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

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Abstract

Testing results show that a southern Georgia high school's students consistently perform poorly on the Georgia High School Graduation Test (GHSGT) in science. This study examined nine variables via logistic regression for correlations with failing scores on the Science GHSGT. Findings indicated that Georgia End of Course Tests (EOCT) in physical science and biology were statistically reliable predictors of student success on the Science GHSGT. Gender was found to have a very small predictive relationship with Science GHSGT scores; female students were less likely than males to pass the Science GHSGT. Science class performance, ethnicity, eighth-grade Criterion-Referenced Competency Test (CRCT) scores in science, mathematics, and reading, and previous grade retention had no significant predictive relationship with Science GHSGT scores.

Keywords: Achievement, Assessment, Evaluation, Mathematics Education, Science Education, Testing

1. 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). 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.

Because they are likely to find steady, long-term, higher-paying employment, high school graduates 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). 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, 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, less productive, more likely to become parents at a young age, and more likely to be involved in criminal activity (Amos, 2008; Bailey, 2005; Levin, 2005; Moretti, 2005).

In the southeastern United States, the percentage of high school students graduating within 4years of entry into the ninth grade has declined since 1980 (SREB, 2005). Among these states, Georgia has one of the lowest graduation rates. The National Center for Education Statistics (NCES) reported that in 1998 only 54% of Georgia's high school students earned a diploma within 4 years of entering the ninth grade, and, that between 2000

and 2005, approximately 60% of Georgia students graduated within the expected 4-year period after entry into the ninth grade (NCES, 2007).

1.1 Georgia Exit Exams

Georgia Code, O.C.G.A §20-2-281 (2014) 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], 2008b).Statewide student performance on the Georgia High School Graduation Tests (GHSGTs) varies among different content areas. The GaDOE (2008c) 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.

1.2 Purpose of the Study

The purpose of this study was to identify characteristics of students at a single high school in southern Georgia that predict potential failure on the Science GHSGT. Through examination of multiple factors including gender, ethnicity, previous 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, the researcher planned to develop a statistical model to identify students at risk of failing the Science GHSGT. The ultimate goal was to develop a model that could be easily implemented by school counselors, teachers, and administrators so that interventional strategies to improve scores on the Science GHSGT could be targeted to those students who need the most improvement.

1.3 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 this study, the researcher addressed 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 a model developed to predict student performance on the Science GHSGT?
3. Does cross-validation of the data confirm the accuracy and reliability of the analytical model?

2. Review of Literature

The task of preparing teenagers for an increasingly demanding job market presents a unique set of challenges for public high schools. Because an estimated 85% of jobs now require at least a high school diploma and some post-secondary degrees, high school

graduates must be prepared for the rigors of a demanding workplace and further education (Alliance for Excellent Education, 2008; Achieve, Inc. & National Governors Association, 2005).Business leaders and college presidents report that high schools are failing to prepare many students for work and higher education, and as a consequence they 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 (Achieve, Inc. & National Governor's Association, 2005).

2.1 Impact of High-Stakes Testson Student Learning and Classroom Instruction

Approximately half of U.S. public school systems require high school exit examinations covering the primary academic content areas (Center on Education Policy, 2007). For most states in the U.S., the content of those tests reflect the academic standards 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 student failure of high-stakes tests may result in detrimental consequences for students, the rationale for using high-stakes tests is based on the belief that these tests improve student learning and classroom instruction (Hanushek& Raymond, 2005).

2.2 Rationale for Using High-Stakes Tests

Proponents of high-stakes testing in public schools posit that in theory, standardized tests, such as benchmark measures or exit examinations, cause students to be more highly motivated and increase parental involvement (McDonnell, 2005; Raymond & Hanushek, 2003). In addition, proponents believe that mandatory 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).

Competency testing 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* included concerns among educational leaders that U.S. public schools were falling behind academically to their international counterparts causin high school exit exams to regain popularity as educational policy makers sought to ensure that students who received high school diplomas had mastered fundamental skills in reading, writing, and mathematics (Amrein& Berliner, 2002; Dorn, 2003).

2.3 Effectiveness of Using High-Stakes Tests in Public Schools

Although the initial intent of using high-stakes tests in public schools was to improve student learning, researchers have reported that exit examinations have failed to improve academic achievement, to increase graduation rates, or to produce graduates who are prepared for work (Jacob, 2001; Marchant & Paulson, 2005; Warren &Grodsky, 2009). After evaluating nationally representative data spanning a 30-year period, 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. Marchant

and Paulson also expressed concern that exit exams did not actually measured the types of knowledge and skills required for success beyond high school.

2.4 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 3 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, Kober, Gayler, & Hamilton, 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.

2.4.1 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 Black 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 ethnic minority graduation rates was 40% to 50% (Editorial Projects in Education [EPE], 2007).

2.4.2 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. Although each disabled student has an Individualized Plan (IEP) to address his or her special needs, since the passage of No Child Left Behind Act (2001), students with disabilities have been expected to meet the same academic requirements as regular education students (Schwartzbeck, 2003).Allbritten, Mainzer, and Ziegler (2004) suggested that certain elements of NCLB conflicted with federal and state requirements for those students.

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.

2.5 High-Stakes Tests and Classroom Instruction

The use of high-stakes tests in K-12schools has affected 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 and Madaus (2003) identified several unintended consequences 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.

Clark, Shore, Rhoades, Abrams, Miao, & Li(2003) interviewed 360 educators from elementary schools, middle schools, and high schools to determine the influence of state-level standardized tests on teaching and learning. Forty percent 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.

According to survey data involving 360 teachers in 100 schools, 79% of the teachers who participated in the survey 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. Shepard and Dougherty (1991) also found that teachers spent an average of 4 weeks per year preparing students for high-stakes tests and lost an additional 5 to 10 days of class time to administer the tests.

2.6 Characteristics of Students, Who Do Not Graduate From High School

2.6.1 Socioeconomic Status. Fang and Sen (2006) found family socioeconomic status 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.

2.6.2 Violence. 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.

2.6.3 Gender. A large collection of research has documented differences in the academic achievement of girls and boys (Dwyer & Johnson, 1997; Entwisle, Alexander, & Olson, 1997; Pomerantz, Altermatt, & Saxon, 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).

2.6.4 Academic performance in school. 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& Lerner, 2007; Stearns &Glennie, 2006). Christenson, Sinclair, Lehr, and Godber (2001) noted that academic difficulties are often accompanied by poor school attendance and frequently begin in elementary school. Lan& 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. Student achievement on standardized tests can also foreshadow 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 tenth graders were 12 times more likely to be low achievers in the 12th grade.

3. 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, previous grade retention, Physical Science EOCT scores, Biology EOCT scores, and eighth-grade CRCT test scores in reading, mathematics, and science.The purpose of the study was to identify predictors of success on the Science GHSGT.

3.1 Description of Participant School

The participant school served approximately 2000 urban students attending grades 9-12 in a south central Georgia city of 50,000 residents. School curriculum offerings included 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 in addition to 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, 2008b) revealed that the school had an ethnic distribution of students, consisting of 19% Caucasian, 75% African American, and 6% other ethnicities (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, 2008b). Special Education students comprised 10.3% of the population, Remedial Education comprised 2.7% of the population, and English Speakers of Other Languages (ESOL) comprised 0.8% of the population (GaDOE, 2008b).

3.2 Dependent Variable

Success or failure on the Science GHSGT was 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 IBM SPSS software database designed for statistical processing of the study data, unique codes were assigned to distinguish passing test scores on the Science GHSGTof 500 or better from failing scores of less than 500.

3.3 Predictor Variables

Nine variables, representing measurable characteristics that may predict failure 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 those factors 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 failure on the Science GHSGT.

3.4 Data Collection and Sample Size

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 the IBM SPSS database.

3.5 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 ensure a sample of sufficient size for this population of students (*N*=2000), two cohorts of students were sampled to obtain an original sample size representative of the student population at the participant school. The final complete sample was comprised of 712 students who were administered the battery of GHSGTs in 2006 and 2007. The SPSS random sample generator was then employed to randomly select approximately one-half of the records from the full dataset. The randomly selected set of378 records were designated for use in validating the statistical model (Data Set B), while the remaining 344 records not designated as Data Set B were clustered for exploratory analysis via logistic regression to determine model fit (Data Set A).

3.6 Data Analysis

3.6.1 Screening for outliers. The analysis subsample (Data Set A) was initially comprised of 378 cases with a gender distribution of 169 males (44.7%) and 209 females (55.3%). The ethnic composition of the original subsample was 23.5% Caucasian (*N*=89), 72.8% African American (*N*=275), and 3.7% other ethnicities (*N*=14). Data screening via determination of Mahalanobis distance of the initial 378 cases in Data Set A resulted in the elimination of 243 cases that were missing data for one or more of the variables examined. Variables with a Mahalanobis distance greater than $\chi^2(9) = 27.877$ at $p = .001$ were eliminated from the analysis. The exploratory analyses described were therefore conducted using 135 of the original 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% (*N*=29), 74.8% Black (*N*=101), and 3.7% other ethnicities (*N*=5).

3.6.2 Logistic regression analysis. Forward logistic regression analysis was conducted to determine the viability of each independent variable to predict the likelihood of student failure on the Science GHSGT. The forward stepping method was employed because the analysis of Data Set A was conducted to explore the viability of the analytical model. Consequently, only variables that significantly predicted the dependent variable were included in the model. Logistic regression analysis included a summary of seven statistics–*B, S.E., Wald, df, Sig., R, Exp(B)*–for each variable included in the model and for the constant (Mertler& Vannatta, 2005). Of primary significance was the *Wald* statistic, which 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. In addition, *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, was 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 Science GHSGT.

3.6.3 Results of exploratory analysis. Forward logistic regression analysis supported an overall model of three predictor variables. Regression results yielded a *-2 Log Likelihood* at Step 3 of 116.31, indicating a reasonably good fit of the data to the model. The Hosmer and Lemeshow Test for goodness of fit of .34confirmed a good fit of the model to the data.

Regression coefficients for variables included in the model are presented in Table 1. *Wald* statistics indicated that Physical Science EOCT, Biology EOCT and gender significantly predict the outcome of the dependent variable. Significance levels of *Wald* values for all three predictors were less than .05, indicating that the variables were statistically significant predictors of student success on the Science GHSGT. Regression coefficients for the variables not included in the model are presented in Table 2. *Wald* statistics with significance of $p \geq .05$ indicated that previous science grades, ethnicity, previous grade retention, Reading CRCT, Mathematics CRCT, and Science CRCT are not reliable predictors of performance on the Science GHSGT.

Odds ratios for gender of .29 were indicative of a slight effect on group membership, meaning a female student is .29 times less likely than a male to pass the Science GHSGT. Odds ratios for Physical Science EOCT indicated that students that passed the Physical Science EOCT were 6.18 times more likely to pass the Science GHSGT, while students who passed the Biology EOCT were 4.67 times more likely to pass.

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 success on the Science GHSGT. These predictors were

entered into the overall model, which correctly classified 82.2% of the cases. In Step 1, the model including only Physical Science EOCT correctly classified 79.3% of the cases; in Step 2, the model including Physical Science EOCT and Biology EOCT correctly classified 77.8% of the cases; in Step 3, the model including Physical Science EOCT, Biology EOCT, and gender correctly classified 82.2% of the cases.

Results of the chi-square goodness-of-fit test for Data Set A confirmed the inclusion of 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 Science GHSGT.

3.7 Cross-Validation of Logistic Regression Model

The cross-validation subsample (Data Set B) was comprised of 334 cases with a gender distribution of 142 males (42.5%) and 192 females (57.5%).The ethnic composition of this subsample was 25.1% White (*N*= 84), 69.8% Black (*N*=233), and 5.1% other ethnicities (*N*=17).

Data screening of the initial 334 cases in the data set resulted in the elimination of 233 cases that were missing data for one or more of the examined variables. The remaining 101 cases were included in the model for analysis. The three predictor variables designated for analysis were screened for outliers via determination of Mahalanobis distance. Variables with a Mahalanobis distance greater than $X^2(3) = 16.266$ at $p = .001$ were eliminated from the analysis. The gender distribution of Data Set B after screening was 64 males (47.4%) and 71 females (52.6%), with an ethnic composition of 21.5% (*N*=29), 74.8% African American (*N*=101), and 3.7% other ethnicities (*N*=5).

3.7.1 Results of logistic regression analysis. Regression coefficients are presented in Table 3. *Wald* statistics for Data Set B indicated that gender and Biology EOCT were the most significant predictors of performance on the Science GHSGT. Significance levels of *Wald* values for gender and Biology EOCT were less than .05, indicating that the variables were significant predictors of failure on the Science GHSGT. Significance level of the *Wald* value for Physical Science EOCT was .15, indicating that the variable was not a statistically significant predictor of failure on the Science GHSGT.

Odds ratios for Biology EOCT indicated that students passing the Biology EOCT were 11.50 times more likely to pass the Science GHSGT. Odds ratios for gender of .48 were indicative of an effect of group membership, meaning a female student is .48 times less likely than a male to pass the Science GHSGT. Conversely, this indicates that a male student is almost twice as likely as a female to pass the test.

3.7.2 Accuracy of the logistic regression model. Logistic regression analysis was conducted to determine the viability of each independent variable to predict that a student is likely to fail the Science GHSGT. The logistic regression analysis indicated that two of the three independent variables tested–gender and Biology EOCT–were

statistically reliable predictors of student failure on the Science GHSGT. The predictors were entered into the overall model which correctly classified 79.8% of the cases.

3.7.3 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 resulted in significance values of $p < .001$, indicating that Biology EOCT and gender were significant predictors of outcome on the Science GHSGT. Regression results yielded a *-2 log likelihood* of 237.67, indicating a reasonably good fit of the data to the model. Additionally, the Hosmer and Lemeshow Test for goodness of fit of $p = .33$ indicated a good fit of the model to the data.

3.7.4 Research questions. In response to research question 1, the logistic regression analyses of Data Set A 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. 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, the 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.

Logistic 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. The 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.

Odds ratios for gender of .288 were indicative of a slight effect on group membership, meaning a female student is .288 times less likely than a male to pass the Science GHSGT. Odds ratios for Physical Science EOCT indicated that students that passed the Physical Science EOCT were 6.176 times more likely to pass the Science GHSGT, while students who passed the Biology EOCT were 4.679 times more likely to pass the Science GHSGT.

In response to research question 2, the classification table generated from analysis of Data Set B with gender, Physical Science EOCT, and Biology EOCT entered in the model revealed that the model accurately classified 82.2% of the cases. Model fit statistics (-2 log likelihood 237.688; Hosmer and Lemeshow Test for goodness-of-fit of $p=0.334$; Chi-square 69.598, $p<0.001$) were reasonably small and were indicative of a reliable fit of the model to the data.

In response to research question 3, cross-validation of the analytical model was accomplished by randomly dividing the complete data set, thus creating two sets of data that

were analyzed via the linear regression model. Analysis of each data set (Data Set A and Data Set B) yielded accurate classification of cases (Data Set A=82.2%; Data Set B=79.8%), and reliability in terms of tests for goodness-of-fit.

After analysis of each data set, Biology EOCT was found to be a statistically significant predictor of performance on the Science GHSGT. The effect of gender was also consistent across the two analyses.

4.0 Discussion and Conclusions

In this study nine potential predictors of success or failure on a high school exit examination in science were assessed. The predictor variables investigated included gender, ethnicity, prior performance in science classes, previous grade retention, Georgia EOCT scores in physical science and biology, and Georgia CRCT scores 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 study yielded a strong correlation to support the use of EOCT scores in biology and physical science as predictors for students at risk of failure on the GHSGT Science. The strongest relationship was found between Physical Science EOCT and student scores on the GHSGT Science. The strength of the predictive relationship between Biology EOCT and Science GHSGT was only slightly smaller than Physical Science EOCT, therefore both sets of EOCT scores were judged to be strongly predictive of outcomes on the Science GHSGT. A negative relationship was found between gender and student success on the Science GHSGT where female students were less likely to experience success on the Science GHSGT than male students. The predictor variables correctly classified about 80% of cases.

4.1 Implications for Schools

This study found Biology EOCT, Physical Science EOCT, and gender to be statistically significant predictors of Science GHSGT success, which is indicative that the assessment scores 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, particularly for female students. The analytical model demonstrated 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 within four years of entry into the ninth grade.

5.0 Recommendations

As of June 2011, the Georgia Board of Education implemented a plan to phase out the use of the Georgia High School Graduation tests over a 3-year time period. End of Course Tests, however, will continue to be used to assess student mastery of state performance standards in all academic subjects. The planned expansion of EOCTs to all required academic subjects as an added requirement to gain credit for required academic courses increases the need to monitor student progress on assessments in earlier grades. Data collected for cross-validation of the logistic regression model suggested that scores in the eighth-grade Science CRCT may be predictive of outcomes on the Science GHSGT. An evaluation of the correlation between eighth-grade Science CRCT and Physical Science EOCT or Biology EOCT is recommended for future study. The establishment of a positive predictive relationship between these assessments can assist counselors and classroom teachers in implementing effective instructional strategies for low performing students.

The conduct of a comprehensive study using testing data from multiple school systems in Georgia is recommended. Further analysis to evaluate the statistical relationships between Science CRCT scores and EOCT scores in physical science and biology will be beneficial not only to local school systems but to Georgia Department of Education testing system as a whole. This analytical model 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.

Tables

Table 1

Regression Coefficients: Variables included in model (Data Set A)

Variable	*B*	*S.E.*	*Wald*	*df*	*p*	*Exp(B)*
Gender	-1.244	.498	6.246	1	.012	.288
Physical Science EOCT	1.821	.519	12.296	1	.000	6.176
BiologyEOCT	1.543	.548	7.919	1	.005	4.679
Constant	-.643	.504	1.628	1	.202	.526

Table 2

Regression Coefficients: Variables not included in model (Data Set A)

Variable	*B*	*S.E.*	*Wald*	*df*	*p*	*Exp(B)*
Science grades	.816	.546	2.236	1	.135	2.261
Ethnicity	-.129	.454	.081	1	.777	.879
Grade Retention	-.087	.627	.019	1	.890	.917
Reading CRCT	1.302	.897	2.106	1	.147	3.676
Mathematics CRCT	-.685	.685	1.000	1	.317	.504
Science CRCT	1.121	.567	3.909	1	.050	3.068

Table 3

Regression Coefficients: Data Set B

Variable	*B*	*S.E.*	*Wald*	*df*	*p*	*Exp(B)*
Gender	-.734	.355	4.281	1	.039	.480
Biology EOCT	2.442	.385	40.144	1	.000	11.500
Physical Science EOCT	.666	.463	2.067	1	.150	1.947
Constant	-.957	.423	5.122	1	.024	.384

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