected for analysis. Variable selection was dependent to some degree on data availability and consistency in the examined permanent records. For example, consistent disciplinary and attendance records were not available and, therefore, the factors were not evaluated.

Gender. The gender for each case was designated as either male or female.

Ethnicity. Each participant was assigned to one of three categories used to designate ethnicity. Caucasian students and African American students were assigned to separate categories. All other minority, Asian, and Hispanic students were combined into one category.

Previous Science Grades. Student performance in high school science classes completed prior to administration of the GHSGT in science was evaluated for statistical significance to exit exam science scores. Performance in ninth-grade biology and tenth-grade physical science was merged to form one category for analysis. Students with a grade below 70% in either course were designated as failing the category. In some instances, advanced students may have opted to take chemistry rather than physical science. In such cases, chemistry was substituted for physical science because of the similarity in course content and because the State of Georgia accepted this substitution at

the time in the state curriculum.

Previous Grade Retention. Research reveals that students who fail and are retained in at least one grade during their academic career are more likely to fail in later grades or drop out of school completely (Lee & Burkam, 2001). Grade retention was therefore evaluated for correlation to performance on the GHSGT in science. Students whose records showed that they were retained one or more times at any grade level were designated as having been retained in a grade at some point. No distinction was made for the number of times a particular student was retained or for the grade level where retention occurred.

EOCT scores in Physical Science and Biology. EOCTs are Georgia Department of Education mandated tests, administered at the conclusion of high school biology and physical science courses. Student scores from the sample group on the Biology EOCT and the Physical Science EOCT were evaluated for correlation with performance on the Science GHSGT.

Eighth-grade CRCT Scores in Reading, Mathematics, and Science. The state of Georgia annually administers CRCTs at the end of the eighth-grade school year in reading, mathematics, and science. CRCT results in these subjects from the sample group were evaluated for correlation with performance on the Science GHSGT.

Data Collection Procedure

The data collection process for this study was conducted after receipt of approval from the Valdosta State University Institutional Review Board (see Appendix A). The principal of the high school from which data were collected granted permission to access electronic records and student transcripts prior to data collection (see Appendix B).

Individual student permanent records were evaluated and relevant data extracted and stored in a database using SPSS software (IBM Corporation, Armonk, NY). Confidentiality of individual student data was maintained by assigning each student record a random identification number using the SPSS random number generator.

Description of Sample

Gay (1996) posited that beyond a certain population size (N = 5000) the population size becomes irrelevant, and that a sample size of 400 participants from such a population results in a 0.90 confidence level at the $p \leq .05$ level. In order to insure a sample of sufficient size for this population of students (N = 2000), 712 student records were sampled to obtain an original sample size representative of the student population at the participant school.

The students in the sample had been administered the battery of GHSGTs in 2006 and 2007 and the eighth-grade CRCTs in 2003 and 2004. Gender, ethnicity, eighth-grade Science CRCT scores, eighth-grade Mathematics CRCT scores, eighth-grade Reading CRCT scores, Biology EOCT scores, Physical Science EOCT scores, and grade retention data were extracted and recorded from permanent paper-based and electronic student records. All data were entered into an SPSS database for statistical analysis.

Data Screening

Prior to analysis, the data were screened for missing values. Only cases with complete data were included in analyses. Some cases contained missing data for one or more variables (gender, ethnicity, eighth-grade Science CRCT scores, eighth-grade Mathematics CRCT scores, eighth-grade Reading CRCT scores, Biology EOCT scores, Physical Science EOCT scores, and grade retention). Reduction of sample size after

elimination of cases with missing data was not a significant concern. Logistic regression analysis, unlike linear regression or general linear models of data analysis, does not depend on linear relationships between dependent and independent variables, as the value predicted describes a non-linear probability of a dichotomous (e.g., "Pass" or "Fail") outcome (Mertler & Vannatta, 2005). Predictors need not be normally distributed or related linearly, making logistic regression a more flexible analytical technique. Logistic regression analysis, therefore, is less dependent on a large sample size. A recommended ratio of cases to independent variables of at least 15 cases to every one independent variable when conducting logistic regression analyses will provide a reliable regression equation (Stevens, 1992). The recommended ratio of cases to predictor variables was maintained for the analyses described in this study. As a consequence, cases that were incomplete were not included in the statistical analyses.

Some data gaps were attributed to student transfers from other school systems where Georgia CRCT and EOCT assessments were not administered. Other missing data were attributed to incomplete permanent records, making retention data or standardized test scores unavailable. In other cases, students who participated in the GHSGT may not have participated in EOCT or CRCT testing. Many students included in the original sample did not take the Georgia Science CRCT in eighth-grade because the test was not yet implemented statewide. The missing data therefore resulted in the elimination of a number of cases from the final analyses.

Data Coding

Table 2 describes the coding employed for the study variables and subsequent analysis via SPSS software. Nine predictor variables representing measurable

characteristics that may predict performance on the Science GHSGT were selected for analysis. The complete data set was randomly divided into two data sets using the SPSS random sample generator. One data set was designated for exploratory analysis via the statistical model, and the other for model validation.

Table 2: *Summary of Data Coding*

Characteristic	Code	Data Level
Science GHSGT	0 = Fail 1 = Pass	Nominal
Gender	0 = Male 1 = Female	Nominal
Ethnicity	0 = Caucasian 1 = African American 2 = Other minority (Asian, Hispanic)	Nominal
Grade Retention	0 = never retained 1 = retained one or more grades	Nominal
Previous Science Grades	0 = Failed at least 1 course 1 = Passed all	Nominal
Reading CRCT	0 = Fail 1 = Pass	Nominal
Science CRCT	0 = Fail 1 = Pass	Nominal
Mathematics CRCT	0 = Fail 1 = Pass	Nominal
Physical Science EOCT	0 = Fail 1 = Pass	Nominal
Biology EOCT	0 = Fail 1 = Pass	Nominal

Logistic Regression Analysis

Data analysis included the use of descriptive statistics and logistic regression analyses. The descriptive statistics were included to summarize the characteristics of the sample (Rasmussen, 1992). Frequencies, means, and distributions were obtained to ensure that all variables support dichotomous outcomes, values were within range, and means and standard deviations were plausible (Tabachnick & Fidell, 2007).

Logistic regression analysis is the statistical method of choice when the outcome is dichotomous (i.e., Pass or Fail), and is closely related to a linear regression model. The logistic model provides the researcher with a description of the strength with which a predictor variable predicts the outcome of the dependent variable (O'Halloran, 2008). This process differs from linear regression which presents a description of a positive, negative, or zero relationship between the predictor and dependent variables using a continuous range of values in the dependent variable (Hinton, 2004).

The central mathematical concept underlying logistic regression is the logit – the natural logarithm of an odds ratio (Peng, Lee, & Ingersoll, 2002). According to Peng et al., logistic regression analysis is well suited for testing hypotheses about relationships between categorical outcome variables and one or more categorical or continuous predictor variables.

When testing hypotheses of relationships between one categorical variable (i.e., Science GHSGT) and a set of predictor variables (i.e., gender, ethnicity, grade retention, CRCT performance, EOCT performance, grade retention), the result is a non-linear relationship (Peng, Manz, & Keck, 2001). Logistic regression resolves the problem via application of the logit transformation to the dependent variable (Peng et al., 2002). The

logistic model predicts the logit of *Y* from *X*, where the logit is the natural logarithm (ln) of odds of *Y*, and odds are ratios of probabilities (π) of *Y* occurring (i.e., student passes Science GHSGT) to probabilities ($1 - \pi$) of *Y* not happening (i.e., student does not pass Science GHSGT) (Peng et al., 2002). The simple logistic model has the form:

$$\text{logit}(Y) = \ln(\text{odds}) = \ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta X.$$

Logistic regression allows the prediction of a discrete outcome from a set of variables, thus allowing for more flexibility of data analysis. The predictor variables can be any mix of continuous, discrete and dichotomous variables (Tabachnick & Fidell, 2007). Logistic regression analysis was used in order to determine the predicted probability of a student passing the GHSGT in science. This statistical technique is appropriate since the dependent variable in this study is dichotomous.

Logistic regression analysis results in a summary of seven statistics and the constant for each variable (Mertler & Vannatta, 2005). As in multiple regression analysis, *B* represents the unstandardized regression coefficient and describes the effect of the independent (predictor) variable on the dependent variable (GHSGT Science). *S.E.* is the standard error of *B,* and *Wald* is a measure of the significance for *B* and is descriptive of the ability of each variable to contribute to the model.

Tabachnick and Fidell (2007) describe the *Wald* statistic as conservative in nature, and therefore recommend application of a more liberal significance level (i.e., $p < .05$ or $p < .1$) when interpreting this value. Degrees of freedom (*df*) and level of significance (*Sig*.) are also reported for the *Wald* statistic. The partial correlation (R) of each predictor variable with the dependent variable is also reported. Finally, *Exp(B*), which is the odds ratio representing any increase in the odds of a variable being classified in a category

when the predictor variable increases by 1, is the final value reported. The odds ratio is a measure of the likelihood of group membership, defined in this study as students who pass the GHSGT in science.

Exploratory and Cross-Validation Analysis

To construct and validate an adequate prediction model, two data sets were used for analysis. The SPSS random sample generator was used to select approximately one-half of the records from the full data set. The first set of 378 randomly selected records (Data Set A) was designated for exploratory analysis via the statistical model. The second set of 334 randomly selected records (Data Set B) was designated for model validation.

A forward logistic regression model was constructed to determine significant and meaningful predictor variables. Forward logistic regression enters each independent variable into the model in a stepwise fashion. The variable is maintained in the model until replaced by a new variable that makes a more significant contribution to prediction of the dependent variable as measured by an increase in R^2 (Mertler & Vannatta, 2005). A total of nine variables were sequentially included in the initial evaluation, and were maintained in the model if found to be significant at $\alpha = 0.05$. Variables that did not meet this standard were not included in the final data analysis.

Cross-validation of the statistical model was accomplished via application of the regression coefficients developed through analysis of Data Set A to Data Set B. The summary statistics and model fit statistics obtained from the analyses of the two data sets were then compared for consistency. Close agreement of the statistics between the two data sets is indicative of a good statistical model (Tabachnik & Fidell, 2007).

Tests for Goodness of Fit

Chi-Square Test. The recommended test for overall fit of a binary logistic regression model is the Hosmer and Lemeshow test, also called the chi-square test (Mertler & Vannatta, 2005). This test is considered more robust than the traditional chi-square test, particularly if continuous covariates are in the model or the sample size is small. A finding of non-significance corresponds to the researcher concluding the model adequately fits the data. This test is preferred over classification tables when assessing model fit.

Overall Model Fit. Overall model fit was further assessed via *-2 Log Likelihood* index. This statistic indicates whether the data are a good fit for the model (George & Mallery, 2000). Small values on this index indicate that the model adequately fits the data. A perfect model will result in a value for this measure equal to zero (0). Similar to the chi-square value, the Goodness-of-Fit measure compares the actual values for cases on the dependent variable with the predicted values on the dependent variable. Additionally, the Nagelkerke R^2 is an estimate of R^2 that indicates the proportion of variability in the dependent variable that may be accounted for by all predictor variables included in the equation.

Mertler and Vannatta (2005) suggest that the model may result in the inclusion of fewer variables than were available at the beginning of the goodness-of-fit tests. At each step, the test itself essentially compares the actual values for cases on the dependent with the predicted values on the dependent variable. All steps that result in significance values (p) of < 0.001 indicate that the variable is a significant and important predictor of the dependent variable. A classification table comparing predicted values for the dependent

variable with the actual observed values from the logistic model data is an additional component that was also included to ensure goodness of fit. Finally, variables included in the model must be interpreted as a table of coefficients (Mertler & Vannatta, 2005).

Summary

This chapter outlined the methodology used to answer the research questions posed in this study. Data describing characteristics of the study participants were collected from permanent school records of two student cohorts in a southern Georgia high school. Analyses of descriptive statistics were conducted to establish population parameters.

A logistic regression model was constructed to analyze the predictor variables for their reliability in the identification of students at risk of failing the GHSGT in science. Forward logistic regression analysis was conducted using SPSS software, and the best predictors of student performance on the GHSGT were identified. Only data sets with no missing data were included in the statistical analyses.

The complete data set was randomly subdivided into two distinct data sets. Data Set A was used for model development, and the developed model was then applied to Data Set B for cross-validation. The results of all analyses are reported in Chapter 4 of this study.

Chapter 4 of this study includes the specific outcomes of the data analyses and discussion of the statistical treatment. Further discussion of the predictors identified as the most reliable indicators of student performance on the Science GHSGT is found in Chapter 5 of this study.

Chapter IV

DESCRIPTION OF DATA ANALYSIS

The purpose of this study was to develop a statistical model via analysis of nine discrete learner characteristics that predict performance on the GHSGT in science. An analysis of six academic variables and three non-academic variables contributed to the development of a model that can be utilized to identify and counsel high school students who exhibit a higher risk of failure on the Science GHSGT.

The predictor variables investigated included gender, ethnicity, prior performance in science classes, previous grade retention, EOCT scores in physical science and biology, and CRCT scores in reading, mathematics, and science. These factors were selected because they provided measureable data points that could be extracted from the permanent school records of students attending Georgia high schools.

Performance on the GHSGT in science was the designated dependent variable in the study. The Science GHSGT was the focus of this study, because the annual failure rate on this portion of the Georgia battery of high school exit exams is higher than the English/language arts, social studies, or mathematics exams. Data were collected from 712 permanent student records. The cases were then randomly divided using SPSS random sample generator, resulting in two data sets with 378 cases in Data set A and 334 cases in Data set B.

Exploratory Analysis of Data via Logistic Regression

Model Development

Data Set A was screened and cases with missing data were omitted from analyses. This resulted in the inclusion of 135 of 378 cases. The gender distribution of Data Set A after screening was 64 males (47.4%) and 71 females (52.6%), with an ethnic composition of 21.5% white (N = 29), 74.8% African-American (N = 101), and 3.7% other ethnicities (N = 5) (see Table 3).

Table 3: *Distribution of Total Sample by Descriptive Characteristic*

Characteristic	Frequency	Percent
Gender		
Male	64	47.4
Female	71	52.6
Ethnicity		
White	29	21.5
African-American	101	74.8
Asian/Hispanic	5	3.7

Logistic Regression Analysis

Research Question 1: Can performance on the Science GHSGT (i.e., Pass or Fail) be accurately predicted from gender, ethnicity, performance in previous high school science classes, previous grade retention, performance on eighth-grade Reading CRCT, performance on eighth-grade Mathematics CRCT, performance on eighth-grade Science CRCT, performance on high school EOCT in Physical Science, or performance on high school Biology EOCT?

To address research question 1, forward logistic regression analysis was conducted on Data Set A to determine which set of independent variables best predict Science GHSGT performance results. Logistic regression was chosen because the predictor variables studied were characterized as nominal and the outcome variable was binary in nature (i.e., Pass/Fail). The forward stepping method was used because the analysis of Data Set A was conducted to explore the viability of the statistical model. Consequently, only variables that significantly predicted the dependent variable were included in the final model.

Results of Exploratory Analysis

Forward logistic regression analyses of Data Set A revealed no statistically significant relationship between performance on the Science GHSGT and ethnicity, performance in previous high school science classes, previous grade retention, performance on eighth-grade Reading CRCT, performance on eighth-grade Mathematics CRCT, or performance on eighth-grade Science CRCT. Regression statistics yielded probability values of $p > .05$ for each of these variables, which is indicative of a lack of a statistically significant relationship. Additionally, chi-square analyses yielded probability values of $p > .001$ for all six variables, confirming the lack of statistical significance with performance on the Science GHSGT. As a result, these six variables were not considered reliable predictors of performance of the Science GHSGT.

Results of the regression analyses of Data Set A revealed a significant relationship between Physical Science EOCT, Biology EOCT, gender, and performance on the Science GHSGT. Regression statistics yielded probability values of $p < .05$ for each of these variables, indicative of a statistically significant relationship. Chi-square analyses

yielded probability values of $p < .001$ for all three variables, confirming the statistical significance between high school EOCT assessments, gender, and performance on the Science GHSGT.

Regression coefficients are presented in Table 4. Three variables were fitted to the data to test whether the variables predict performance on the Science GHSGT.

Table 4: *Regression Coefficients: Variables Included in Model (Data Set A)*

	B	*S.E.*	*Wald*	*df*	*p*	*Exp(B)*
Gender	-1.24	.50	6.25	1	.01	.29
Physical Science EOCT	1.82	.52	12.30	1	.00	6.18
Biology EOCT	1.54	.55	7.92	1	.01	4.68
Constant	-.64	.50	1.63	1	.20	.53

The result showed that

Predicted logit of (Science GHSGT) = -.64
+ (-1.24)*Gender + (1.82)*Physical Science EOCT + (1.54)*Biology EOCT

According to the model, the log of the odds of successful student performance on the Science GHSGT was negatively related to gender ($p < .05$) and positively related to Physical Science EOCT ($p < .05$) and Biology EOCT ($p < .05$). The odds ratios for gender of .29 were indicative of a slight effect of group membership, meaning a female student is .29-times less likely than a male to pass the GHSGT in science. Odds ratios for Physical Science EOCT indicated that students that passed the Physical Science EOCT were 6.2-times more likely to pass the Science GHSGT, while students who passed the Biology EOCT were 4.7-times more likely to pass the Science GHSGT.

Regression coefficients for the variables not included in the model are presented in Table 5. *Wald* statistics with significance levels $p \geq .05$ indicated that previous science grades, ethnicity, previous grade retention, eighth-grade Reading CRCT, Mathematics CRCT, and Science CRCT are not reliable predictors of performance on the Science GHSGT.

Table 5: *Regression Coefficients: Variables Not Included in Model (Data Set A)*

	B	*S.E.*	*Wald*	*df*	*p*	*Exp(B)*
Science grades	.82	.55	2.24	1	.14	2.26
Ethnicity	-.13	.45	.08	1	.78	.88
Grade Retention	-.09	.63	.02	1	.89	.92
Reading CRCT	1.30	.90	2.11	1	.15	3.68
Mathematics CRCT	-.69	.69	1.00	1	.32	.50
Science CRCT	1.12	.57	3.91	1	.05	3.07

The logistic regression analysis indicated that three of the nine independent variables – Physical Science EOCT, Biology EOCT, and gender – were statistically reliable predictors of student performance on the GHSGT in science. These predictors were entered into the final model which correctly classified 82.2% of the cases.

Tests for Goodness-of-Fit

Research Question 2: What is the accuracy and reliability of the developed model?

In response to research question 2, regression results yielded a -2 Log Likelihood of 116.31, indicating a reasonably good fit of the data to the model. While a -2 Log

Likelihood of zero is an indicator of a perfect fit of data to the model, the value obtained in this analysis was indicative of a good fit (Mertler & Vanatta, 2005). The Hosmer and Lemeshow Test for goodness-of-fit of .34 indicated a good fit of the model to the data. In this test, a significance value less than .05 indicates a poor fit of the model to the data, therefore this test showed the model to fit the data well.

Results of the chi-square goodness-of-fit test for Data Set A confirmed the inclusion of these three predictor variables in the model. At each step, the chi-square goodness-of-fit test compared the actual values for cases on the dependent variable (Science GHSGT) with the predicted values on the dependent variable. All steps resulted in significance values of $p < .001$, indicating that Physical Science EOCT, Biology EOCT, and gender are significant predictors of outcome on the GHSGT in science.

Validation of Logistic Regression Model

Cross-validation Procedure

Research Question 3: Does cross-validation of the data confirm the accuracy and reliability of the analytical model?

Cross-validation of the analytical model was accomplished via analysis of Data Set B. After screening for cases with missing data, 102 of the original cases were included for analysis. The gender distribution of Data Set B after screening was 48 males (47.1%) and 54 females (52.9%), with an ethnic composition of 22.6% Caucasian (N = 23), 72.6% African-American (N = 74), and 4.9% other ethnicities (N = 5) (see Table 6).

Table 6: *Distribution of Total Sample by Descriptive Characteristic*

Characteristic	Frequency	Percent
Gender		
Male	48	47.1
Female	54	52.9
Ethnicity		
White	23	22.6
African-American	74	72.6
Asian/Hispanic	5	4.9

Results of Logistic Regression Analysis

Regression coefficients are presented in Table 7. *Wald* statistics for Data Set B indicated that gender and Biology EOCT were the significant predictors of performance on the Science GHSGT. Significance levels of *Wald* values for gender and Biology EOCT were less than .05, indicating that these variables were significant predictors of performance on the Science GHSGT. Significance level of the *Wald* value for Physical Science EOCT was .15, indicating that this variable was not a statistically significant predictor of performance on the GHSGT in science.

Odds ratios for Biology EOCT indicate that students passing the EOCT in biology were 11.5-times more likely to pass the Science GHSGT. Odds ratios for gender of .48 were indicative of a slight effect of group membership, meaning a female student is .48-times less likely than a male to pass the Science GHSGT.

Table 7: *Regression Coefficients: Data Set B*

	B	*S.E.*	*Wald*	*df*	*p*	*Exp(B)*
Gender	-.73	.36	4.28	1	.04	.48
Biology EOCT	2.4	.39	40.14	1	.00	11.50
Physical Science EOCT	.67	.46	2.07	1	.15	1.94
Constant	-.96	.42	5.12	1	.02	.38

Accuracy of the Logistic Regression Model

Logistic regression analysis was conducted to determine the viability of each independent variable to predict student performance on the Science GHSGT. The logistic regression analyses indicate that two of the three independent variables tested–gender and Biology EOCT–are statistically reliable predictors of student performance on the GHSGT in science. These predictors were entered into the overall model which correctly classified 79.8% of the cases (see Table 8).

Table 8: *Classification Table (Data Set B)*

			Predicted		
			Science GHSGT		
			Fail	*Pass*	*Percentage Correct*
Step 1	Science GHSGT	Fail	47	30	61.0
		Pass	20	151	88.3
	Overall Percentage				79.8

Reliability of the Logistic Regression Model

Results of the chi-square goodness-of-fit test for Data Set B confirmed the inclusion of two predictor variables in the model. For each predictor variable, the chi-square goodness-of-fit test compared the actual values for cases on the GHSGT in science with the predicted values on the dependent variable. All steps resulted in significance values of $p < .001$, indicating that Biology EOCT and gender were significant predictors of outcome on the GHSGT in science (see Table 9).

Table 9: *Omnibus Test of Model Coefficients (Data Set B)*

		Chi-square	*df*	*Sig.*
Step 1	Step	69.598	3	.000
	Block	69.598	3	.000
	Model	69.598	3	.000

Regression results yielded a *-2 log likelihood* of 237.67, indicating a reasonably good fit of the data to the model. While a *-2 log likelihood* of zero is an indicator of a perfect fit of data to the model, the value obtained in this analysis was not extremely large (i.e., >500). Additionally, the Hosmer and Lemeshow Test for goodness of fit of $p = .334$ indicated a good fit of the model to the data.

Summary

Presented in this chapter were the descriptive data obtained for each of the predictor variables tested. The compiled data were randomly divided into two distinct data sets and the logistic regression model applied to each data set. Exploratory analysis of Data Set A indicated that gender, Physical Science EOCT, and Biology EOCT were

statistically significant predictors of performance on the Science GHSGT.

Gender was found to have a statistically significant effect on Science GHSGT performance, with female students 0.29-times less likely to pass than male students. Analysis of Data Set A indicated that students who passed the Physical Science EOCT were 6.2-times more likely to pass the Science GHSGT, while students who passed the Biology EOCT were 4.7-times more likely to pass the Science GHSGT. Analysis of both sets of data found both gender and the Biology EOCT to be a statistically significant predictor of performance on the Science GHSGT.

Accuracy and reliability of the analytical model were confirmed via chi-square and goodness-of-fit statistics, as well as cross-validation with Data Set B.

Chapter V

DISCUSSION

In an increasingly competitive global economy, earning a high school diploma is critical in gaining successful employment and building a productive career (Southern Regional Educational Board [SREB], 2005). Civic leaders recognize the economic and social benefits that high school graduates offer to society (Amos, 2008). These same leaders also realize the negative economic, social, and personal consequences that result when increasing numbers of dropouts settle in their communities.

High school graduates are likely to find steady, long-term, higher-paying employment, and are far less likely to rely on government-funded assistance (Garfinkel, Kelly, & Waldfogel, 2005). High school graduates also tend to live longer (Muennig, 2005) and become engaged in their communities by voting, volunteering, and paying taxes (Junn, 2005), and are less likely to become parents at an early age (Haveman et al., 2001).

Many states use standardized tests for making decisions regarding students' grade-level placements and graduation eligibility. As of 2006, 22 states had implemented the use of high school exit examinations with three additional states making plans to add exit examinations by 2012 (Center on Education Policy, 2007). With the exceptions of Minnesota, Indiana, Ohio, New York, and Rhode Island, states requiring exit examinations were located among the southern tier of states within the United States. In 2002, nearly half of all public school students and more than half of all minority students

lived in the 22 states that required students to pass a graduation exit examination (Chudowsky et al., 2002). Those states were the most populous states with higher than average minority student population, higher rates of poverty, and lower per-pupil spending than the national average.

The disparity in high school graduation rates between White and minority students is well documented. In 2003, for example, the national graduation rate for White students was 78%, compared with 72% for Asian students, 55% for African-American students, and 53% for Hispanic students (Greene & Winters, 2006). As evidenced from those percentages, students from minority groups failed to graduate from high schools more frequently than non-minority students. In some states the difference between White and minority graduation rates was 40 or 50 percentage points (Editorial Projects in Education [EPE], 2007).

As with the minority gap, a large collection of research has documented differences in the academic achievement of girls and boys (Dwyer & Johnson, 1997; Entwisle et al., 1997; Pomerantz et al., 2002). According to those studies, girls typically receive higher grades than boys for reading, spelling, and writing, and equal or higher grades in math and science. A different picture emerges when one examines the performance of girls and boys on achievement tests. Although girls perform better than boys on achievement tests of reading, spelling, and writing, boys perform better than girls on achievement tests of mathematics and science (U.S. Department of Education, 2000a, 2003).

Academic difficulties, such as poor grades for coursework and grade-level retentions, have been recognized as primary reasons for students to drop out of school

(Gestdottir, 2007; Stearns and Glennie, 2006). Christenson et al. (2001) noted that academic difficulties are often accompanied by poor school attendance and frequently begin in elementary school. Lan and Lanthier (2003) identified poor academic achievement as the earliest potential indicator for dropout status, often beginning prior to eighth grade. After eighth grade, students' poor academic performances led to a deterioration of other personal attributes, such as attitudes toward school and relationships with peers, which contributed to eventual withdrawal from school.

High school dropouts suffer serious consequences on both a personal and public level, and are a source of concern to community leaders (Neild & Balfanz, 2006). Students who do not complete high school are more likely to drain resources from the local economies in which they settle, and civic leaders are concerned that these dropouts lack the skills and knowledge necessary to make them eligible for consistent, high-quality, long-term employment. Rouse (2005) found that only about half of the nation's high school dropouts maintain regular jobs, as compared with 69% of high school graduates and 74% of college graduates. Moreover, communities must often bear the additional financial burden of providing health care for an uneducated populace that is typically less healthy (Levin, 2005), less productive (Bailey, 2005), more likely to become parents at a young age (Amos, 2008), and more likely to be involved in criminal activity (Moretti, 2005).

In the southeastern United States, the percentage of high school students graduating within four years of entry into the ninth grade has declined since 1980 (SREB, 2005). Among these states, Georgia has one of the lowest graduation rates. Georgia law O.C.G.A §20-2-281 requires all high school students to successfully complete all

mandated courses and pass graduation tests in writing, English/language arts, mathematics, science and social studies to receive a high school diploma (Georgia Department of Education [GADOE], 2008c). Statewide student performance on the GHSGT varies among different content areas but science consistently has the highest failure rate. The GADOE (2008d) reported the average student failure rate in science as 28%.

The purpose of this study was to identify characteristics of students at a single high school in southern Georgia that predict student performance on the Science GHSGT. Through examination of multiple factors including gender, ethnicity, previous performance in science classes, CRCT scores in science, mathematics and reading, EOCT scores in biology and physical science, and grade retention, a statistical model to identify students at risk of failing the Science GHSGT. By addressing the factors that affect performance, plans can be developed that may lead to not only success on the test but also higher graduation rates.

Research Design and Methodology

Description of Participant School

The participant school served approximately 2000 inner–city students attending grades nine through twelve in a south central Georgia city of 50,000 residents. School curriculum offerings include college preparatory, honors level, and Advanced Placement courses in all academic disciplines. Additionally, an International Baccalaureate (IB) Programme, which offered students the opportunity to earn an IB diploma as well as a Georgia High School diploma, was in its first year of full implementation.

Examination of the 2007-2008 Georgia Public Education Report Card (Georgia

Department of Education, 2008d) revealed an ethnic distribution of students, consisting of 19% Caucasian, 75% African-American, and 6% other ethnicities (i.e., Hispanic, Asian, American Indian, and Multiracial). The gender ratio among the student body was 46.5% male and 53.5% female. Students eligible to receive free and reduced price meals comprised 56% of the school population (GADOE, 2008d). Special Education students comprised 10.3% of the population, Remedial Education 2.7%, and English to Speakers of Other Languages (ESOL) 0.8% (GADOE, 2008d).

Dependent Variable

Performance on the Science GHSGT served as the dependent variable in the study. A category for the dependent variable was created to distinguish students who passed the test from those who did not pass. In an SPSS software database designed for statistical processing of the study data, passing test scores on the GHSGT in science of 500 or better were assigned a code of one (1), and failing scores of less than 500 were assigned a code of zero (0).

Predictor Variables

Nine variables identified through a literature review as important correlates with academic performance were selected for analysis. Variable selection was dependent to some degree on data availability and consistency in the examined permanent records. Consistent disciplinary and attendance records were not available, and therefore discipline and attendance could not be evaluated. Gender, ethnicity, performance in Biology/Physical Science classes, grade retention, Biology EOCT scores, Physical Science EOCT scores, and eighth-grade CRCT scores in reading, mathematics, and science were evaluated for correlation to performance on the Science GHSGT.

Data Collection and Sample Size

The data collection process for this study was conducted after receipt of approval from the Valdosta State University Institutional Review Board. The principal of the high school from which data were collected granted permission to access electronic records and student transcripts prior to data collection. Individual student permanent records were evaluated and relevant data were extracted and stored in an SPSS database. The complete data set was randomly divided into two data files using SPSS. The first set of records (Dataset A) was analyzed using Forward Logistic Regression to determine the set of variables that best predict performance on the Science GHSGT. The results were tested using the second set of records (Dataset B) for validation.

Exploratory Analysis

After screening for missing data, 135 of the original 378 cases from Dataset A were analyzed via the developed statistical model. The gender distribution was 64 males (47.4%) and 71 females (52.6%), with an ethnic composition of 21.5% Caucasian (n = 29), 74.8% African-American (n = 101), and 3.7% other ethnicities (n = 5).

A significant relationship between Physical Science EOCT, Biology EOCT, gender, and performance on the Science GHSGT was found. These predictors were entered into the overall model which correctly classified 82.2% of the cases. Regression coefficients for variables included in the model are presented in Table 1.

Odds ratios for Physical Science EOCT indicate that students that passed the Physical Science EOCT were 6.2-times more likely to pass the Science GHSGT, while students who passed the Biology EOCT were 4.7 times more likely to pass the Science GHSGT. Odds ratios for gender of .29 were indicative of a slight effect of group

membership, meaning a female student is .29-times less likely than a male to pass the Science GHSGT (see Table 4).

The analysis revealed no statistically significant relationship between ethnicity, performance in previous high school science classes, previous grade retention, performance on eighth-grade Reading CRCT, performance on eighth-grade Mathematics CRCT, or performance on eighth-grade Science CRCT. As a result, these six variables were not considered reliable predictors of performance of the Science GHSGT. Regression coefficients for the variables not included in the model are presented in Table 5.

Cross-validation of the Statistical Model

Data Set B was analyzed via the developed statistical model to validate model reliability. Gender and Biology EOCT were statistically reliable predictors of performance on the Science GHSGT. The validation analysis did not find Physical Science EOCT to be a statistically reliable predictor of performance on the Science GHSGT. Although Physical Science EOCT was found to be an unreliable predictor in the validation data set, regression results yielded a *-2 log likelihood* of 237.67. The *-2 log likelihood* value indicates a reasonably good fit of the data to the model. While a *-2 log likelihood* of zero is an indicator of a perfect fit of data to the model, the value obtained in this analysis was not extremely large (i.e., > 500). The overall model is therefore judged to be statistically reliable. Physical Science EOCT results may not be as reliable as Biology EOCT results in predicting performance on the Science GHSGT. Further study will be required to determine the validity of Physical Science EOCT as a predictor.

Summary and Discussion

This study analyzed the correlation of student performance on the GHSGT in science to nine potential predictors of performance on this mandatory high school exit examination. The predictor variables investigated included gender, ethnicity, prior performance in science classes, previous grade retention, EOCT performance in physical science and biology, and CRCT performance in reading, mathematics, and science. The factors were selected because they provided measureable data points that could be extracted from the permanent school records of students attending a local Georgia high school.

To identify and meet student academic needs and to ensure high school graduation, identification of characteristics of students at a higher risk of failure is essential. Development of a reliable analytical method for predicting student outcomes on high school exit examinations will assist schools in allocation of staff and funding additional academic support for low achieving students.

The results support the use of EOCT performance in biology and physical science as predictors for students at risk of failure on the Science GHSGT. The strongest relationship was found between Physical Science EOCT and student performance on the Science GHSGT. The strength of the predictive relationship between Biology EOCT and Science GHSGT was only slightly smaller than Physical Science EOCT, therefore performance on both Physical Science and Biology EOCTs were judged to be strongly predictive of outcomes on the Science GHSGT.

A small negative relationship was found between gender and student performance on the Science GHSGT, with female students slightly less likely to experience success on

the Science GHSGT than male students. This relationship, while small, supports the body of research documenting gender differences between males and females in terms of academic performance on science assessments (American Association of University Women, 1999; American College Testing Program, 1997; Dwyer & Johnson, 1997; Entwisle et al., 1997; Pomerantz et al., 2002).

The factors contributing to less successful performance by female students in this study were not examined. Literature suggests, however, that among African Americans, males typically outperform females on science achievement tests (Guo, 2007; Seiler, 2001). The gap in achievement for female students in this study raises an immediate concern for performance assessments in science. Possible factors contributing to this finding may be approach to schoolwork, as suggested by Kenny-Benson et al. (2006), or other contextual factors in the school studied (Seiler, 2001). Beyond the immediate concern for performance on science assessments, the tendency towards underperformance in science for female students in the school described in this study may have implications in terms of future aspirations and career choices.

Implications for Schools

This study found a strong predictive relationship between Biology EOCT, Physical Science EOCT, and Science GHSGT performance, which is indicative that EOCT performance scores in science should be considered when preparing students for high school exit exams in science. For school leaders, the use of EOCT test scores for early identification of students at risk of failure on the high school exit exam in science is the first step in the development of interventional strategies to improve outcomes on the Science GHSGT. The statistical model used in this study can be easily implemented by

school counselors, teachers, and administrators. Ultimately, improvement of the pass rate on the Science GHSGT may increase the number of students who graduate from high school in within four years of entry into the ninth grade.

Although Biology and Physical Science EOCT performance exhibits a strong predictive relationship with performance on the Science GHSGT, performance on eighth-grade CRCTs in science, reading, and mathematics do not predict performance on the Science GHSGT. This finding is of particular interest because a strong emphasis is placed on CRCT performance in elementary and middle grades in Georgia. All Georgia school systems administer CRCTs to students in grades one through eight to measure student understanding of content presented in the curricula during the early and middle grades (GADOE, 2008a, 2008e). While performance on elementary and middle school CRCT assessments may measure short-term mastery of curricular content, these assessments have no correlation to performance on high school assessments.

Recommendations

As of June 2011, the Georgia Board of Education implemented a plan to phase out the use of the GHSGTs tests over a 3-year time period. However, EOCTs will continue to be used to assess student mastery of state performance standards in all academic subjects. The planned expansion of EOCTs to other required academic subjects as an added requirement for credit increases the need to monitor student progress on assessments in earlier grades.

This study revealed no predictive relationship between the CRCT and EOCT assessments. The conduct of a comprehensive study using testing data from multiple school systems in Georgia is recommended. Further analysis to evaluate the statistical

relationship between Science CRCT scores and EOCT scores in physical science and biology will be beneficial not only to local school systems, but to the GADOE testing system as a whole. The statistical model developed in this study can be easily adapted to evaluate relationships between test scores in all core academic areas, and therefore can be a versatile tool for predicting student outcomes on mandatory state testing, including EOCTs. Further, the ability to predict the failure rate on a given test may prove valuable in the revision of existing tests or the design of assessments planned for future implementation.

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APPENDIX A:

Institutional Review Board Approval

Institutional Review Board (IRB)
rotection of Human Research Participants

ROTOCOL EXEMPTION REPORT

PROTOCOL NUMBER: IRB-02331-2008

INVESTIGATOR: Carol A. Dowler

PROJECT TITLE: Predictive Model for Student Performance on the Science GHSGT

DETERMINATION:

☑ This research protocol is exempt from Institutional Review Board oversight under Exemption Category 4. You may begin your study immediately. If the nature of the research project changes such that exemption criteria may no longer apply, please consult with the IRB Administrator (irb@valdosta.edu) before continuing your research.

☐ Exemption of this research protocol from Institutional Review Board oversight is pending. You may **not** begin your research until you have addressed the following concerns/questions and the IRB has formally notified you of exemption. You may send your responses to irb@valdosta.edu.

ADDITIONAL COMMENTS/SUGGESTIONS:

Although not a requirement for exemption, the following suggestions are offered by the IRB Administrator to enhance the protection of participants and/or strengthen the research proposal:

None

If you make any of these suggested changes to your protocol, please submit revisions so that IRB has a complete protocol on file.

Barbara H. Gray *12/13/11* ***Thank you for submitting an IRB application.***

APPENDIX B:

Permission to Access Student Records

VALDOSTA HIGH SCHOOL
3101 N. FORREST ST.
VALDOSTA, GEORGIA 31602
Telephone 229-333-8510
Fax 229-333-8584

Georgia School of Excellence

Brett Stanton
Principal

Page Arnette, Curriculum Specialist
Ansel Cox, Assistant Principal
Ingrid Hall, Assistant Principal
Phyllis Harvey-Brown, Assistant Principal

Rufus McDuffie, Assistant Principal
Julia McKissack, Instructional Specialist
Mike Samaras, Assistant Principal
George Ward, Vocational Supervisor

December 18, 2007

Barbara H. Gray, Director
Valdosta State University Office of Grants and Contracts
1500 N. Patterson St.
Valdosta, Georgia 31698

I, Brett Stanton, authorize Carol A. Dowler to access current and archived student records at Valdosta High School as needed to complete a doctoral dissertation. This research shall be conducted under the direction of Ms. Dowler's dissertation chairman, Dr. Verilette Hinkle. In addition, this research will be conducted in strict compliance with guidelines as set forth by the Valdosta State University Institutional Review Board for Protection of Human Subjects. Access to physical records stored in the Valdosta High School records room and computer records shall be authorized for the duration of the research conducted by Ms. Dowler.

Sincerely,

Brett Stanton, Principal
Valdosta High School