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The Relationship between Selected Standardized Test Scores and Performance in Advanced Placement Math and Science Exams: Analyzing the Differential Effectiveness of Scores for Course Identification and Placement

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THE RELATIONSHIP BETWEEN SELECTED STANDARDIZED TEST SCORES AND PERFORMANCE IN ADVANCED PLACEMENT MATH AND SCIENCE EXAMS: ANALYZING THE DIFFERENTIAL EFFECTIVENESS OF SCORES FOR COURSE IDENTIFICATION AND PLACEMENT

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To: Dean Delia C. Garcia
College of Education

This dissertation, written by Josué N. Urbina, and entitled The Relationship between Selected Standardized Test Scores and Performance in Advanced Placement Math and Science Exams: Analyzing the Differential Effectiveness of Scores for Course Identification and Placement, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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The dissertation of Josué N. Urbina is approved.

Dean Delia C. Garcia
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Florida International University, 2014

DEDICATION

This dissertation study is dedicated to my Heavenly Father and my family.

Thank you for being my source of inspiration, direction and strength.

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ABSTRACT OF THE DISSERTATION

THE RELATIONSHIP BETWEEN SELECTED STANDARDIZED TEST SCORES AND PERFORMANCE IN ADVANCED PLACEMENT MATH AND SCIENCE EXAMS: ANALYZING THE DIFFERENTIAL EFFECTIVENESS OF SCORES FOR COURSE IDENTIFICATION AND PLACEMENT

by

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There is a national need to increase the STEM-related workforce. Among factors leading towards STEM careers include the number of advanced high school mathematics and science courses students complete. Florida's enrollment patterns in STEM-related Advanced Placement (AP) courses, however, reveal that only a small percentage of students enroll into these classes. Therefore, screening tools are needed to find more students for these courses, who are academically ready, yet have not been identified.

The purpose of this study was to investigate the extent to which scores from a national standardized test, Preliminary Scholastic Assessment Test/ National Merit Qualifying Test (PSAT/NMSQT), in conjunction with and compared to a state-mandated standardized test, Florida Comprehensive Assessment Test (FCAT), are related to selected AP exam performance in Seminole County Public Schools. An ex post facto correlational study was conducted using 6,189 student records from the 2010 - 2012 academic years.

Multiple regression analyses using simultaneous Full Model testing showed differential moderate to strong relationships between scores in eight of the nine AP courses (i.e., Biology, Environmental Science, Chemistry, Physics B, Physics C Electrical, Physics C Mechanical, Statistics, Calculus AB and BC) examined. For example, the significant unique contribution to overall variance in AP scores was a linear combination of PSAT Math (M), Critical Reading (CR) and FCAT Reading (R) for Biology and Environmental Science. Moderate relationships for Chemistry included a linear combination of PSAT M, W (Writing) and FCAT M; a combination of FCAT M and PSAT M was most significantly associated with Calculus AB performance.

These findings have implications for both research and practice. FCAT scores, in conjunction with PSAT scores, can potentially be used for specific STEM-related AP courses, as part of a systematic approach towards AP course identification and placement. For courses with moderate to strong relationships, validation studies and development of expectancy tables, which estimate the probability of successful performance on these AP exams, are recommended. Also, findings established a need to examine other related research issues including, but not limited to, extensive longitudinal studies and analyses of other available or prospective standardized test scores.

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CHAPTER I

INTRODUCTION

The scientific future of the United States is in part entrusted to its educational system. It is this system that can serve as a resource to produce the nation's science, technology, engineering and mathematics (STEM) workforce. The vitality of the workforce is largely derived from the steady stream of scientists and the innovations that they produce (The National Academies, 2005). This workforce is important as the country is challenged with an increasingly interconnected and complex world, economic uncertainties and rapid development of technological advances (Babco, 2002; The National Academies, 2014).

One of the major factors, in determining entry into STEM careers, is the number of advanced mathematics and science courses taken in high school (George, Neale, Van Horne & Malcom, 2001; Mattern, Shaw & Ewing, 2011). In a study concerning whether students who take AP math and AP science exams were more likely to major in STEM-related disciplines than students who did not take those courses, researchers established that correlations existed. These researchers found that students who took AP Calculus AB or BC exams were more likely to earn degrees in physical science and engineering concentrations than their non-AP student counterparts (Tai, Liu, Almarode, & Fan, 2010). Likewise, students who took an exam in AP Biology, Chemistry or Physics were more likely to earn degrees in life science concentrations than students who did not take an AP exam in those sciences (Tai, Liu, Almarode, & Fan, 2010). Researchers and policy makers therefore advocate efforts to increase the availability of rigorous courses such as AP science and math courses, as these courses provide the building blocks for the STEM workforce (Babco, 2002; The National Academies, 2010). More specifically, persistent proposed action plans highlight the importance of the high school component of the pipeline as expressed by the following statements written in *Rising above the Gathering Storm and Rising above the Gathering Storm, Revisited: Rapidly Approaching a Category 5:*

> Action A-3: Enlarge the pipeline by increasing the number of students who take AP and IB science and mathematics courses. The competitiveness of US knowledge industries will be purchased largely in the K–12 classroom: We must invest in our students' mathematics and science education. A new generation of bright, well-trained scientists and engineers will transform our future only if we begin in the 6th grade to significantly enlarge the pipeline and prepare students to engage in advanced coursework in mathematics and science. (The National Academies, 2005, p. 4)

> Action A-3: Enlarge the pipeline of students who are prepared to enter college and graduate with a degree in science, engineering, or mathematics by increasing the number of students who pass AP and IB science and mathematics courses. (The National Academies, 2010, p. 28)

The AP program is seen by many as a high-quality, rigorous and academically challenging option available to students in preparation for post-secondary education (Bleske-Rechek, Lubinski, & Benbow, 2004; Burton, Whitman, Yepes-Bara, Cline, & Kim, 2002; Dougherty, Mellor, & Jian, 2006; The National Academies, 2010; National Research Council [NRC], 2002; Klopfenstein, 2003). These courses allow students to earn college credit during high school by attainment of a qualifying score on the corresponding AP exam. Furthermore, Ndura, Robison and Ochs (2003) explained that only half of all students who enroll at 4-year institutions actually complete their degree. A suggested explanation was that most students are not well prepared for the rigors of higher education. A proposed solution has been to identify more students to take Advanced Placement courses in high school (Ndura et al., 2003). However, according to the following table (Table 1) national statistics collected show that many students never reach the opportunity to take at least one AP exam before graduation.

Table 1

Student Attrition en route to Success with AP Courses & Exams

Out of 100 entering kindergarten # of students that	**Milestone**
< 68	Are aware of college readiness requirements by 8th grade
30	Are academically prepared for Common Barriers the next step on a path leading to AP by 8th grade
25	Take PSAT (grades 9-11)
20	Achieve a PSAT/NMSQT score that indicates a 50% likelihood of success on AP
15	Enrolled in 1 or more AP courses (grades 10-12) before graduation
12	Take at least 1 AP exam before Graduation
11	Score 3 or higher on at least 1 AP exam by graduation

*Note: Modified version of table as reported by The Broad Foundation (2009) using analysis of data from The College Board, Annual Report to the Nation; National Center for Education Statistics (NCES); Long Beach Unified School District (LBUSD); The Broad Prize.

According to the Broad Foundation (2009) only a small percentage of students in the K – 12 classrooms will eventually take advantage of the accelerated AP curriculum. More specifically, Table 1 emphasizes that for every 100 kindergarteners entering school, only 15 will enroll in one or more AP courses before graduation. Included among the many barriers is a lack of student and parental awareness, students not taking standardized tests that indicate readiness, as well as capable students not being identified.

In response to similar statistics offered in Table 1, there have been dramatic increases in federal and state funding for AP course offerings (NRC, 2002; Klopfeinstein, 2003; Holstead, Spradlin, McGillivray & Burroughs, 2010). Reported statistics during 1997 through 2006 show that the number of AP examinees increased nationally by 142 % (Educational Testing Service [ETS], 2008). Similarly, an increase of 125% was reported from 1999 (685, 981students) to

2008 (1,546,020 students) by the National Center for Educational Statistics (2010). AP is consequently considered one of the fastest growing high school programs in America (Farkas Duffett Research Group [FDR], 2009).

At the state level, Florida Department of Education (FLDOE) has outlined a plan known as the *Next Generation PreK-20* wherein there is a continued effort to increase student participation in AP courses (FLDOE, 2011b). In 2011, Florida was highlighted as the number one state in America for percentage of seniors taking an AP exam with 43.5 % of students (65,741) taking at least one assessment before graduation as compared to the national average of 28.3 %. In that same year Florida was third in the nation for the total number of AP exams taken by students at 231,632 (College Board, 2011; FLDOE, 2011).

General Statement of the Problem

At a glance, enrollment into AP courses is increasing in Florida and therefore the identification of students for course placement is not problematic. However, a closer look at Florida's AP enrollment data reveals a genuine problem with respect to America's STEM workforce needs, as shown in Table 2 and 3.

Table 2

Exam Participation and Performance in Florida Public Schools 2009 – 2010 by AP Subject

AP Subject	Total Enrolled	% of Total Population	Score of 1	Score of 2	Score of 3	Score of 4	Score of 5	% 3 or above
Biology	8,845	4%	54%	16%	12%	9%	8%	29%
Chemistry	5,284	3%	47%	17%	18%	12%	6%	36%
Env. Sci.	9,532	4%	46%	19%	15%	15%	5%	35%
Physics B	3,803	2%	38%	20%	22%	12%	8%	42%
Physics C (E & M)	418	<1%	25%	22%	13%	22%	8%	43%
Physics C (Mechan.)	965	<1%	25%	21%	20%	10%	16%	46%
Statistics	9,235	3%	38%	22%	20%	14%	10%	44%
Calculus AB	11,297	4%	44%	11%	17%	13%	14%	44%

Note. Table developed by using publicly available archived yearly data by the College Board for the state of Florida and by Florida Department of Education Accountability, Research and Measurement (2009 – 2010).

Table 3

Exam Participation and Performance in Florida Public Schools 2010 – 2011 by AP Subject

AP Subject	Total Enrolled	% of Total Population	Score of 1	Score of 2	Score of 3	Score of 4	Score of 5	% 3 or above
Biology	9,253	3%	52%	15%	13%	12%	9%	34%
Chemistry	6,286	2%	48%	17%	17%	11%	6%	34%
Env. Sci.	13,175	4%	36%	27%	14%	18%	5%	37%
Physics B	4,152	1%	35%	19%	23%	14%	9%	46%
Physics C (E & M)	539	<1%	37%	19%	13%	14%	17%	44%
Physics C (Mechan.)	1,063	<1%	23%	20%	22%	18%	17%	57%
Statistics	4,449	4%	41%	19%	21%	13%	6%	40%
Calculus AB	12,060	4%	42%	11%	17%	14%	16%	47%

Note. Table developed by using publicly available archived yearly data by the College Board for the state of Florida and by Florida Department of Education Accountability, Research and Measurement (2010 – 2011).

As exemplified by both tables, only a small percentage of students in Florida Public Schools enroll in STEM-related AP math and science courses. Furthermore, only a limited number of students perform well enough (score of 3 or higher) to be recommended for college credit. For example, students participating in the AP math and science programs represented approximately 19% of Florida's total public school system population between 2009 and 2011. Similar statistics highlighted in *A Report to the Nation* 2011, show that only 14.8 % of Florida's graduating class, in 2010 - 2011, enrolled in at least one AP science course before completing high school (College Board, 2011). Therefore, finding screening tools to help identify more of Florida's students who are academically ready to enroll in AP mathematics and science courses will help to widen the narrow STEM pipeline.

Rationale for the Study

Individuals who advocate for dramatically increasing the AP mathematics and science participation rate must be aware of possible unintended consequences. Klopfenstein (2003) warned that educators must appreciate the demands of the AP program so that students are not haphazardly placed into these classes. A special concern has been raised about properly identifying students who are ready to take a college level course in high school (Farkas Duffett Research Group [FDR], 2009). According to Wagner (2001) these courses are taught at a college level; therefore, they inherently require more effort on the part of the student and the teacher than traditional high school courses. Hence, expanding access needs also to be moderated with adequate advisement of students. In an independent survey by the Thomas B. Fordham Institute, researchers reported that about 60% of participating AP teachers voiced that too many students overestimate their abilities and were inappropriately placed. Furthermore, a committee gathered to consider the future of the Advanced Placement Program, stated that broadening access to AP, while maintaining the quality of the AP program could create competing forces between participation and performance (College Board, 2001).

In a traditional college or university in the United States, schools have specific quantitative and qualitative records that they review as they make placement and/or acceptance decisions. For example, aside from reviewing letters of recommendation, many universities also look at standardized tests. These standardized examination scores and percentile rank are the two factors calculated in order to construct a selection index. This selection index is one of the main criteria used to make college admission decisions, especially in public universities (Tam & Sukhatme, 2004). Typically, colleges in the United States accept either the American College Test (ACT) or the Scholastic Assessment Test (SAT) as part of the admission process. However, although an AP course is intended to be equivalent of a university level course, there is no selection index calculated or prescribed criteria in advising students towards AP placement.

In contrast, being overly cautious in selecting students, also poses a challenge for educators. Such is the case when dealing with students of various ethnicities, low-income, and/or females subgroups that have been historically underrepresented in AP programs at the national, state and local level (Burton et al., 2002; Ndura, Robinson, & Ochs, 2003; Lee, 2001). Whiting and Ford (2009) reported that, acting as gatekeepers; teachers and counselors often under refer these students for screening into the AP program. Yet, for many underrepresented Hispanic and African-American low-income students, exposure to such AP courses may be the best, if not the only opportunity to participate in rigorous, college-level high school curricula (ETS, 2008). Having the opportunity to gain college or university credit, moreover, may help students economically, but especially low income students. Such opportunity aids to minimize the escalating college costs as the fee to take the AP exam is often subsidized for minority and low income students. In the case that it is not subsidized, it is still substantially less than paying for college credits. Underrepresented ethnicities and women that are already enrolled in the public school system, furthermore, provide an untapped homegrown reservoir of talent (Blickenstaff, 2005; George et al., 2001). In essence, properly identifying and allocating students based on an accurate assessment is important for future outcomes of all students. Therefore, learners with the talent and capabilities who are accurately placed will be able to use the school system as a roadway for social and economic mobility (Oakes and Gution, 1995; Hallinan, 1994).

The PSAT/NMSQT as a Selected Standardized Test for AP Identification and Placement

In an attempt to find ways to identify students for AP course placement, a few dissertations have studied the relationships between AP science scores and various quantitative measures such as SAT mathematics, SAT verbal, SAT combined scores, Preliminary Scholastic Assessment Test/ National Merit Qualifying Test (PSAT/NMSQT), PSAT Math, PSAT Reading, PSAT Writing, attendance, grade point average, class rank, grade level, grade point average and count of prior science courses (Camera, Ewing & Millsap, 2006; Camara & Millsap, 1997, 1998; Sheperd, 1997; Wagner, 2001). Sheperd (1997) found that a multiple regression analysis showed that the best combination of predictors in performance in AP Biology to be SAT verbal score, SAT mathematics score and attendance for a sample taken from a Virginia public school system.

Wagner (2001) identified scores from standardized exams from the PSAT Math and PSAT Writing to have the strongest correlations with performance in AP Chemistry, for both the sample taken from the South Carolina public school students and for a sample taken from a school belonging to a National Consortium for Specialized Secondary Schools of Math, Science and Technology.

Currently, for educators looking to quantitatively identify more students for their AP program, researchers advocate using the PSAT/NMSQT scores (Camera et al, 2006; Camara & Millsap, 1997, 1998; Wagner, 2001). Researchers found strong relationships (as high as $r = .732$, $p < .05$) reported by Camara and Millsap (2006) between the PSAT/NMSQT scores and AP examination scores. The College Board, overseer of the AP program, has in turn developed a web-based program that is readily available to educators called *AP Potential*. This is an online tool that generates a roster of students predicted to perform with a qualifying score of 3 or better on the AP exam (College Board, 2009).

There is a practical challenge, however, for educators in relying only on PSAT/NMSQT scores as a standardized criterion for identification of potential AP students. An example is that for certain AP subjects offered as early as ninth grade, these scores are not likely to be available since the majority of students do not take these tests until October of their sophomore year (Camera et al., 2006; Camara & Millsap, 1997, 1998; Palin, 2001). Scores received from the 10th grade administration, henceforth, will only be beneficial for 11th grade and 12th grade identification and placement. Table 4 highlights the percentage of PSAT/NMSQT test takers over a 10 year span:

Table 4

PSAT/NMSQT 10th grade participation in Florida Public Schools 2000 - 2009

Academic Year	Total Enrolled	Test Takers	Percentage of Test *Takers*
2000	170,436	77,807	45.7
2001	173,071	87,939	50.8
2002	184,244	101,047	54.8
2003	191,353	116,237	60.7
2004	201,400	135,442	67.3
2005	211,446	141,683	67.0
2006	210,533	142,235	67.6
2007	209,867	140,150	66.8
2008	207,127	138,347	66.8
2009	199,206	129,902	65.2

Note. Participation 2000 – 2009. Modified using PSAT/PLAN report, FLDOE (2008a) and archived yearly data by the state of Florida Department of Education Accountability, Research and Measurement (publicly available by FLDOE website).

As the Table 4 shows, in fall 2008, 66.8% of the 10th graders in Florida public schools took the PSAT/NMSQT. This is approximately the same percentage of students taking the exam since 2004 as highlighted in Table 4. In 2009 this percentage represented 69,304 sophomores for whom PSAT/NMSQT scores were not available and henceforth for whom the AP potential tool would not apply. Likewise participating districts also vary; the PSAT was the predominant test for only 32 of the 67 county school districts in Florida (FLDOE, 2008a). Many districts, therefore, did not have any students taking the PSAT and would not be able to use this standardized test for student advisement. Furthermore, as indicated earlier, AP courses are available to students as early as the ninth grade. For example, 10.5% of the students took an AP Biology exam, AP Environmental 4%, AP Chemistry 6% before their junior year in high school (College Board, 2011). Hence, finding other standardized test scores that can be utilized when the PSAT/NMSQT scores are not available or to supplement these scores, henceforth, would have practical benefits for educators attempting to use a quantitative data-driven approach in identifying potential students for AP mathematics and science courses.

The FCAT as a Supplemental Standardized Test for AP Identification and Placement

Paralleling AP expansion of the last decade, standardized statewide assessment has taken root in the American public school system. The federal No Child Left Behind Act of 2001 requires states to measure the performance of all students in all public schools on an annual basis. In Florida, the Florida Comprehensive Assessment Test (FCAT) was developed to assess students on various measures of readiness as a response to this Act (FLDOE, 2007). The FCAT evaluates student thinking skills at various levels by categorizing question items from Low to High Complexity. In the Low Complexity category, the test items require students to demonstrate simple skills or abilities such as locating details in a text, graph, or chart. On the other end, the FCAT high-complexity items require students to think in a more abstract and elaborate manner. For instance, FCAT Mathematics skills include, but are not limited to, solving a non-routine problem, providing mathematical justifications, formulating original problems and mathematical models for complex situations, analyzing or producing deductive arguments. FCAT scores, reflective of the student's mastery of this cognitive complexity, are reported as Scale Scores (SS), Developmental Scale Scores (DSS) and Achievement Level Scores (FLDOE, 2005).

A conceptual alignment was reported to exist between skills assessed by the PSAT/NMSQT and the state standards assessed by the FCAT (College Board, 2010). The College Board established that every Skill Category and Description of Skill is also assessed by the FCAT as described in the Next Generation Sunshine State Standards (NGSSS). For example, PSAT/NMSQT Math skills such as solving problems using algebraic equations and symbols to represent relationships, patterns and functions were also addressed by state standard by MA.192.A.2.3. Likewise, PSAT/NMSQT English Language skills such as reasoning and inference to understand assumptions, suggestions and implications when reading passages and drawing informed conclusions that require students to determine the main idea in higher level text were also gaged by state standards LA.910.1.7.3 (College Board, 2010).

Several studies suggest that a relationship may exist between state tests and other standardized tests. Wilson (2004) examined the Texas Assessment of Knowledge and Skills (TAKS), and its relationship with PSAT/NMSQT in order to provide initial data for school districts in Texas. That researcher found a moderate linear relationship between TAKS and PSAT ($r = .511$, $p < .001$). However, he pointed out, more research is needed in the manner in which state assessments and other standardized assessments relate (Wilson, 2004). In a dissertation Beard (2007) used predictive discriminant analysis to study the link between the PSAT/NMSQT and FCAT and found that FCAT pass or failure can be predicted with an accuracy as high as 83.4%. In Miami Dade County Public Schools (MDCPS), Froman, Brown and Tirado (2008) examined the correlation between FCAT and AP scores in that district. Researchers established strong positive relationships as high as ($r = .60$, $p < .05$) between both assessments.

Purpose of the Study

Educators advocating for increased enrollment in AP mathematics and science are challenged to adequately place students into these courses. The purpose of this study was to investigate the extent to which a national standardized test, PSAT/NMSQT, in conjunction with and compared to, a state-mandated standardized test, FCAT, can be used to identify potential AP students who may not have otherwise been identified by other measures. The study analyzed the correlations between scores on the PSAT/NMSQT in conjunction with the FCAT scores as they related to performance on the AP science and math examinations for the 2010 – 2011 and 2011 - 2012 academic school years in Seminole County Public Schools (SCPS). The study was intended to serve as a baseline investigation in Florida.

Statement of the Problem

This study examined the extent to which scores from a national standardized test, PSAT/NMSQT, in conjunction with and compared to, state-mandated standardized test scores, FCAT, were related to AP Performance as measured by AP Scores in Math and Science courses in Seminole County Public Schools. Various Multiple Regression Analyses (MRA) using subset scores from both standardized tests were conducted in order to compare the degree to which these standardized scores are related to AP exam performance in the following STEM-related courses: (a) Biology (b) Chemistry (c) Environmental Science (d) Physics B (e) Physics C- Electricity and Magnetism (f) Physics C-Mechanics (g) Statistics (h) Calculus AB (i) Calculus BC. The primary aim was to investigate the combined correlations that are associated with the selected standardized test scores and corresponding AP exam performance in STEM-related AP disciplines. A secondary aim was to investigate the amount of variance in the outcome variable, AP exam performance, which is accounted for by the individual predictors, PSAT/NMSQT and FCAT sub-scores. The PSAT/NMSQT sub category scores are reported as follows: (a) Mathematics (PSAT-M) (b) Critical Reading (PSAT-CR) (c) Writing (PSAT-W). The FCAT scores are reported as follows: (a) Mathematics (FCAT-M) b) Reading (FCAT-R) (c) Writing (FCAT-W).

Research Questions

Question 1. (a) To what extent were the combined selected standardized test scores, PSAT/NMSQT (Math, Critical Reading and Writing scores) and FCAT (Math, Reading and Writing scores), related to performance on each of the selected AP math and science exams in Seminole County Public Schools for students during the 2010 – 2011 and 2011 - 2012 academic school years? (b) What is the extent of unique variance that each selected standardized test sub-scores (PSAT-M, PSAT-R, PSAT-V, FCAT-M, FCAT-R, FCAT-W) accounts for in the relationship?

Question 2. (a) To what extent were PSAT/NMSQT scores alone related to AP exam performance for students with at least one reported AP math and science score during 2010 – 2011 and 2011 - 2012 academic school years in Seminole County Public Schools for selected

STEM-related subjects? (b) What is the extent of unique variance that each selected standardized test sub-scores (PSAT-M, PSAT- CR, PSAT-V), accounts for in the relationship?

Question 3. (a) To what extent were FCAT scores alone related to AP exam performance for students with at least one reported AP math and science score during 2010 – 2011 and 2011 - 2012 academic school years in Seminole County Public Schools for selected STEM-related subjects? (b) What is the extent of unique variance that each selected standardized test sub-scores (FCAT-M, FCAT-R, FCAT-W) accounts for in the relationship?

Definitions

The following terms are defined as follows for this study:

Achievement. Related to score received on the AP exam as defined by the College Board; a qualifying grade for college or university credit is 3 or higher on the AP exam.

Achievement Levels. Related to FCAT scores and expressed in five categories. Each category represents the success students demonstrate with content assessed on the FCAT SSS.

AP Course. Designed to be the equivalent of a one or two-semester college course, based on AP Score recommendations ranging from 1 - 5 on the AP exam, some high school students may be granted college credit. Each post-secondary institution has its own AP credit policy regarding their particular interpretation of an AP score recommendation.

AP Student. A particular student that enrolled and completed an AP course exam.

AP Exam. A standardized test given to students in May, towards the end of each academic school year. The test consists of two sections, a section of multiple choice questions and a portion with four free-response questions. The AP exam aims to measure the students' ability to acquire the conceptual framework, factual knowledge, mathematical skills, reading comprehension, and analytical skills necessary in the specific discipline of study (College Board, 2011).

AP Exam Score. Each AP Exam is scored using a 5-point scale: 5- Extremely well qualified; 4- Well qualified; 3- Qualified; 2- Possibly qualified; 1- No recommendation

Developmental Scale Score (DSS). A type of scale score used to determine a student's annual progress from grade to grade. The FCAT Reading DSS range from 86 to 3008. The FCAT Math DSS ranged from 375 to 2605 (FLDOE, 2009).

FCAT. Florida Comprehensive Assessment Test administered to students in Grades 3 - 10, which assess mastery over the Sunshine State Standards (FLDOE, 2009).

FCAT/SSS. The FCAT Sunshine State Standards is criterion-referenced to the SSS benchmarks in reading, mathematics, science and writing (FLDOE, 2009).

PSAT/NMSQT. Preliminary Scholastic Aptitude Test/National Merit Scholarship Qualifying Test published by the College Board. It measures critical reading skills, math problem-solving skills and writing skills.

CHAPTER II

REVIEW OF THE LITERATURE

Historical Perspective

Thomas Kuhn (1996) reminds us of the importance of history and the development of new theoretical thought. Kuhn reveals that there is no theoretical foundation developed without a historical progress. Instead he highlights that, "That is why a new theory, however special its range of application, is seldom or never just an increment to what is already known. Its assimilation requires the reconstruction of prior theory and the re-evaluation of prior fact, an intrinsically revolutionary process that is seldom completed by a single man and never overnight" (p.7). In light of this view, the historical continuum of the Advanced Placement Program and Florida Comprehensive Assessment Test will be highlighted in order to gain a theoretical perspective wherein the social implications between standardized testing and the AP program intertwine.

History of the Advanced Placement Program.

Origins (1950 – 1990). In 1951, The Ford Foundation Fund for the Advancement of Education sponsored two equivalent investigations that lead to the establishment of Advanced Placement: General Education in School and College and the Kenyon Plan. In both cases the conclusion was similar, secondary schools and colleges must work together to avoid replication in course work and instead allow an elite number of motivated students to work at the height of their capabilities and advance as quickly as possible. In accordance, this set in action a partnership between secondary and higher education institutions in the development of curricula and standards for the creation of advanced placement courses in high schools (DiYanni, 2008).

The first decade of advanced academics, Rothschild (1999) explained, began in May 1951, as an assembly of educational specialists from three elite prep schools; Andover, Exeter, and Lawrenceville, and three prominent colleges; Harvard, Princeton, and Yale, gathered to discuss the best use of the last two years of high school and the first two years of college. A committee published a final report, *General Education in School and College*, through Harvard University Press in 1952. Rothschild (1999) then explained that, in fact, the term 'advanced placement' appeared for the first time on page 118 of that report. Diyanni (2008) explained that the report urged schools and colleges to work together as part of a continuous process to raise the standards in the educational system. The overall impact of the report concluded that, schools should encourage more independent study. This report hence helped to advance a seven-year program with an outline for advanced placement. Program standards would be evaluated through examinations of the students that would enable participating colleges to accept or reject students based on these scores (Rothschild, 1999).

Diyanni (2008) explained that simultaneously, a committee of representatives from 12 colleges and 12 secondary schools was formulating the Kenyon Plan. The Committee, with assistance from the Fund for the Advancement of Education, then followed the recommendations of both studies and enlisted leaders from various disciplines from the areas of higher education. These professors accepted the challenge of creating high school course descriptions and assessments for colleges to find sufficient rigor to employ as a standard for granting credit. In1952, they launched a pilot program involving several schools that had introduced advanced courses in eleven initial subjects, from Biology to Spanish Language. In the mid-1950s, the pilot program was underway in 27 schools and had been proven successful (Rothschild, 1999).

By 1961, the program began receiving resources and support from various commissioners of states while an increased number of colleges began granting college credit for successful AP exam grades. Furthermore, many more high schools began adopting the courses (Diyanni, 2008). However, all was not well, as Rothschild (1999) explained, "Education was not immune to the social and political shocks of the late 1960s" (p.185). Instead, only 14 percent of nation's high school students challenged themselves with the rigorous AP curriculum. Rothschild explained that the low representation in the AP program could possibly be explained by the cultural trends of the late sixties. Even though the democratic viewpoint in this era called for the enhancement of education for the many, rather than an elitist education for the few, the program resisted the cultural opposition, and remained a program for the privileged (Diyanni, 2008).

In the mid-eighties after a report, *A Nation at Risk*, the trend of the sixties changed. This report deplored the state American education and in turn fueled and ignited a greater enrollment pattern into AP courses. The eighties included the spread to urban schools with traditionally underrepresented minorities. Students in the eighties hence reacted differently by accepting the academic advantages of the program, unlike the sixties, whose enrollment pattern demonstrated social exclusivity (Rothschild, 1999).

Present (1990 – 2013). In the most recent decades, the AP program has continued to increase in enrollment. By 1990, the College Board began expanding on the goals of the AP program by introducing Pre-AP programs, including AP Vertical Teams and Building Success workshops for teachers (Diyanni, 2008). More recently, *A Report to the Nation 2007* highlighted that students representing 16,000 secondary public schools took AP exams. Additionally, although most of these students were from schools in the United States, 878 of these schools were located outside of the U.S. (College Board, 2008). Therefore the AP program has expanded from its inception to now include great international appeal (Viadero, 2006; Sadler, P. M., Sonnert, G., Tai, R. H., & Klopfenstein, K, 2010). Rothschild (1999) explained, as the numbers of students challenging themselves with the rigors of the AP program increases, the answer to the question of who can be considered an AP student changes. Wherein in its early history AP students were more likely to come from homes of highly educated parents such as judges, professors, surgeons, etc., by 1998 the typical AP student could not easily be distinguished. Still, in a *Report of the Commission on the Future of the Advanced Placement Program* the commission's top recommendation was to "focus on expanding access to AP in underserved schools and for underserved populations, while continuing to maintain AP's high quality" (p.7). Additionally, the authors noted that future trend has shifted to expand to students who are willing to accept the program's rigor (College Board, 2001). Moreover, the College Board committed themselves to ensure that AP courses would be accessible to underserved racial, ethnic, and socio- economic groups in urban and rural areas. (College Board, 2001; Viadero, 2006; Sadler, Sonnert, Tai, & Klopfenstein, 2010).

Implications of Historical change in AP Course Placement Criteria. Early on in the AP program's history several researchers criticized the impact of a tracking guided program, such as AP placement, on the social implications that it may have. Alexander, Cook and McDill (1978) wrote that a membership to a college track enhanced the probability of entering college therefore it was a sorting mechanism that occurred at the high school level that paralleled the sorting of society in the near future. Other arguments of the tracking system included the notion that suggested that these sorting channels limited the resources by providing the most to the ones that need it the least (Rosenbaum, 1975). In addition he also stated that students in non-college tracks were denied access to teachers, counselors, resources, and information which would broaden their interests and challenge their abilities. Furthermore, they are discouraged from competition and association with more advantaged students and are usually not required to strive towards excellence in academics (Rosenbaum, 1975). In summary the authors' conclusion was that differential tracking in secondary education propagates social and economic inequalities, by widening the previously existing differences in ability (Alexander et al., 1978; Rosenbaum, 1975).

To compound the problem even further, according to Spade and Vanfossen (1997), the tracking seems to actually originate as early as kindergarten, and selection factors range widely. This same argument was also made evident in an article written Merrilee K. Finley (1984), where the author discussed the fact that tracking contributed to the reproduction of the social order of the next generation. Tracking was referred to as a mechanism of sorting, selecting, and socialization. In addition, researchers indicated that the small differences in student's achievement, derived primarily from differences in social-class background become accentuated over time through a perpetual process of organizational selection (Spade et al., 1997). Hallinan (1996) claimed that research on the effects on tracking on student achievement was consistent. Positive effects are shown for high-tracked students; negative effects are shown for low-tracked students, and negligible effects for regular track.

According to Oakes and Gution (1995), from a human capitalist perspective in education, tracking schools serves a primary function to prepare students for a productive workplace. Because the labor force is differentiated, schools offered an extensive amount of learning opportunities within various tracks as students are being prepared for different levels of the workforce. Therefore, students may increase their human capital potential of knowledge and skills, which will establish how much return they can attain in terms of income and social status as adults. This human capital theory recognizes that not all academic tracks have the same rate of return. However, it asserts that the competition for various options is an open contest based on merit. On the other hand, Oakes and Guiton (1995) also points out a competing structural theory of how tracking takes place. "Rather than competing in a wide-open competition for slots in particular curricula, then, students follow rather narrow curriculum paths that are established quite early in their school careers by factors not limited to their ability to benefit from a particular path" (p. 6).

According to Oakes and Gution (1995), the theoretical framework from which schools operate probably lies somewhere in the middle between these two; Oakes and Gution (1995) state that "Schools do not simply offer a wide range of offerings from which students and their parents choose. But neither do they simply match students to curricular and occupational opportunities in ways likely to reproduce their current social and economic status" (p. 7). In any case, properly identifying and allocating students based on an accurate assessment of relevant abilities and interest may be important to future outcomes for the student. These researchers highlighted that students that have the talent and capabilities and are accurately placed will be able to use the school system as roadway for social and economic mobility (Oakes and Gution, 1995; Hallinan, 1996; Spade and Vanfossen, 1997).

Analyzing available assessment data and the extent to which it adequately informs educators towards AP placement in mathematics and science therefore have long term implications for students in Seminole County Public Schools. It is therefore pertinent to understand the historical continuum from which the current statewide assessment program available for educators in SCPS was developed.

History of the Florida Comprehensive Assessment Test

Origins (1971 – 1990). Intertwining with the AP program, a statewide assessment program has also experienced a marked expansion. The Accountability Act of 1971, Section 229.57, established a uniform statewide educational objective for grade level and subject area that includes reading, mathematics, and writing. Furthermore, it intended to assess student progress and the degree to which students have achieved the educational objectives (FLDOE, 2007). The FCAT is the latest initiative in Florida's statewide accountability system.

The first statewide assessment, called the State Student Assessment Tests (SSAT) was given in reading, writing, and math in Grades 2 and 4. In 1974, the Educational Accountability Act was amended to require the assessment of all students in reading, mathematics and in writing by 1976. By that year, the Florida Legislature expanded the Educational Accountability Act to require assessments in Grades 3, 5, 8 and 11. The Grade 11 graduation test was the State Student Assessment Test, Part II (SSAT-II) but was renamed in 1984 to the High School Competency Test (HSCT). A Grade 10 assessment was later added known as the Grade Ten Assessment Test (GTAT). All these tests were then replaced by FCAT and FCAT 2.0 (FLDOE, 2010; 2011c).

Present (1990 – 2013). The School and Accountability Act of 1991 called for major modifications for Florida's public educational system. A decade later Goal 3 in the *Blueprint 2000,* published by the Florida Commission on Education Reform and Accountability, highlighted a goal for improving student performance in reading, writing, mathematics, and thinking skills. The standards from Blueprint 2000 were reinforced by the Florida Comprehensive Assessment Design [FCAD] (FLDOE, 2010). The FCAD proposed a formal development of a new statewide assessment system as part of the goal to increase student achievement. This assessment system later was named the Florida Comprehensive Assessment Test (FCAT). The FCAT was later followed by the adoption of the Sunshine State Standards (SSS) that were guided by a set of learning expectations for seven content areas and in four separate grade clusters (PreK – 2, 3 – 5, 6 – 8, 9 -12). The benchmarks of the SSS are the foundation of the FCAT and representative of the skills and knowledge deemed essential for Florida students (FLDOE, 2010). Currently, there are several statewide uses of the FCAT. At the student level, FCAT scores are being used for promotion and graduation requirement. Furthermore, scores are used for develop progress monitoring plans for students. Additionally, at the school level, FCAT scores are being used to assess Adequate Yearly Progress (AYP) of each school. Moreover, under the Florida A-Plus plan, every public school in Florida are assigned yearly school grades, A through F, based on the proportion of its students passing the FCAT (Statewide Uses of the FCAT, 2010). In light of these uses, it is clear that the FCAT, like AP, has also become an integral part of Florida's public school system. A central question in this dissertation it the extent to which, FCAT scores, can be utilized as a supplement to using the PSAT/NMSQT scores for identification of potential AP science and mathematics students.

AP Course Selection Procedures

AP Course Selection Decisions in Public Schools

Recent studies have highlighted that the course selection process in high school varied by institution. Burton, Yepes-Para, Cline and Kim (2002) conducted a study that, among other variables, looked at the role that teachers played in the student selection process. The researchers focused their study on approximately 400 schools with the most underrepresented minorities who were enrolled in AP Calculus AB in 1998. A similar invitation was done for another 400 schools with a high ratio of minority enrollment in AP literature therefore there was some overlap among schools. Teachers in these schools were identified as effective or non-effective depending on their student's results on the AP exam as compared to multiple regression equations based on PSAT that predicted how successful these students should be. A school questionnaire was also devised for school principals in which they were asked to comment on state policies and practices for their AP program. The researcher also focused on policies and practices for assigning teachers to teach AP classes. A separate teacher questionnaire was given in order to get the teacher's perspectives. The researcher found that teachers played a vital role in the recruitment process of students into the AP classes. The following research highlights the most researched and available tools available to teachers for identification of potential AP students.

AP Math and Science Course Selection Procedures

In 1997 Spade, Columba and Vanfossen studied how tracking and course selection procedures occurred in mathematics and science. The purpose of their study was to examine both the types of courses offered to assess the number of options available to students, as well as how students are placed in classes, by studying the course-placement decisions and the criteria used to make those decisions in "excellent" and "average" schools across social-class communities.

The method they used for the study was first categorizing six schools in New York State based on performance of students on a norm-referenced exam as either average or excellent. A further system of classification organized each school based on social economic status of the community derived from an approximation of the social class of the school. To choose the schools, data were obtained from the New York State Department of Education, as well as the U.S. Census. These schools were matched based on the average income of families in the school district and the type of community they were in. The six schools were categorized as Working-average, Working-excellent, Middle-average, Middle-excellent, Affluent–average, and Affluent-excellent. Once categorized, the enrollment pattern and course offerings were quantitatively organized. Afterwards, interviews with each department head of the six schools were conducted to gain an insight.

The researchers found that the number of advanced courses offered in both math and science increased with the social class of the school. Furthermore, excellent schools, regardless of social class offered more advanced courses in their area of excellence. Lowest social class districts and average schools were less successful in getting students to enroll in advanced math and sciences. Interviews suggested that there was a climate of high performance expectations in excellent schools, regardless of social class. Analyses of procedures associated with course placement suggested that both scores on standardized tests and teachers' recommendations were used differently across schools in different social class communities. Average schools had a relaxed approach regarding recruitment policies and more emphasis was placed on students' and parents' choice. Excellent schools had a more systematic and active approach to recruitment that involved teachers, counselors, parents, etc. All staff in these schools considered their role to be a critical factor in course-placement decisions. The authors believed that course taking was the most powerful factor affecting student's achievement that is under school control. The researchers suggested that although schools can do very little regarding the social class of the school, they can indeed impact the course enrollment pattern and course offerings through the student selection process (Spade et al., 1997).

Demographic Representation in AP Courses

Ndura, Robinson and Ochs (2003) examined students' ethnic background on their enrollment in AP classes during high school. Through questionnaires developed by the authors, the researchers examined AP course data in a mid-sized school district in the western United States. The surveys were mailed through interoffice correspondence to the teachers in the school district in the fall of 2002 during the first week of class. The teachers returned the completed surveys to the District Science Coordinator. The data obtained were from eight of 10 high schools in a diverse district with an approximate student population of 58,000. In general, the district served a lower middle to upper class socioeconomic status. Hispanic students made up the majority ethnic minority. Six other ethnic minorities were classified as "other" for the purpose of this study. The AP students who were surveyed ranged from 14 to 18 years of age. All students in AP courses offered by the district were surveyed and had an approximate return rate of 50%. In this particular district, students were neither encouraged nor discouraged to challenge themselves through the AP program.

The researchers found that with the exception of Asian and Pacific Islanders, minority students were severely underrepresented in AP programs (Ndura et al., 2003). In the study minority students enrolled in AP classes comprised 17.5% of the student body. However, minority students in this district comprised approximately 30% of the total school enrollment. Furthermore, researchers also looked at who in the schools had the biggest influence on taking AP classes. The data indicated that parents and teachers had the largest influence, followed by friends and then counselors. In the survey the number one response for choosing an AP course was to obtain a challenging course that would allow them to be surrounded by "smart people" (p. 27). The researchers also highlighted a positive relationship between parents' academic background and income with the students' enrollment in such programs. According to the researchers, although the recent federal aid that aims to provide equity by allowing more AP access for disadvantaged students is positive, "more work needs to be done to ensure equitable access and success in AP programs" (p. 33). Ndura, et al. (2003) claimed that since literature suggested that inequality in the classroom reproduces an unjust social system, having more minorities enroll in AP courses would benefit all of society as it would provide an opportunity for a greater development of cultural capital.

Moore and Slate (2006) studied enrollment patterns in AP courses in all high schools across the State of Texas for the 2004 – 2006 academic school years. The goal of the study was to examine the extent of the differences that were present in AP enrollment for those academic school years as a function of student ethnicity. The number of high schools whose data were analyzed included 1789 schools for 2004 – 2005 and 1809 schools for 2005 – 2006. The researchers used data from the Texas Education Agency's Academic Excellence Indicator System (AEIS) database. The performance indicators were the Texas Assessment of Knowledge and Skills (TAKS), State Developed Alternative Assessment II (SDAA II) and Reading Proficiency Test in English (RPTE) and Advanced Placement course enrollment. Each indicator was disaggregated by ethnicity, gender, special education, low income status, and limited proficiency status. The results indicated that roughly 17% of the student body enrolled in at least one AP course. Almost a fifth of the Anglo American student body was enrolled compared with 10% of Hispanic and African American students. Limited English Proficient and students with special learning needs were low. Student success in these courses differed as a function of gender and ethnicity with African American students being the least successful (Moore and Slate, 2006).

In a dissertation Gregory (2009) studied the factors associated with advanced placement enrollment, course grade, and passing of the AP examination among Hispanic and African American students in Southern California. The sample size included 4 grade-level cohorts of high school students totaling 22,227. The correlation was studied using logistic and multiple regression analysis. The results indicated an overall significant strong relationship among student demographic factors to include gender, socioeconomic status, ethnicity and parent education level. It was also found that females enrolled in more AP courses than males. Asians enrolled in 1.6 times in more AP courses than any other minority.

Based on this literature review, ethnic and socioeconomic status disparity in AP enrollment patterns are highlighted to still exist at various educational institutions throughout the United States. However, practical tools to identify potential AP students, regardless of ethnic background, socioeconomic status, gender or otherwise, are limited for educators' use. The following research highlights the development of the main tool that has been developed for such use. This dissertation aims to extend these studies in order to examine the use of FCAT as an educational indicator in order to predict performance on AP science examinations in Seminole County Public Schools for the purpose of identifying additional AP students.

Using PSAT/NMSQT to Identify Potential AP Students

In 1997, Camara and Millsap investigated using the PSAT/NMSQT and course grades in predicting success in the advanced placement program. The purpose of this study was to examine the relationship of educational indicators in predicting performance on AP examinations. Researchers examined the variables and the combination thereof that best predicts performance on various AP examinations. Additionally, the time interval between PSAT/NMSQT and AP examinations was also tested. Furthermore, the effect of student's grade level was investigated. The last variable tested was the effect of gender as a predictor to success on AP examinations.

In their methodology, the researchers used two cohorts of students completing the PSAT/NMSQT in October 1993 and October 1994. Additionally, students' records were matched against the SAT I data base in order to examine additional variables. Still, those students that completed the SAT I were asked to complete a Student Descriptive Questionnaire (SDQ), which requested additional information such as courses, grades, college and financial plans, etc. The number of students that completed the PSAT/NMSQT, AP registrations and SDQ were 501,469 prior to September 1995. The number of students that completed multiple AP examinations during that time period was 704,919. Henceforth, two overlapping data sets were used for analyses. First, the students' AP examination grades (n = 704, 919) were correlated to their PSAT/NMSQT scores. The PSAT/NMSQT scores were broken down as follows: (1) Verbal Reasoning (2) Mathematics Reasoning (3) Sum of Verbal + Mathematics and (4) 2 X Verbal + Mathematics, which is the selection index for the National Merit Scholarship. Expectancy tables that demonstrated the proportion of students within specified score ranges on the PSAT/NMSQT who achieved a grade >3 on the AP examination were then created.

In addition to test scores, 71% of students also completed SDQ (n = 501, 469) therefore other factors included cumulative high school grades, average course grades, number of years of high school courses completed in a particular subject. Multiple regressions and correlation analyses were examined for this group.

An additional relationship was studied between scores on PSAT/NMSQT and AP examinations using subcategories such as time interval between testing (7 or 19 months), students' grade level, or an interaction between both factors.

Camara and Millsap (1997) found a strong positive between PSAT/NMSQT scores and AP grades for all but four out of 29 examinations. Two of the four examinations were language tests. The product-moment correlations were greater than .50 in the case of 17 examinations. In AP Biology the Verbal + Math Score had the greatest correlation (r = .641 females, r = .586 males), as opposed to Verbal or Math alone or the combination 2V + M. However, all correlations were greater than .50. Additionally, females had a consistently greater product-moment correlation for all scores rather than males. Although males had constantly higher mean scores in 18 of the 25 AP examinations which included only Art History, English, Literature, and four foreign languages. With regards to ethnic differences, Camara and Millsap reported that small sample sizes prevented a thorough examination for many of the 25 AP examinations.

However, the relationship between AP grades with PSAT/NMSQT scores were calculated separately by gender for seven ethnic groups on three large volume AP examinations. Camara and Millsap (1997) found the correlations to be consistent across racial and ethnic groups. Additionally, the researchers found that the relationship between PSAT/NMSQT score and AP examinations was stronger for minority groups than white counterparts on 13 of 18 analyses.

Through the SDQ data, Camara and Millsap (1997) also examined the strength of the relationship between AP examinations and high school courses and grades. It is important to note that this data was derived out of a self-reported survey administered during the PSAT testing. Overall, correlations of AP examinations grades with PSAT/NMSQT scores demonstrated a stronger relationship than the correlations between AP grades and course grades. The mean correlation for the same 25 AP examinations was .267. The correlation for AP Biology was .345. Furthermore, the number of high school courses in related subjects had the lowest overall correlations with AP examinations, with most correlations below .10.

Another analysis included the effects of the time interval between completion of PSAT/NMSQT and AP examination (7 or 19 months). Camara and Millsap (1997) found that there was no statistical significant difference between assessments completed in the same school year (7 month interval) and the preceding year (19 months).

In a follow-up study, Camara, Ewing and Millsap (2006) expanded on a previous study that examined the relationship between PSAT/NMSQT scores and AP examination grades. The purpose of this study was to further evaluate the current test data as a continuous process of validation for using the PSAT/NMSQT scores in order to identify potential AP students. Hence the study attempted to replicate and extend findings from an earlier study published by Camara and Millsap in 1997. The study examined sophomores and juniors (n = 1,035,696) who completed the PSAT/NMSQT in October 2000 or October 2001 and at least one AP examination the following school year (19 months later) in May 2002 or May 2003. In addition, about 71%

of these students also completed the SAT questionnaire prior to November 2003 which was utilized to assess the students' other academic performance and course taking patterns. In particular, this study added subjects such as Environmental Science, World History, Statistics, and Human Geography. Additionally, the population that was studied represented a 35% increase in the number of students taking the PSAT/NMSQT and a 100% increase in the number of students taking one or more AP examinations. Moreover, it constituted a 6% increase in sophomores. It also included several other correlations that were not included in previous studies. In summary, the analysis included the following correlations with AP examination grades: (1) Verbal (2) Math (3) Writing (4) Verbal + Math (5) Verbal + Math + Writing (6) Math + Writing (7) Verbal + Writing Expectancy tables were also tabulated for those AP courses that showed a moderate to high correlation with PSAT/NMSQT performance.

In a dissertation, Wagner (2001) developed multiple regression analyses instruments to predict success in AP chemistry. The purpose of the study was to determine the profile of successful students on the AP chemistry exam. In the investigation Wagner studied two populations. The first population was students from South Carolina's Governors School for Science and Mathematics. The second population was students from South Carolina's public school system. The commonality between both populations is that they all had taken the AP Chemistry exam within the last 5 years. The purpose of the first part of the dissertation was to establish reliable predictors for success on the AP chemistry exam as well as to make a Multiple Regression Analysis (MRA) in order to make placement decisions in the Governor's school. The second part extended the investigation to determine the MRA for the public schools in South Carolina using available data from 2000. For the first part, the sample size studied was 89 students, 54 male and 35 female. The Governor's school represented was a residential magnet school that is tailored for students that demonstrated a high aptitude for mathematics and science. The sample size for the students in South Carolina's public school was 581. The study involved correlation analyses in which the criterion variable was AP Chemistry exam score and the predictor variables included PSAT math, verbal and writing. In addition, the number of prior science courses, score on self-assessment and score on teacher generated placement test also served as additional predictor variables. In the first part, the data was collected from permanent school records. For the second part the research personally requested and searched through personal records for each district in the South Carolina public school system. The overall data obtained was 35 of 46 schools with a sample of 440 of 581students. In part one of the studies, the researcher found that there were three predictor variables that were significantly correlated to the criterion variable. The reported correlations included PSAT math (r =.483), PSAT verbal (r = .332) and previous science course (r = .229) at $p < .05$. Furthermore, multiple regression analyses showed that only PSAT math, PSAT writing and placement tests accounted for 61.9% variance in AP score. In the second part of the study the researcher reported a multiple regression that included PSAT math, PSAT writing, Placement Test, Prior Science Courses, and PSAT verbal accounting for 63% of the variance in AP score: $F(5, 19) = 6.477$, $p < .001$. However, only PSAT math, PSAT writing, and Placement Test accounted for significant amount of variance in AP score. These variables accounted for 61.9 % of variance $F(3, 21) = 11.395$ and $p < .001$

Relationship Studies between State-Mandated Exams and College Readiness Tests

Wilson (2004) examined the Texas Assessment of Knowledge and Skills (TAKS), and its relationship with PSAT/NMSQT in order to provide initial data for school districts in Texas regarding using TAKS as an indicator for student achievement and to assist in planning in pre-K-16 education. The population for the study was 3,243 sophomores from 55 Texas high schools that participate in Texas AP/IB Center's PSAT Pilot Program. These particular participating schools were purposely selected into the program based on a high proportion of students of low socio-economic status as well as having a low AP enrollment. The population had 2,626 Hispanic students (81%), 403 White students (12.4%), 153 African American students (4.7%) and 61 students not classified (1.9%).

The study included 2002 PSAT scores with 2003 TAKS scores in Reading, Math, Science and History. The subgroups researched were divided based on ethnicity, socioeconomic status, and gender. TAKS scores were supplied from Texas Education Agency's Public Education Management and Information System (PEIMS) database. All of the PSAT examination scores were found to be significantly correlated with TAKS examination scores. The PSAT Verbal and TAKS Reading examination scores had a moderated relationship r = .432 (p < .001). PSAT Verbal scores had a stronger correlation with TAKS Math scores r = .511 (p < .001). PSAT Verbal examination scores also exhibited a moderate relationship with TAKS

Science scores r = .445 (p < .001). Likewise, PSAT Verbal scores and TAKS History scores correlated moderately r = .520 (p <.001). In general, as PSAT Verbal scores increased the TAKS Reading, Math, Science and History scores also increase. The PSAT Writing Skills and TAKS Reading examination scores exhibited a moderate relationship r = .409 (p < .001). PSAT Writing Skills examination scores also exhibited a moderate relationship with TAKS science scores r = .410 (p < .001). Therefore this study indicated that a state-mandated exam could have a moderate to strong correlation with a college readiness exam.

Summary of Literature Review

As noted in the historical analysis, the AP program has shifted in participation from being more exclusive to becoming more inclusive (DiYanni, 2008; Rothschild, 1999; Viadero, 2006). In the process, student enrollment has increased dramatically. The social implications of widening access to a historically narrow tracking system have been questioned (Alexander et al., 1978; Rosenbaum, 1975; Finley, 1984; Spade et al., 1997; Hallinan, 1994; Oakes, 1985; Oakes & Guiton, 1995). Yet, researchers agree that as schools expand their AP program educators would benefit from having a systematic approach to the student selection process (Oakes & Gution, 1995; Hallinan, 1994, 1996: Spade & Vanfossen, 1997). Another point of agreement is that teachers play a vital role in this part of the progression (Burton, Yepes-Para, Cline and Kim, 2002; Ndura, Robinson & Ochs 2003; Whiting & Ford, 2009). Furthermore, it was cited that more “Excellent” AP programs as defined by Ndura et al. (2003) were those schools that used a methodical approach. Nonetheless, these methodical approaches such as the high school AP tracking sytem, track mobility and course selection process varies from school to school (Burton, Yepes-Para, Cline and Kim, 2002; Gregory, 2009; Hallinan, 1996; Ndura, Robinson & Ochs, 2003; Moore & Slate, 2006; Spade, Columba & Vanfossen, 1997). Several researchers established that correlations between standardized assessments can be utilized to identify potential AP students (Camara et al., 2006; Camara & Millsap, 1997; Ewing et al., 2006; Froman et al., 2008; Wagner, 2001). Research has not provided a prescribed model for advising students into Advanced Placement courses. However, researchers established that although schools are limited as to what can be done regarding the ethnic and social background of the students, educators can impact their students’ education through the approach in which students are advised for course placement (Spade, Columba, & Vanfossen, 1997). Research is limited concerning the use of standardized statewide assessments in advising students towards Advanced Placement.

CHAPTER III

METHODOLOGY

This study investigated the relationship between PSAT/NMSQT, in conjunction with and compared to FCAT scores, as related to AP exam performance in STEM-related courses. The research was conducted using an ex post facto research design that used multiple linear regression models for analyses. According to McNeil, Newman, and Fraas (2011) using multiple linear regressions one can construct models reflecting specific research questions being asked. In other words, Multiple Regression Analysis (MRA) investigates a set of predictor variables in order to explain the proportion of the variance that is associated with a particular criterion variable (McNeil et al., 2011). Utilizing multiple linear regressions one can test relationships between categorical and continuous variables, or between continuous variables. MRA was also chosen because it is more robust than traditional analysis of variance.

The purpose of correlation studies, according to Gay and Airasian (2003), is to determine relationships between variables. Hence, "if a relationship exists between two variables, it means that scores within a certain range of one variable are associated with scores within a certain range on the other variable" (p.311). If two variables are highly correlated, scores on one variable can be used to predict scores on the other variable. In other words, "even though correlational relationships are not cause-effect ones, the existence of a high correlation does permit prediction" (p.312). Hence, correlational studies provide a numerical estimate the strength of the linear relationship between two variables. The higher the correlation between the two variables, the more accurate are predictions based on the relationship. It is also important to note that rarely are two variables perfectly correlated or perfectly uncorrelated, but variables may be sufficiently related to permit useful predictions (Gay & Airasian, 2003).

Moreover, more than one variable can be used to make predictions regarding another variable using a univariate design. In this type of design, one dependent (criterion) variable is being predicted by a set of one or more independent (predictor) variables (McNeil et al., 2011). For tests that are used to classify or select various individuals, predictions based on a set of predictor variables are extremely important. Predictive validity is concerned with the degree to which a variable can predict how well individuals will perform in the future. Although, no test will have perfect predictive validity, predictions based on a combination of several test scores are more likely to be more accurate than predictions based on the scores of any single test. Therefore, if several predictor variables correlate well with a criterion variable, then a prediction based on a combination of predictors will be more accurate than a prediction based on any one of them (Gay & Airasian, 2003).

The research design was guided by hypotheses and tests for alternative hypotheses in order to achieve include greater internal validity as compared to research design without a hypothesis. The design used a Full Model test, which simultaneously included both PSAT and FCAT scores for examination with MRA. Alternately, the design used a Restricted Model test, which only included either all PSAT scores or all FCAT scores in the MRA.

Research Hypotheses

Alternate Hypotheses to Research Question 1. (a) The combined selected standardized test scores, PSAT/NMSQT (Math, Verbal and Writing scores) and FCAT (Math, Reading and Writing scores) have a strong positive association to performance on each of the selected AP mathematics and science exams in Seminole County Public Schools for students with a reported AP score during the 2010 – 2011 and 2011 - 2012 academic school years for the selected STEM related courses. (b) Each selected standardized test sub-scores (PSAT-M, PSAT-R, PSAT-V, FCAT-M, FCAT-R, FCAT-W) will account for a statistically significant unique contribution in the relationship with the AP scores, in the Full Model.

Alternate Hypotheses to Research Question 2. (a) The PSAT/NMSQT scores alone have strong positive association to AP exam performance for students with a reported AP mathematics and science score during 2010 – 2011 and 2011 - 2012 academic school years in Seminole County Public Schools for the selected STEM related courses. (b) Each selected standardized test sub-scores (PSAT-M, PSAT-R, PSAT-V) will account for a statistically significant unique contribution in the relationship with the AP scores, in this Restricted Model.

Alternate Hypotheses to Research Question 3. (a) The FCAT scores alone have a strong positive association to AP exam performance for students with a reported AP mathematics and science score during 2010 – 2011 and 2011 - 2012 academic school years in Seminole County Public Schools for the selected STEM related courses. (b) Each selected standardized test sub-scores (FCAT-M, FCAT-R, FCAT-W) will account for a statistically significant unique contribution in the relationship with the AP scores, in this Restricted Model.

Sample

The sample of scores studied were those available for students who took at least one of the selected STEM related AP science and mathematics courses whose PSAT and FCAT scores were also available for at least one of the two academic years. This sample of scores aimed to investigate a prediction equation using PSAT/NMSQT and FCAT scores for placement into selected STEM-related AP science and mathematics courses. Correlations using the PSAT/NMSQT scores have been established and presented by various researchers (Camera et al., 2006; Camara & Millsap, 1997, 1998; Palin, 2001; Shepherd, 1997; Wagner, 2001). According to Gay and Airasian (2003) the sample for a correlational study should minimally be 30 participants. Furthermore, statistical significance is dependent upon sample size. The larger the sample size the more closely it approximates the population and the more probable it is that a given correlation coefficient represents a significant relationship (Gay and Airasian, 2003).

Demographics of the Sample

Seminole County Public Schools (SCPS) in Florida was used to investigate the relationship between FCAT, PSAT/NMSQT and corresponding performance on the AP mathematics and science exams. The county was the 12th largest in Florida with 64,228 students enrolled for the 2010 – 2011 school year (FLDOE, 2011). Demographically, the county was considered diverse with comparable statistics to state norms; in 2011 it had 56.46 % White students compared to 43.05% White students in Florida, 21.09% compared to 28.03% Hispanic students, 13.85 % compared to 22.97% African American students statewide. As far as AP participation is concerned, the district was well represented demographically as it had 40.8% White participation compared to 28.4% in the state, 16.9% African-American participation as compared to 16.4% and 32.7% Hispanic participation compared to 27.3% in Florida (Seminole County Schools [SCPS], 2009; FLDOE, 2011c). From a PSAT/NMSQT participation standpoint, SCPS was above the state norm (84.6 %) as it had 4,552 sophomores take the exam out of 5,379 possible students (FLDOE, 2011).

Performance based, the county was classified as an Academically High-Performing school district and an “A” district since the inception of district grade in 1999 through 2012 by SCPS (2012). In terms of student performance on the FCAT, SCPS ranked third overall for the State of Florida regarding the number of students demonstrating proficiency. More specifically as compared to the state of Florida, SCPS ranked #4 in FCAT Reading, #3 in FCAT Mathematics, #2 in FCAT Writing at the end of the last decade. SCPS also ranked #1 in FCAT Reading, Mathematics, and Writing for Central Florida districts (FLDOE, 2010). The following table (Table 5) also highlighted SCPS as a top performing county as shown:

Table 5

Participation and Performance of the top ten districts in Florida districts with highest number of AP test takers in 2010

Districts Ranked By Total Number of AP Exams Administered	Total Number Exams Taken	Number of Exams with a Score of 3 or Higher	Percentage with Score of 3 or Higher
1. DADE	38,572	14,931	38.7
2. BROWARD	30,827	13,921	45.2
3.HILLSBOROUGH	29,637	10,995	37.1
4. PALM BEACH	24,113	11,572	48.0
5. DUVAL	21,042	5,047	24.0
6. ORANGE	20,512	8,415	41.0
7. SEMINOLE	**10,912**	**6,121**	**56.1**
8. PINELLAS	9,822	4,024	41.0
9. OSCEOLA	6,372	1,426	22.4
10. POLK	6,153	1,576	25.6
Total	197,962	82,052	37.9

Note. Table developed using publicly available archived yearly data for the state by Florida Department of Education Accountability, Research and Measurement (2010) using the FLDOE website.

As demonstrated in Table 5, Seminole County School District had the highest percentage of scores with 3 or higher in the State of Florida in 2010 with 56.1 percent of students achieving a qualifying score. Therefore, the study included an analysis from a comparatively high achieving, relatively large, diverse population with a high rate of PSAT/NMSQT and AP participation and performance.

Collection of Data

The researcher used data available for the following AP courses: (a) Biology (b) Environmental Science (c) Chemistry (d) Physics B (e) Physics C- Electricity and Magnetism (f) Physics C-Mechanics (g) Statistics (h) Calculus AB (i) Calculus BC scores from SCPS District Office of Assessment, Research and Data Analysis available for students for the 2010 – 2011 and 2011 - 2012 academic school years. The data was requested and special permission by district supervisors was granted to release the required data for the study. The released data was then aggregated into spreadsheets by subject area and academic school years. A total of 18 spreadsheets with 6,189 student records were organized for analysis.

Treatment of Data

This study examined the relationship of two selected standardized tests, PSAT/NMSQT and FCAT, with corresponding performance in AP science and mathematics courses as measured by the students' AP exam scores for the selected academic school years. Using IBM Statistical Package for the Social Sciences (SPSS) 21.0, a series of multiple regression analyses using subset scores from both standardized tests were conducted in order to compare the degree to which these standardized scores were associated to AP exam performance in the following AP courses: (a) Biology (b) Chemistry (c) Environmental Science (d) Physics B (e) Physics C- Electricity & Magnetism (f) Physics C-Mechanics (g) Statistics (h) Calculus AB (i) Calculus BC. The PSAT/NMSQT scores that were used for this study were reported as follows by the College Board: (a) Mathematics (PSAT-M) (b) Critical Reading (PSAT-CR) (c) Writing (PSAT-W). The FCAT scores that were used for this study were reported as follows by the Florida Department of Education (a) Mathematics (FCAT-M) (b) Reading (FCAT-R) (c) Writing (FCAT-W).

A primary aim of the study was to analyze various models with various PSAT/NMSQT and FCAT sub-scores included as predictor variables, to a varying degree. A secondary aim was to investigate the amount of variance in the outcome variable, AP exam performance, which was accounted for by each of the predictors, PSAT/NMSQT and FCAT scores individually. Testing for statistical significance was reported to include descriptive and inferential statistics. Descriptive statistics permitted the researcher to significantly describe various pieces of data with a few indicators. Inferential statistics allowed the researcher to make inferences about the populations based on the results of the samples (Gay & Airasian, 2003). Included in the multiple regression analysis were calculations Multiple R and Adjusted R square to evaluate the amount of variance of the dependent variable that was accounted for by the combination of predictor variables in the model tested. Prediction models were also evaluated using standardized (partial) regression coefficients (beta) to assess each predictor variable's unique contribution to the prediction of the dependent variable.

Statistical Analysis

Model testing used a series of Multiple Regression Analyses for each selected STEM-related AP subject area. To answer question 1 in the study, all the predictor variables (PSAT/NMSQT scores and FCAT scores) were entered together using the standard (simultaneous) regression method. In this method all the predictor variables are entered, the program evaluates the equation all at once. This method provides a full model solution for hypothesis testing (Meyers, Gamst & Guarino, 2006). The same standard regression method was then analyzed utilizing a restricted model that used only PSAT/NMSQT scores for each particular AP course to answer question 2. A third model was evaluated by another restricted model with the same simultaneous regression method by entering only FCAT scores in order address question 3. An abbreviated version of each of the research questions is shown below.

Question 1. (a) To what extent were the combined selected standardized test scores, PSAT/NMSQT and FCAT scores related to performance on each of the selected AP mathematics and science exams in SCPS for selected STEM-related AP courses? (b) To what extent did each score contribute uniquely to the model tested?

Question 2. (a) To what extent were the PSAT/NMSQT scores alone related to performance on each of the selected AP mathematics and science exams in SCPS for selected STEM-related AP courses? (b) To what extent did each score contribute uniquely to the model tested?

Question 3. To what extent were the FCAT scores alone related to performance on each of the selected AP mathematics and science exams in SCPS for selected STEM-related AP courses? (b) To what extent did each score contribute uniquely to the model tested?

For each of the models tested, an analysis was inspected for statistical significance by examining the F-test. The F-test looks at whether the degree of relationship of two or more predictors are correlated to the estimated criterion and expressed in the correlation coefficient, R. If the correlation coefficient (R) is significantly greater than zero the null hypothesis is rejected and the alternative hypothesis retained (Meyers et al., 2006). The multiple regression equation for the Full Model was $Y = b_1X_1$ (PSAT M) + b_2X_2 (PSAT CR) + b_3X_3 (PSAT W) + b_4X_4 (FCAT M) + b_5X_5 (FCAT R) + b_6X_6 (FCAT W) + c, where Y was the estimated criterion and c the constant, including the error term. Also, the analysis evaluated the strength of the relationships of the significant variables, where R^2 provides the proportion of the total variance in the dependent variable that is accounted for by its linear relationship with the predictor variables (Meyers et al., 2006). Effect size (ES) using the multiple correlation (R^2) was also used to measure the general effect of the predictors on the criterion variable. ES evaluates the proportion of shared variance and offers an indication of the magnitude of the findings (Cohen, 1988). Multiplying R^2 by 100 allowed interpretations of R^2 as a percentage or degree of criterion variance accounted for by a linear combination of predictor variables. Using Cohen (1988) effect size guidelines, for R^2 the interpretations were as follows: .0196 (small), .1300 (medium), .2600 (large). Likewise, Zero-order correlations coefficients were interpreted during model testing using the following interpretations: 0.1 (small), 0.3 (medium), 0.5 (large) with either a positive or negative relationship.

To answer the second part of each central question, all the predictor variables (PSAT/NMSQT scores and FCAT scores) were evaluated for unique contribution to the Full Model. Significance tests for individual regression Beta weights (β) were conducted to determine to what extent each predictor variable, b1x1 (PSAT M) or b2x2 (PSAT CR) or b3x3 (PSAT W) or b4x4 (FCAT M) or b5x5 (FCAT R) or b6x6 (FCAT W), significantly predicted the AP Score in either a full or restricted model. This evaluation is valid as the standardized regression coefficients, β (Beta weights), represent the amount the criterion variable (Y) changes when the corresponding predictor changes one unit while other predictors are constant (Meyers et al., 2006).

Significance Testing and Power Analysis

The F test was used to test the statistical significance of the relationships in the hypothesis testing. The F test was selected as it is very robust. In addition, as this was a baseline study, two-tailed tests of significance were used to test the relationships of the variables since the direction of the correlation was unknown. The *p* level of significance was set as .05 following the conventional level in the social sciences.

A power analysis (Cohen, 1988) was conducted using a small (.02), medium (.15), and large (.35) effect size for each of the selected STEM-related AP courses. Since power is a function of *n*, the statistical power varied per course. A power analysis for AP Physics with average n = 100 the varying degree of power included: small effect (.22), medium effect (.81), large effect (>.99). A power analysis for AP Calculus BC with average n = 150 the varying degree of power included: small effect (.25), medium effect (.95), large effect (>.99). A power analysis for AP Biology, AP Chemistry, AP Physics B with average n = 250 the varying degree of power included: small effect (.38), medium and large effect (>.99). A power analysis for all the remaining courses to include AP Environmental Science, AP Calculus AB and AP Statistics with average n = 550 the varying degree of power yielded a small effect (.50), medium and large effect (>.99).

Delimitations of the Study

The sample was purposely delimited to Seminole Public School students who took at least one of the selected STEM related subject AP exam during the 2010 – 2011 and 2011 - 2012 academic school years and for whom an FCAT score and PSAT/NMSQT score were also available. In addition, although many different criteria can be used to identify potential students for enrollment into the Advanced Placement courses offered by SCPS, this study was delimited to an investigation of FCAT scores and PSAT/NMSQT scores as possible criteria for student selection. The FCAT includes Achievement Level Scores, Scale Scores and Developmental Scores based on the Sunshine State Standards. The study was delimited to using FCAT Achievement Level Scores as predictor variables as these scores provide the most practical application for educator use. Furthermore, FCAT scores selected were delimited to the previous year FCAT scores for each particular student. For example, for a ninth grade student who enrolled in an AP level course the corresponding FCAT score for this study was from the eighth grade FCAT. However, for an 11^{th} grade student the FCAT score that corresponds was from the 10^{th} grade.

CHAPTER IV

ANALYSES AND RESULTS

To examine the research questions, standard correlational regression analyses were used to test various statistical models that inspected numerous relations between advanced placement scores of selected STEM-related math and science AP courses in Seminole County Public Schools for the 2010 – 2011 and 2011 – 2012 academic school years. The multiple independent variables of interest included PSAT/NMSQT and FCAT test scores with the corresponding relationships to AP scores for students who completed an AP exam in the selected disciplines of study. The following chapter will present the examinations of assumptions, descriptive statistics, and the multiple regression analyses completed.

Evaluation of Assumptions for Multiple Regression Analyses

Multiple Regression Analyses (MRA) are a set of statistical techniques that allow one to assess the relationship between one Dependent Variable (DV), in this case, Advanced Placement score and several Independent Variables (IVs), for this study, PSAT and FCAT scores. Prior to testing the models, however, underlying assumptions about the appropriateness of using Multiple Regression Analyses were first examined. Conditions that should be validated prior to analysis include: Ratio of cases to IVs for sample size determination, Outliers, Multicollinearity, Normality, Linearity and Homoscedasticity (Tabachnick and Fidell, 2012).

Evaluation of Sample Size

A minimum recommendation for Multiple Linear Correlation analyses is to have at least 5 times more cases than IVs. In the case of this study, 6 IV's (PSAT M, PSAT CR, PSAT W, FCAT M, FCAT R, FCAT W) were the maximum number of variables needed for the Full Model testing (Gay and Airasian, 2003). Therefore, the study required that a minimum of 30 cases be included for any regression analyses calculated (Tabachnick and Fidell, 2012). For the purpose of this study the smallest sample size analyzed included 62 cases for Physics C Electrical, which had more than the required minimum number of cases needed for analysis.

Evaluation of Outliers

Outliers with an extreme value on one variable are cases considered univariate. Among continuous variables, univariate outliers are cases with very large standardized scores on one or more variables. Cases with standardized scores in excess of +/- 2.5 are potential outliers (Hair, Anderson, Tatham and Black, 2009). Outliers are important to identify as they may represent extreme cases that have inflated influence on the regression equation (Tabachnick and Fidell, 2012). Therefore, using SPSS, Casewise Diagnotics were performed on each data set in order to identify any potential outliers with residuals beyond 2.5 standard deviations.

Multivariate outliers are cases with uncommon grouping of two or more scores. Multivariate outliers can be evaluated using an SPSS function that calculates Mahalanobis distance for each case. Mahalanobis' distance is a metric for estimating the extent to which a particular case is from the center of all the variables' distributions. Any case with a large Mahalanobis distance may be indicative of being an outlier (Ben-Gal, 2005). Moreover, it is also important to note if the indication is statistically significant. Any case with a large statistically significant Mahalanobis distance, evaluated with critical chi-square with degrees of freedom equal to the number of predictors, can then be considered for removal (Tabachnick & Fidell, 2012). Hair et al. (2010) nonetheless highlights, that except if there is demonstrable proof that identified cases are truly not representative of any of the observations of the population outliers should be retained. Following these guidelines, other than errors in data entry that were identified, examination of outliers did not warrant the removal of any specific cases from the study.

Evaluation of Multicollinearity

Multicollinearity may be a problem when estimating a generalized linear regression model. Multicollinearity arises when there is a linear relationship between one or more of the

IVs, making the model challenging for calculation. In such a case, inclusion of two or more IVs with a high degree of correlation between them does not add more information to the model than would be expected by having just one of the IVs included in the model. In essence, the regression model is being asked to estimate a parameter with redundant information therefore not providing a reliable estimate of each variable's individual regression coefficient. In such cases, high intercorrelations between IVs increase the standard error of the beta coefficients (Tabachnick & Fidell, 2012). In order to avoid multicollinearity, it is recommended that when two independent variables are found to have a correlation greater than .80 between them, one of them should be excluded from the regression analysis (Meyer et al., 2006). Furthermore, a secondary diagnostic for multicollinearity is to examine the variance of inflation factor (VIF) and Tolerance of each predictor variable. SPSS calculates the Tolerance and VIF for each predictor by estimating a linear regression of that predictor on all the other IVs in order to calculate an R^2 for the regression (Tolerance = 1-R^2 and the inverse called VIF = 1/ (1-R^2). The VIF estimates the degree of variance inflation due to linear dependence among predictor variables. Typical suggested values of Tolerance of less than .10 and VIF above 10 normally suggest a problem with multicollinearity (Hair et al., 2009). Such was the case in this study as FCAT scores are reported in two manners, Developmental Scale Scores and Achievement Level Scores. Correlation diagnostics revealed a high degree of correlation between Developmental Scale Scores and Achievement Level Scores with VIF and Tolerance beyond the suggested norms. Therefore, the researcher chose only to include FCAT Achievement Level Scores in order to minimize the potential of utilizing redundant FCAT scores for analysis. In addition, correlations between IVs (PSAT M, PSAT CR, PSAT W, FCAT M, FCAT R, FCAT W) were also checked for adequate inclusion in the multiple regression computation. All predictor variables were confirmed to produce values within the suggested parameters; therefore all six predictor variables were included for analyses.

Evaluation of Normality

The supposition of normality is that errors of prediction are normally distributed about each and every predicted DV score. If this is the case, then an examination of the residual scatterplot provides a graphical representation of normality. If all the assumptions are met, the scatterplot will depict a pile up of residuals in the center of the plot at each predicted score value, and a symmetrical distribution from the center trailing to either side (Tabachnick & Fidell, 2012). The shape of the graph's arc also indicates the skewness of the distribution, and shall be examined for either a positive or negative skew (Hair et al., 2009). Another test for normality is the normal probability plot, provided by the SPSS program for regression. The test is essentially a graph of residuals in which the expected normal values are graphed along with the actual normal values. If the expected normal values of the residuals correspond to actual normal values, the plot will depict a fairly constant line that starts at the bottom left to the upper right corner of the graph (Tabachnick & Fidell, 2012). All reported data, including residuals in the Multiple Regression Analyses for this study, were confirmed to be normally distributed.

Evaluation of Linearity

Linearity of relationship between predicted DV scores and errors of prediction was also assumed. Failure of linearity of residuals in regression does not actually invalidate the analysis instead it weakens the results. The power of the analysis is lowered to the degree that the Model does not capture the full range of the relationships among the IVs and the DV. In other words, to the extent that a nonlinear relationship exists, R^2, underestimates the variance explained overall and the beta coefficient is a diminished representation of the each variable's unique contribution. The various bivariate scatterplots formed relatively straight lines, thus there was no violation of linearity for any of the multiple linear regression models analyzed.

Evaluation of Homoscedasticity

The assumption of homoscedasticity is related primarily to the dependence of relationships between variables. The main supposition is that dependent variables have equal levels of variance across the range of the predictor variables (Hair et al., 2010). A bivariate scatterplot was examined for each multiple linear regression analysis to check whether or not heteroscedasticity, a non-constant variance of residual error for all values of the predictor variables, was an issue. Heteroscedascitity usually shows up as a funnel shape in the scatterplot versus the expected oval shape depicted by an assumed homogenous variance of residual error. In the case where the assumption of homoscedasticity is violated it may represent an interaction effect between a predictor variable in the model and an unmeasured predictor variable that was not included. A moderate violation of this assumption, nonetheless only impacts the regression model minimally. An obvious assumption failure, however, suggests the need for improving the model by either an appropriate transformation of either DV or IVs or by including other variables in the regression (Cohen, Cohen, West & Leona, 2010). In the examination of all scatterplots, there was no evident violation of this assumption.

Model Testing and Organization of Results for Selected Math and Science Course

The following section presents the results for each selected STEM-related AP course in Seminole County Public Schools. The descriptive statistics, correlation coefficients, F statistics, beta weights and probability levels, highlighted in this section are all presented in table format and can be found in the appendices. The results reported in this chapter are highlight the most significant values and are presented in the following order, inclusive of a summary table for each: (a) Biology (b) Environmental Science (c) Chemistry (d) Physics B (e) Physics C- Electrical (f) Physics C- Mechanical (g) Statistics (h) Calculus AB (i) Calculus BC. The written summaries answer the corresponding research question as it pertains to each selected STEM-related AP mathematics and science course for the appropriate academic school years.

Model Testing for Each STEM-Related AP Course

Hypothesis Testing for AP Biology

Research Question 1. In 2010 – 2011, the linear combination of PSAT and FCAT scores was significantly related to AP exam scores, F (3, 208) = 30.824, $p < .001$. The null hypothesis was rejected. The model was significantly better than expected by chance, thus the alternative hypothesis was retained. A strong relationship between a combination of predictor variables, PSAT and FCAT with AP scores, was highlighted by the multiple correlation coefficient R (.689). A large effect size was indicated by Adjusted R^2 which was .459, indicating that about 45.9% of the variance of AP scores in the sample could be accounted for by the linear combination of both sets of test scores. Each of the predictor variables had a significant ($p < .001$ - .05) zero-order correlation with AP scores. Beta weights showed that three test scores were statistically significant contributors to the variance in AP score: PSAT M (.502, $p < .01$), PSAT CR (.216, $p < .05$), FCAT R (.192, $p < .05$).

Similarly, the linear predictor measure of combined scores was also significantly related to AP exam scores in 2011 – 2012, F (6, 264) = 19.983, $p < .001$. This model was likewise significantly better than would be expected by chance, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R (.559) showed a strong linear relationship between combined PSAT/NMSQT and FCAT scores with AP scores. About 31.2% of the variance of AP scores in the sample could be accounted for by the predictor variables, Adj. R^2 (.312). Five of the test scores had a significant ($p < .001$) zero-order correlation with AP scores. Analyzing the beta weights showed that three of the six test scores were statistically significant contributors to the overall variance in AP score to include PSAT M (.232, $p < .01$), PSAT CR (.217, $p < .05$), FCAT R (.129, p <.05).

Research Question 2. Results for AP Biology 2010 – 2011 and 2011 – 2012 using only PSAT/NMSQT scores as predictor variables showed that the combined PSAT scores were significantly related to AP exam scores in 2010 - 2011, F (3, 208) = 56.510, $p < .001$. The model was statistically significant, thereby showing a relationship of AP Biology scores to PSAT/NMSQT alone. Thus, the null hypothesis was rejected and the alternative hypothesis was retained. The multiple R coefficient (.670), demonstrated a strong relationship with AP Biology scores. The Adj. R^2 (.441) indicated that approximately 44.1% of the variance of AP Biology scores in the sample could be accounted for by the linear combination of the predictor test scores from the PSAT. Each of the three test scores had a significant ($p < .001$) zero-order correlation with AP Biology scores. The beta weights demonstrated the relative strength for the predictor variables in the model. Two of the three PSAT scores were statistically significant contributors to the overall variance in AP Biology score to include PSAT M (.471, $p < .001$) and PSAT CR (.247, $p < .001$).

In the same manner the linear combination PSAT scores was significantly related to AP exam scores in 2011 – 2012, F (3, 267) = 37.973, $p < .001$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient (R) was .547, and Adj. R^2 (.291) demonstrated that about 29.1% of the variance of AP Biology scores in the sample could be accounted for by scores on the PSAT. All three test scores had a significant ($p < .001$) zero-order correlation with AP Biology scores. Analyzing the beta weights showed that two of the PSAT scores were statistically significant contributors to the overall variance in AP Biology score to include PSAT M (.252, $p < .001$), PSAT CR (.255, $p < .001$).

Research Question 3. In the 2010 – 2011 academic school year, the linear combination FCAT scores was significantly related to AP exam scores in 2010 - 2011, F (3, 208) = 23.504, $p < .001$. The model was considered significantly better than would be expected by chance, demonstrating a linear relationship of AP Biology score to FCAT scores alone. Thus the alternative hypothesis was retained and the null hypothesis was rejected. Both the multiple correlation coefficient R (.503) and Adj. R^2 (.242) were moderate, indicating that approximately 24.2% of the variance of AP Biology scores in the sample could be accounted for by the linear combination of the FCAT scores. All three FCAT scores had a significant ($p < .05$) zero-order correlation with AP Biology scores. Each of the test scores' beta weights provided the relative strength of the contribution to the model. Two of the FCAT scores were statistically significant contributors to the overall variance in AP Biology score to include FCAT M (.213, $p < .01$) and FCAT R (.345, $p < .001$).

MRA results show that the linear combination predictor measure, FCAT scores, was likewise significantly related to AP Biology exam scores in 2011 – 2012, F (3, 267) = 16.957, $p <$ .001. The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R (.400) showed a moderate relationship between a combination of PSAT and FCAT with AP Biology scores. About 15.1% of the variance of AP Biology scores in the sample could be accounted for by the predictor variables, Adj. R^2 (.151). Two predictor variables had a significant ($p < .001$) zero-order correlation with AP scores. Their beta weights showed significant contributions to the variance in AP Biology score: FCAT M (.224, $p < .001$), PSAT CR (.238, $p < .001$).

The table below (Table 6) highlights the most significant relationships as they relate to the between PSAT, FCAT and AP test scores for the appropriate academic school years in Seminole County Public Schools for AP Biology. As can be seen in Table 6, The Full Model, containing both PSAT and FCAT scores established the strongest relationships, then using only FCAT or PSAT alone as predictor variables. For example, for the 2010 – 2011 academic school years, the Full Model's correlation coefficient was .689 as compared to .670 (PSAT only) and .503 (FCAT only). In addition, a clear pattern of significant test scores was seen in all 3 models. A combination of PSAT M, CR, and FCAT R provided the most significant relationships in the model, regardless of the academic school year.

Table 6
Summary table highlighting significant relationships with AP exam scores

Variable	R	Adj. R^2	Significant Test Scores	β
	Advanced Placement Biology			
Full Model $_1$				
2010 - 2011	.689*	.459*	PSAT M & CR, FCAT R	.502*, .216**, .192**
2011 - 2012	.559*	.312*	PSAT M & CR, FCAT R	.232*, .217***, .129**
PSAT Model $_2$				
2010 - 2011	.670*	.441*	PSAT M & CR	.471*, .247*
2011 - 2012	.547*	.291*	PSAT M & CR	.252*, .255*
FCAT Model $_3$				
2010 - 2011	.503*	.253*	FCAT M & FCAT R	.213**, .345*
2011 - 2012	.242*	.151*	FCAT M & FCAT R	.224*, .238*

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, (2010 – 2011, *N = 212; 2011 – 2012, N = 271)*

Hypothesis Testing for AP Environmental Science

Research Question 1. A combination of PSAT and FCAT scores was significantly related to AP exam scores in 2010 - 2011, $F(6, 813) = 99.519$, $p < .001$. The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R was .651, highlighting a strong association between a combination of PSAT/NMSQT and FCAT scores with AP exam scores. An analysis of the Adj. R^2 (.423) indicated that approximately 42.3% of the variance of AP Environmental Science scores in the sample could be accounted for by the linear combination of PSAT and FCAT scores. All six test scores had a significant ($p < .001$) zero-order correlation with AP scores. Three of the six test scores were statistically significant contributors to the overall variance in AP Environmental Science score to include PSAT M (.334, $p < .001$), PSAT W (.231, $p < .05$), FCAT M (.200, $p < .05$).

In a similar fashion, the linear combination predictor measure was significantly related to AP exam scores also in 2011 – 2012, F (6, 824) = 134.616, $p < .001$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R (.704) demonstrated a strong relationship between a combination of PSAT and FCAT scores with AP Environmental Science exam scores. The Adj. R^2 (. 491), signified that about 49.1% of the variance of AP scores in the sample could be accounted for by the test scores. All six test scores had a significant ($p < .01$) zero-order correlation with AP scores. Analyzing the beta weights showed that three test scores were statistically significant contributors to the variance in AP Environmental Science score to include PSAT M (.314, $p < .001$), PSAT CR (.333, $p < .001$), FCAT R (.084, $p < .05$).

Research Question 2. For 2010 – 2011, the model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained as the linear combination PSAT scores was significantly related to AP Environmental exam scores in 2010 – 2011, F (3, 816) = 56.510, $p < .001$. The multiple correlation coefficient R (.670) demonstrated a strong relationship between PSAT and AP Environmental Science scores. PSAT scores accounted for about 44.1% of the variance of AP scores in the sample, Adj. R^2 (. 441). All PSAT scores had significant ($p < .001$) zero-order correlations with AP scores. Analyzing beta weights showed that two of the PSAT scores were statistically significant contributors to the overall variance in AP Environmental Science score to include PSAT M (.471, $p < .001$), PSAT CR (.247, $p < .001$).

The model, using the linear combination of PSAT scores, was statistically significant in 2011 – 2012, F (3, 827) = 37.973, $p < .001$. The multiple correlation coefficient R (.547) and Adj. R^2, or effect size, was moderate (.291). This indicated that approximately 29.1% of the variance of AP scores in the sample could be accounted for by the linear combination of the PSAT exam scores. Each of the three PSAT sub-scores had a significant ($p < .001$) zero-order correlation with AP scores. Beta weights were examined to compare the relative strength each PSAT score added to the model. Two of the three PSAT scores were statistically significant contributors to the overall variance in AP Environmental Science score to include PSAT M (.252, p < .001) and PSAT CR (.255, p < .001).

Research Question 3. Using only FCAT scores, the model was significantly related to AP exam scores in 2011 – 2012, F (3, 816) = 56.510, p< .001. The null hypothesis was rejected and the alternative hypothesis was retained. A moderate relationship between FCAT and AP scores was shown, R (.488). The Adj. R^2 was moderate (.235), signifying that about 23.5% of the variance of AP scores in the sample could be accounted for by the PSAT test scores. All PSAT scores had significant (p < .001) zero-order correlations with AP Environmental Science scores. Analyzing beta weights showed that two test scores were statistically significant contributors to the overall variance in AP Environmental Science score to include FCAT M (.313, p < .001), FCAT R (.241, p < .001).

Likewise, a significant relationship between FCAT scores and AP scores was also shown for 2011 - 2012, F (3, 827) = 111.802, p< .001.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R was .488, thereby showing a moderate relationship between AP scores and FCAT scores in Environmental Science. An Adj. R^2 (. 286), indicated that approximately 28.6% of the variance of AP scores in the sample could be accounted for by the linear combination of the FCAT scores. Each of the three FCAT scores had a significant (p < .001) zero-order correlation with AP scores. Two of the three FCAT scores were statistically significant contributors to the overall variance in AP Environmental Science score to include FCAT M (.321, p < .001) and FCAT R (.280, p < .001), as shown by their beta weights. The most significant relationships with AP Environmental Science test scores are summarized in the table 7 below.

Table 7
Summary table highlighting significant relationships with AP exam scores

	Advanced Placement Environmental Science			
Variable	R	Adj. R^2	Significant Test Scores	β
Full Model $_1$				
2010 - 2011	.651*	.423*	PSAT M & W, FCAT M	.321*, .290*, .200*
2011 - 2012	.704*	.491*	PSAT M & CR, FCAT R	.314*, .333*, .084***
PSAT Model $_2$				
2010 - 2011	.646*	.415*	PSAT M & CR	.353*, .322*
2011 - 2012	.696*	.483*	PSAT M & CR	.361*, .374*
FCAT Model $_3$				
2010 - 2011	.488*	.235*	FCAT M & FCAT R	.313*, .241*
2011 - 2012	.537*	.286*	FCAT M & FCAT R	.321*, .280*

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, (2010 – 2011, $N = 820$; 2011 – 2012, $N = 831$)

As demonstrated by Table 7, both PSAT and FCAT exam scores moderate to strong relationships with AP Environmental Science exam scores to varying degrees. Full Model hypothesis testing showed that for each academic school year, a combination of PSAT with FCAT exam scores had a stronger relationship to AP Environmental exam scores than either test examined alone. Overall, the results were fairly consistent across all measures for both academic years. Math and reading scores had steady significant relationships with AP Environmental Science exam scores, however, writing scores did not show the same significant relationship on any measure.

Hypothesis Testing for AP Chemistry

Research Question 1. The linear combination of PSAT and FCAT exam scores was significantly related to AP exam scores in this academic discipline for 2010 - 2011, F (6, 202) = 15.465, $p< .001$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R was .561, demonstrating a strong moderate relationship between the combined PSAT and FCAT scores with AP exam scores. The Adj. R^2(. 294), indicated that approximately 29.4% of the variance of AP scores in the sample could be accounted for by the linear combination of combined scores. All six test scores had a significant ($p < .01$) zero-order correlation with AP scores. Beta weights showed that three test scores were statistically significant contributors to the overall variance in AP score to include PSAT M (.334, $p < .001$), PSAT W (.231, $p < .05$), FCAT M (.200, $p < .05$).

PSAT and FCAT scores analyzed showed a significant linear combination related to AP Chemistry scores in 2011 – 2012 also, $F(6, 227) = 14.581$, $p < .001$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. There was a strong relationship between the combined PSAT and FCAT scores as shown by the multiple correlation coefficient R (.704). The Adj. R^2 (. 259), demonstrated that about 25.9% of the variance of AP scores in the sample could be accounted for by the combined test scores. All six test scores had a significant ($p < .01$) zero-order correlation with AP Chemistry scores. Analyzing the beta weights showed that only one variable was a statistically significant contributor to the variance in AP Chemistry score to include PSAT M (.458, $p < .001$).

Research Question 2. In the 2010 – 2011 academic school year, the linear combination PSAT scores was likewise significantly related to AP exam scores, $F(3, 205) = 27.556$, $p < .001$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient (R) was .536, and Adj. R^2 was moderate (.277), signifying that about 27.7% of the variance of AP scores in the sample could be accounted for by the predictor variables. All PSAT scores had significant ($p < .001$) zero-order correlations with AP Chemistry scores. Analyzing beta weights showed that two of test scores were statistically significant contributors to the overall variance in AP Chemistry score to include PSAT M (.395, $p < .001$), PSAT W (.265, $p < .01$).

In 2011 - 2012 the linear combination PSAT scores was also significantly related to AP Chemistry exam scores, F (3, 230) = 28.249, $p < .001$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient (R) was .519, and Adj. R^2,or effect size, was moderate (.260), indicating that approximately 26.0% of the variance of AP scores in the sample could be accounted for by the linear combination of the PSAT scores. Each of the three test scores had a significant ($p < .001$) zero-order correlation with AP scores. Beta weights demonstrated that only one test was a statistically significant contributor to the overall variance in AP Chemistry score, PSAT M (.468, $p < .001$).

Research Question 3. The linear combination predictor measure was significantly related to AP exam scores in 2010 – 2011, F (3, 205) = 15.653, $p < .001$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient (R) was .432, and Adj. R^2, or effect size, was moderate (.174), signifying that about 17.4% of the variance of AP Chemistry scores in the sample could be accounted for by the exam scores from the FCAT test. All FCAT scores had significant ($p < .001$) zero-order correlations with AP Chemistry scores. Analyzing beta weights showed that only one FCAT score was a statistically significant contributor to the overall variance in the score of the AP Chemistry exam, FCAT M (.414, $p < .001$).

The FCAT only restricted model showed that the linear combination predictor measure was also significantly related to AP exam scores in 2011 – 2012, F (3, 230) = 9.822, $p < .001$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R was .337 thereby establishing a moderate relationship between FCAT exam scores and AP Chemistry scores in the sample. The Adj. R^2 (.102) was moderate, indicating that approximately 10.2% of the variance of AP Chemistry scores in the sample could be accounted for by the linear combination of FCAT exam scores. Each of the three FCAT scores had a significant ($p < .01$) zero-order correlation with AP Chemistry scores. However, only one FCAT score was a statistically significant contributor to the overall variance in AP score, FCAT M (.199, $p < .01$).

The summary table (Table 8) below illustrates the most statistically significant relationships established by the multiple regression analyses for Seminole County Public Schools during the 2010 – 2011 and 2011 and 2012 academic school years for AP Chemistry with the PSAT and FCAT exams.

Table 8
Summary table highlighting significant relationships with AP exam scores

	Advanced Placement Chemistry			
Variable	R	Adj. R^2	Significant Test Scores	β
Full Model $_1$				
2010 - 2011	.561*	.294*	PSAT M & W, FCAT M	.334*, .231**, .200**
2011 - 2012	.527*	.259*	PSAT M	.458*
PSAT Model $_2$				
2010 - 2011	.536*	.277*	PSAT M & W	.395*, .265**
2011 - 2012	.519*	.260*	PSAT M	.468*
FCAT Model $_3$				
2010 - 2011	.432*	.186*	FCAT M	.414*
2011 - 2012	.337*	.114*	None	Not applicable

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, (2010 – 2011, *N = 209; 2011 – 2012, N = 234)*

As can be seen by Table 8, although all models showed moderate relationships with the AP Chemistry exam scores, the individual significance across models was inconsistent. In some instances, as depicted by the Full Model from 2010 - 2011, there were three significant test scores associated with AP exam scores. In the following year, only one score, PSAT M, had a significant relationship. Nonetheless, math scores from both PSAT and FCAT exams, demonstrated the strongest most consistent relationships between exams across multiple models and multiple academic school years.

Hypothesis Testing for AP Physics B

Research Question 1. The linear combination of PSAT and FCAT scores was significantly related to AP Physics B exam scores in 2010 - 2011, F (6, 272) = 22.961, $p<$ .001.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. A moderately strong relationship between combined test scores, PSAT and FCAT, was shown by the multiple correlation coefficient R (.580). An examination of the Adj. R^2 (. 322) indicated that approximately 32.2% of the variance of AP Physics B scores in the sample could be accounted for by the linear combination of the following test scores. Five test scores had a significant ($p < .001$) zero-order correlation with AP Physics B scores. FCAT W also had a significant (p<.05) zero-order correlation with AP scores. Examining the beta weights, two predictor variables were identified to be statistically significant contributors to the overall variance in AP Physics B score to include PSAT M (.283, $p < .001$), FCAT M (.197, $p < .01$).

A combination of test scores was significantly related to AP Physics B exam scores in 2011 – 2012 also, F = 17.850, $p< .001$. The model was considered significantly better than would be expected by chance thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R was moderate (.505). The Adj. R^2 was also moderate (.241). Therefore, about 24.1% of the variance of AP Physics B score s in the sample could be accounted for by a combination of PSAT and FCAT scores. All six scores in the model had a significant ($p < .001$- .05) zero-order correlation with AP Physics B score s. The beta weights showed that two test scores were statistically significant contributors to the overall variance in AP Physics B score to include PSAT M (.237, $p < .001$), FCAT M (.174, $p < .05$).

Research Question 2. The restricted model using a linear combination of PSAT scores was significantly related to AP exam scores in 2010 – 2011, $F(3, 275) = 41.033$, $p < .001$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R (.556) showed a moderately strong relationship between AP Physics B score s and PSAT scores. The Adj. R^2, was large (.302), signifying that about 30.2% of the variance of AP Physics B score s in the sample could be accounted for by the predictor variables. All predictor variables had significant ($p < .001$) zero-order correlations with AP Physics B score s. Analyzing beta weights showed that two of predictor variables were statistically significant contributors to the overall variance in AP Physics B score to include PSAT M (.362, $p < .001$), PSAT CR (.189, $p < .01$).

In the same manner, the linear combination PSAT/NMSQT scores was significantly related to AP Physics B exam scores in 2010 - 2011, $F(3, 316) = 28.704$, $p < .001$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient (R) was .463, and Adj. R^2 were moderate (.207). About 20.7% of the variance of AP Physics B score s in the sample could be accounted for by the linear combination of the PSAT/NMSQT scores. Each of the three test scores had a significant ($p < .001$) zero-order correlation with AP Physics B scores. However, only one test score was a statistically significant contributor to the overall variance in AP Physics B score, PSAT M (.317, $p < .001$), as shown by the beta weights analyzed.

Research Question 3. The FCAT only restricted model using the linear combination FCAT scores alone was significantly related to AP exam scores in 2010 – 2011, $F(3, 275) = 26.301$, $p < .001$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient (R) was .472 was moderate and Adj. R^2 (.214), signified that about 21.4% of the variance of AP Physics B score s in the sample could be accounted for by the predictor variables. All FCAT scores had significant

($p < .001 - p < .05$) zero-order correlations with AP Physics B score s. Analyzing beta weights showed that two of FCAT scores were statistically significant contributors to the overall variance in AP Physics B score to include FCAT M (.349, $p < .001$), FCAT R (.182, $p < .01$).

In 2011 – 2012, the linear combination FCAT scores was likewise significantly related to AP exam scores, F (3, 316) = 28.704, $p < .001$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient (R) was .463, and Adj. R^2 was moderate (.175), indicating that approximately 17.5% of the variance of AP Physics B score s in the sample could be accounted for by the linear combination of the predictor variables. Each of the three FCAT scores had a significant ($p < .01$) zero-order correlation with AP Physics B score s. A comparative analysis of each FCAT score's relative strength showed that two predictor variables were statistically significant contributors to the overall variance in AP Physics B score , FCAT M (.297, $p < .001$), FCAT R (.175, p <.01) .

For Seminole County Public Schools during the 2010 – 2011 and 2011 and 2012 academic school years, the summary table below (Table 9) illustrates the most statistically significant relationships established by the multiple regression analyses for AP Physics B as related to PSAT and FCAT exam scores. An analysis of the overall summary of all three models in Table 9 reveal that both PSAT and FCAT exam scores were moderately associated with AP exam scores for the sample of studied. Results demonstrated a high degree of consistency between and within models tested. The Full Models tested explained more variance in AP Physics B exam scores than using either of the two other models alone.

Table 9
Summary table highlighting significant relationships with AP exam scores

	Advanced Placement Physics B			
	R	Adj. R^2	Significant Test Scores	β
Full Model 1				
2010 – 2011	.580*	.322*	PSAT M & FCAT M	.283*, .197**
2011 – 2012	.505*	.241*	PSAT M & FCAT M	.237*, .174**
PSAT Model 2				
2010 – 2011	.556*	.302*	PSAT M & CR	.362*, .189***
2011 – 2012	.463*	.207*	PSAT M & CR	.317*, .110***
FCAT Model 3				
2010 – 2011	.472*	.214*	FCAT M & FCAT R	.349*, .182**
2011 – 2012	.428*	.175*	FCAT M & FCAT R	.297*, .175**

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, (2010 – 2011, *N = 279; 2011 – 2012, N = 320)*

Table 9 also shows that writing scores did not have any significant relationships, as opposed to math and reading scores. Math scores, on both the PSAT and FCAT exams, had the greatest beta coefficients. This demonstrated that math scores the most relative strength on all models test as they explained a higher degree of variance in the AP Physics B exam score.

Hypothesis Testing for AP Physics C-Mechanical

Research Question 1. PSAT and FCAT scores in a linear combination were significantly related to AP exam scores in 2010 - 2011, $F(3, 101) = 2.893$, $p < .01$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient (R) was .281, and Adj. R^2 was small (.079), indicating that approximately 7.9% of the variance of AP Physics C (Mechanical) scores in the sample could be accounted for by the linear combination of the PSAT and FCAT scores. Five test scores had a significant zero-order correlation with AP Physics C (Mechanical) scores with PSAT

M, PSAT CR, PSAT W, FCAT R ($p<.01$) and FCAT M ($p<.05$). Beta weights analyzed demonstrated, however, that there was only one statistically significant predictor variable that contributed to the overall variance in AP Physics C (Mechanical) score, PSAT M (.264, $p < .05$).

Similarly, the combined PSAT and FCAT score was significantly related to AP exam score in 2011 – 2012 also, $F(6, 116) = 4.432$, $p< .001$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was also retained. The multiple correlation coefficient (R) was .505 moderate, with Adj. R (.144) signifying that about 14.4% of the variance of AP Physics C (Mechanical) scores in the sample could be accounted for by the predictor test scores. Five exam scores had a significant zero-order correlation with AP Physics C (Mechanical) scores with PSAT M, PSAT CR, PSAT W, FCAT R and FCAT M ($p<.01$). However, analyzing the beta weights showed that only one of the six test scores was a statistically significant contributor to the overall variance in AP Physics C (Mechanical) score, PSAT M (.358, $p < .01$).

Research Question 2. Using a restricted model, the linear combination of PSAT scores was significantly related to AP exam scores in 2010 – 2011, $F(3, 101) = 7.484$, $p< .001$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient (R) was .426 and Adj. R^2 was moderate (.158), signifying that about 15.8% of the variance of AP Physics C (Mechanical) scores in the sample could be accounted for by the predictor variables. All PSAT scores had significant ($p < .01$) zero-order correlations with AP Physics C (Mechanical) scores. Analyzing beta weights showed that only one exam score on the PSAT was a statistically significant contributor to the overall variance in AP Physics C (Mechanical) score: PSAT M (.270, $p < .01$).

The model was statistically significant in 2011 – 2012 also as the null hypothesis was rejected and the alternative hypothesis was retained, $F(3, 119) = 8.099$, $p< .001$. The multiple correlation coefficient (R) was .412 showed a moderate relationship, and Adj. R^2 was also moderate (.149), indicating that approximately 14.9 % of the variance of AP Physics C (Mechanical) scores in the sample could be accounted for by the linear combination of the predictor variables. Each of the test scores had a significant ($p < .05$) zero-order correlation with AP Physics C (Mechanical) scores. Only one predictor variable was a statistically significant contributor to the overall variance in AP Physics C (Mechanical) score, PSAT M (.408, $p < .001$), as depicted by a comparison of beta weights.

Research Question 3. A direct combination of FCAT scores was significantly related to AP Physics (Mechanical) exam scores in 2010 – 2011, F (3, 101) = 2.893, $p < .05$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R was .281and effect size was small (.052), signifying that about 5.2% of the variance of AP Physics C (Mechanical) scores in the sample could be accounted for by the FCAT scores. All test scores had significant ($p < .01$) zero-order correlations with AP Physics C (Mechanical) scores; however, beta weights showed that there were not statistically significant predictors contributing to the overall variance in AP Physics C (Mechanical) score.

The alternative hypothesis was retained for 2011 – 2012 as well, as the linear combination predictor measure was significantly related to AP exam scores, F (3, 119) = 4.510, $p < .001$. The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient (R) was .320, and Adj. R^2,or effect size, was small (.079), indicating that approximately 7.9 % of the variance of AP Physics C (Mechanical) scores in the sample could be accounted for by the linear combination of the FCAT scores. Two FCAT test scores, FCAT M and FCAT R had a significant ($p < .01$) zero-order correlation with AP Physics C (Mechanical) scores. Nonetheless, beta weights showed that only one predictor variable was a statistically significant contributor to the overall variance in AP Physics C (Mechanical) score, FCAT M (.230, $p < .05$).

The significant relationships between AP Physics C (Mechanical) as related to PSAT and FCAT exam scores during the 2010 - 2012 academic school years for Seminole County Public Schools were highlighted in Table 10 for the multiple regression analyses examined.

Table 10
Summary table highlighting significant relationships with AP exam scores

	Advanced Placement Physics C: Mechanical			
Variable	R	Adj. R^2	Significant Test Scores	β
Full Model $_1$				
2010 - 2011	.281*	.079*	PSAT M	.264***
2011 - 2012	.432*	.142*	PSAT M	.358**
PSAT Model $_2$				
2010 - 2011	.426*	.158*	PSAT M	.270**
2011 - 2012	.412*	.149*	PSAT M	.408*
FCAT Model $_3$				
2010 - 2011	.281*	.052*	None	Not applicable
2011 - 2012	.320*	.079*	None	Not applicable

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, (2010 – 2011, *N = 105; 2011 – 2012, N = 123)*

Summary Table 10 shows that although there are statistically significant relationships between AP Physics C (Mechanical) exam scores and the other standardized test scores, to include PSAT and FCAT, the strength of the relationships are small to moderate as evidenced by the Multiple coefficient R. Similarly, the Adj. R^2 values indicate that significant test scores can account for only a small variance in the AP exam score. The FCAT exam scores are not significantly associated to AP Physics C (Mechanical) and the PSAT M scores are only marginally related to the AP exam.

Hypothesis Testing for AP Physics C- Electrical

Research Question 1. The Full Model combination of PSAT and FCAT scores was significantly related to AP exam scores in 2010 - 2011, F (6, 55) = 3.199, $p < .01$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The coefficient R was moderate (.509) with an effect size of .178. This indicated that approximately 17.8% of the variance of AP Physics C (Electrical) scores in the sample could be accounted for by the linear combination of the combined exam scores. Five test scores had zero-order correlation with AP Physics C (Electrical) scores with PSAT M, PSAT CR, PSAT W, FCAT R ($p<.01$) the beta weights showed that there was only one statistically significant predictor variable that contributed to the overall variance in AP Physics C (Electrical) score, PSAT M (.237, $p < .05$).

Simultaneous entering of PSAT and FCAT scores showed that the Full Model was significantly related to AP exam scores in 2011 – 2012 also, F (6, 65) = 3.060, $p < .05$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. There was a moderate correlation coefficient R (.469) with corresponding Adj. R^2 (.148). The values illustrated that about 14.8% of the variance of AP Physics C (Electrical) scores in the sample could be accounted for by the combined standardized test scores. Although four of the test scores had a significant zero-order correlation with AP Physics C (Electrical) scores, PSAT M, PSAT W, FCAT M, R ($p<.05$) only one of the six predictor variables was a statistically significant contributor to the overall variance in AP Physics C (Electrical) score, PSAT M (.461, $p < .01$) as shown by each predictor exam scores' beta weights.

Research Question 2. A combination of PSAT scores was significantly related to AP exam scores in 2010 – 2011, F (3, 58) = 5.215, $p < .01$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R (.461) showed a moderate relationship between PSAT and AP Physics C

(Electrical) scores. The Adj. R^2, or effect size, was moderate (.172), suggesting that about 17.2% of the variance of AP Physics C (Electrical) scores in the sample could accounted by the PSAT/NMSQT scores. All test scores had significant (p < .01) zero-order correlations with AP Physics C (Electrical) scores. Analyzing beta weights showed that only one score was a statistically significant contributor; however, to the overall variance in AP Physics C (Electrical) score: PSAT M (.251, p < .005).

The restricted model using a linear combination of PSAT/NMSQT scores was significantly related to AP exam scores in 2011 – 2012 also, F (3, 68) = 5.093, p< .01.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R was .428 and Adj. R^2 (.147). Approximately 14.7 % of the variance of AP scores in the sample could be accounted for by the linear combination of the PSAT scores. Two of the three predictor variables had a significant (p < .05) zero-order correlation with AP Physics C (Electrical) scores. A comparative analysis of beta weights showed that only one predictor variable was a statistically significant contributor to the overall variance in AP Physics C (Electrical) score, PSAT M (.487, p < .001).

Research Question 3. The linear combination FCAT scores alone, in 2010 – 2011, showed that FCAT scores were significantly related to AP exam scores, F (3, 58) = 4.118, p< .01.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. About 13.3% of the variance of AP scores in the sample could be accounted for by the FCAT scores as Adj. R^2 (.133) effect size was moderate. The multiple correlation coefficient (R) was .419 also showing a moderate relation between FCAT and AP exam scores. Two of the three FCAT scores had significant (p < .01) zero-order correlations with AP scores. Analyzing beta weights showed that only one FCAT score was a statistically significant contributor to the overall variance in AP score to include FCAT R (.344, p < .01).

In a similar fashion, the linear combination FCAT scores was also significantly related to AP exam scores in 2011 -2012, F (3, 68) = 2.985, $p < .01$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R was .341 and Adj. R^2 (.077). This indicated that approximately 7.7 % of the variance of AP scores in the sample could be accounted for by the linear combination of the FCAT scores. Two of the three FCAT scores had a significant ($p < .05$) zero-order correlation with AP scores. Beta weights were compared to evaluate the relative strength of the individual FCAT score in the model, but no statistically significant contributors to the overall variance in AP score were found.

Table 11
Summary table highlighting significant relationships with AP exam scores

	Advanced Placement Physics C: Electrical			
Variable	*R*	Adj. R^2	Significant Test Scores	β
Full Model $_1$				
2010 - 2011	.509*	.178*	PSAT M	.237***
2011 - 2012	.469*	.148*	PSAT M	.461**
PSAT Model $_2$				
2010 - 2011	.461**	.172*	PSAT M	.251***
2011 - 2012	.428**	.147*	PSAT M	.487*
FCAT Model $_3$				
2010 - 2011	.419**	.133*	FCAT R	.344**
2011 - 2012	.341***	.077*	None	Not applicable

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, (2010 – 2011, *N = 105; 2011 – 2012, N = 123)*

Depicted in Table 11 below is a summary of the significant relationships between AP Physics C (Electrical) as related to PSAT and FCAT exam scores during the 2010 – 2011 and 2011 and 2012 academic school years for Seminole County Public Schools. For AP Physics C

(Electrical) it appears that FCAT exam scores are not significantly associated to AP exam scores. Overall, all models show a moderate relationship when multiple test scores are combine as shown by Multiple Coefficient R. However, only the mathematics PSAT score has a consistent relationship with the AP Physics C (Electrical) exam score. Furthermore, models tested only contribute to less than 18% of the variance seen on the score of the corresponding AP exam.

Hypothesis Testing for AP Statistics

Research Question 1. For this particular AP course, the linear combination of PSAT and FCAT scores was significantly related to AP exam scores in 2010 - 2011, F (6, 412) = 41.849, $p<$ .001.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R (.615) showed a strong relationship between PSAT and FCAT scores and AP scores. The Adj. R^2 (. 370), indicated that approximately 37.0% of the variance of AP scores in the sample could be accounted for by the linear combination of PSAT and FCAT scores. All six test scores had a significant ($p < .01$) zero-order correlation with AP scores. Four of the six test scores were statistically significant contributors to the overall variance in AP score to include PSAT M (.321, $p < .001$), PSAT CR (.167, $p < .001$), PSAT W (.117, $p < .05$), FCAT M (.117, $p < .05$), as their unique beta weights demonstrated.

The alternative hypothesis was also retained in 2011 – 2012 as the combination of PSAT and FCAT scores likewise was significantly related to AP exam scores, F (6, 437) = 51.690, $p<$ .001. The multiple correlation coefficient R (.646) demonstrate a strong relationship between PSAT and FCAT scores. The Adj. R^2 (.409) showed that about 40.9% of the variance of AP scores in the sample could be accounted for by the predictor variables. All six test scores had a significant ($p < .001$) zero-order correlation with AP scores. Analyzing the beta weights showed that two of the six test scores were statistically significant contributors to the overall variance in AP score to include PSAT M (.480, $p < .001$), PSAT W (.134, $p < .01$).

Research Question 2. MRA results using the combination of PSAT scores showed that the model was significantly related to AP exam scores in 2010 – 2011, F (3, 415) = 79.547, $p <$ .001. The null hypothesis was therefore rejected and the alternative hypothesis was retained. There was a strong association between PSAT scores and AP Statistics scores as shown by the multiple correlation coefficient R (.604). The effect size, Adj. R^2 (.361) was large, showing that about 36.1% of the variance of AP Statistics scores in the sample could be accounted for by the predictor variables. All PSAT scores had significant ($p < .01$) zero-order correlations with AP Statistics scores. Analyzing individual beta weights showed that all three test scores were statistically significant contributors to the overall variance in AP Statistics score to include PSAT M (.374, $p < .001$), PSAT CR (.180, $p < .001$), PSAT W (.144, $p < .05$).

In a manner similar to 2010 – 2011 results, the linear combination of PSAT scores was also significantly related to AP exam scores in 2011 – 2012, F (3, 437) = 102.543, $p < .001$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R (.643) suggested a strong relationship between the combined PSAT scores and AP exam scores. The Adj. R^2 (. 409), indicated that approximately 40.9 % of the variance of AP Statistics scores in the sample could be accounted for by the combination of PSAT scores. All three PSAT scores had a significant ($p <$ .001) zero-order correlation with AP Statistics scores. Analyzing beta weights showed two test scores that were statistically significant contributors to the overall variance in AP Statistics score, PSAT M (.506, $p < .001$) and PSAT W (.144, $p < .05$).

Research Question 3. The combination of FCAT scores was significantly related to AP exam scores in 2010 – 2011, F (3, 415) = 37.112, $p < .001$.The analyzed model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R (.460) showed a moderate combined relationship between FCAT scores and AP exam scores. The Adj. R^2 (.206) showed that about 20.6% of the variance of

AP Statistics scores in the sample could be accounted for by a combination of FCAT scores. All FCAT scores had significant (p < .001) zero-order correlations with AP Statistics scores. Analyzing unique beta weights indicated that two FCAT scores were statistically significant contributors to the overall variance in AP Statistics score to include FCAT M (.374, p < .001), FCAT R (.180, p < .001).

Utilizing a restricted model, the combination of FCAT scores was also a significant predictor measure of AP exam scores in 2011 – 2012. The model was statistically significant, F (3, 437) = 33.835, p< .001, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R (.434) showed a moderate relationship between a combination of FCAT scores and the variance in AP exam scores. According to the Adj. R^2 (.183) approximately 18.3 % of the variance of AP Statistics scores in the sample could be accounted for by the linear combination of the FCAT scores. All three FCAT scores had a significant (p < .001- .05) zero-order correlation with AP Statistics scores. Analyzing their beta weights showed that two test scores were statistically significant contributors to the overall variance in AP Statistics score, FCAT M (.308, p < .001) and FCAT W (.181, p < .001). Table 12 emphasizes the most significant relationships between AP Physics C (Electrical) as related to PSAT and FCAT exam.

Table 12
Summary table highlighting significant relationships with AP exam scores

	Advanced Placement Statistics			
Variable	R	Adj. R^2	Significant Test Scores	β
Full Model 1				
2010 - 2011	.615*	.370*	PSAT M, CR, PSAT W & FCAT M	.321*, .167*, .117**, .117**
2011 - 2012	.646*	.409*	PSAT M & W	.480*, .134**
PSAT Model 2				
2010 - 2011	.604*	.361*	PSAT M, CR, W	.374*, .180*, .144**
2011 - 2012	.643*	.409*	PSAT M & W	.506*, .144**
FCAT Model 3				
2010 - 2011	.460*	.206*	FCAT M & R	.328*, .177*
2011 - 2012	.434*	.183*	FCAT M & R	.308*, .181*

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, (2010 – 2011, *N = 419; 2011 – 2012, N = 441)*

Results were relative consistent across all models and for multiple years. All models illustrated a moderate to strong relationship between PSAT and FCAT exam scores as associated to AP Statistics. Math scores on either exam demonstrated the greatest contribution to related AP exam score variance for all models analyzed, as illustrated by their beta weights. Combined PSAT exam scores had a strong correlation with AP Statistics exam scores. Likewise, a combination of FCAT math and reading scores were correlated to scores on the AP statistics exam, to a lesser more moderate degree.

Hypothesis Testing for AP Calculus AB

Research Question 1. In the Full Model testing of the linear combination of PSAT and FCAT scores, results showed that this combination was significantly related to AP exam scores, $F(6, 643) = 42.409$, $p < .001$. The null hypothesis was therefore rejected and the alternative hypothesis was retained. The multiple correlation coefficient R (.533) showed a moderate relationship between the combined test scores and AP exam scores. The effect size, Adj. R^2

(.277), approximated that 27.7% of the variance of AP scores in the sample could be accounted for the combination of PSAT and FCAT scores. All six test sub-scores had a significant (p < .01) zero-order correlation with AP scores. However, by analyzing their beta weights, only two test scores were determined to be statistically significant contributors to the overall variance in AP score to include PSAT M (.381, p < .01), FCAT M (.117, p < .05).

Entering all variables simultaneously for 2011 – 2012 student data, showed that a combination of PSAT and FCAT scores was significantly related to AP Calculus AB exam scores, F (6, 758) = 37.298, p< .001. The model was statistically significant, thus the null hypothesis was rejected in this model also. A moderate relationship was demonstrated by the multiple correlation coefficient R (.477) between the combined PSAT and FCAT scores with AP scores. Approximately 22.2% of the variance of AP scores in the sample could be accounted for by the linear combination of PSAT and FCAT scores, Adj. R (.222). All six test scores had a significant (p < .01) zero-order correlation with AP scores. Unique beta weights, determined three test scores to be statistically significant contributors to the overall variance in AP Calculus AB exam score to include PSAT M (.282, p < .001), PSAT CR (.142, p < .01), FCAT M (.092, p < .05).

Research Question 2. The predictor measure of using PSAT scores alone was significantly related to AP exam scores in 2010 – 2011, F (3, 650) = 81.321, p< .001.The model was statistically significant, thus the alternative hypothesis was retained. The multiple correlation coefficient R (.522) suggested a moderate relationship between the combination of PSAT scores and AP Calculus AB scores. About 27.0% of the variance of AP Calculus AB scores in the sample could be accounted for by the PSAT scores, Adj. R^2(.270). All PSAT scores had significant (p < .001) zero-order correlations with AP Calculus AB scores. Analyzing individual beta weights showed that two predictor variables were statistically significant contributors to the overall variance in AP score to include PSAT M (.099, p < .005) and PSAT CR (.439, p< .001).

In comparison, the linear combination predictor measure of PSAT scores for 2011 - 2012 was also significantly related to AP exam scores, F (3, 761) = 71.419, $p < .01$.The model was statistically significant, thus the null hypothesis was rejected in this model as well. The multiple correlation coefficient R (.469) demonstrated a moderate relationship between PSAT scores and AP Calculus AB scores for that academic school year. The Adj. R^2 (.217), indicated that approximately 21.7 % of the variance of AP Calculus AB scores in the sample could be accounted for by the linear combination of PSAT scores. Two of the three PSAT scores had a significant ($p < .05$) zero-order correlation with AP scores. A beta weight analysis showed that two test scores were statistically significant contributors to the overall variance in AP Calculus AB score to include PSAT M (.320, $p < .001$) and PSAT CR (.163, $p < .001$).

Research Question 3. FCAT scores, in combination, were significantly related to AP exam scores in 2010 – 2011, F (3, 650) = 40.152, $p < .001$. The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R (.396) suggested a moderate relationship between FCAT and AP Calculus AB scores. The Adj. R^2 (.153), attributed 15.3% of the variance of AP scores in the sample the combination of FCAT scores. All FCAT scores had significant ($p < .001$-.05) zero-order correlations with AP Calculus AB scores. Analyzing beta weights showed that two predictor variables were statistically significant contributors to the overall variance in AP score to include FCAT M (.316, $p < .005$) and FCAT CR (.142, $p < .001$).

In the same manner, the linear combination FCAT scores was significantly related to AP exam scores in 2011 – 2012, F (3, 761) = 71.419, $p < .01$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R (.345) highlighted a moderation relationship between FCAT scores and AP Calculus AB scores. An approximate 11.6% of the variance of AP Calculus AB scores in the sample could be accounted for by the linear combination of FCAT scores, Adj. R^2 (.116). Two of the three FCAT scores had a significant ($p < .001$) zero-order correlation with AP scores. Analyzing unique beta weights showed that two FCAT scores were statistically significant contributors to the overall variance in AP Calculus AB score to include FCAT M (.240, $p < .001$) and FCAT R (.153, $p < .001$).

Table 13
Summary table highlighting significant relationships with AP exam scores

	Advanced Placement Calculus AB			
Variable	*R*	Adj. R^2	Significant Test Scores	β
Full Model $_1$				
2010 - 2011	.533*	.277*	PSAT M, FCAT M	.381*, .117**
2011 - 2012	.477*	.222*	PSAT M & CR, FCAT M	.282*, .142**, .092*
PSAT Model $_2$				
2010 - 2011	.522*	.270*	PSAT M & CR	.099***, .439*
2011 - 2012	.469*	.147*	PSAT M & CR	.320*, .163*
FCAT Model $_3$				
2010 - 2011	.396*	.153	FCAT M & FCAT R	.316*, .142*
2011 - 2012	.345*	.116	FCAT M & FCAT R	.240*, .153*

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, (2010 – 2011, *N = 652; 2011 – 2012, N = 765)*

A summary table above provides the most significant relationships between standardized exam scores to include PSAT and FCAT scores as they are related to AP Calculus AB exam for Seminole County Public Schools during the 2010 – 2011 and 2011 and 2012 academic school years. Overall, the models were fairly consistent when across multiple academic school years analyzed when examining only one exam, such as PSAT or FCAT. Less consistency was found when the exams where combined. As exemplified in Table 13, a combination of PSAT and FCAT scores had the strongest association to the variance exhibited in the AP Calculus AB exam scores. The mathematics exam scores had the strongest and most consistent relationships for all models tested. Writing scores did not show any significant relationships with AP Calculus AB as one may suspect with intense mathematics courses. Reading scores, however, although to a lesser degree than the math scores, had significant relationships in multiple models with AP Calculus AB exam scores.

Hypothesis Testing for AP Calculus BC

Research Question 1. AP Calculus BC exam scores examined showed a statistical significant relationship between the combined PSAT and FCAT scores with AP Calculus BC scores, F = 2.217, $p < .05$. Thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient R (.269) signified a weak combined relationship. The Adj. R^2 was small (.040), indicating that approximately only 4.0% of the variance of AP Calculus BC scores in the sample could be accounted for by the linear combination of the combined PSAT and FCAT scores. A comparison of beta weights identified that there were no statistically significant contributors to the overall variance in AP Calculus BC score for this course.

Analyzing the results for Calculus BC for 2011 – 2012 and entering all variables simultaneously, the linear combination of PSAT and FCAT scores was also related to AP exam scores, F (6, 191) = 3.864, $p < .001$. Statistically, the null hypothesis was rejected for the model and the alternative hypothesis was retained. The multiple correlation coefficient R (.329) showed a moderate relationship between AP Calculus BC scores and the combined PSAT and FCAT scores. The, Adj. $R^2$was small (.080), indicating that only approximately 8.0% of the variance of AP scores in the sample could be accounted for by the linear combination of FCAT and PSAT scores. In the model analyzed, a comparison of beta weights identified that two of the six test scores were statistically significant contributors to the overall variance in AP Calculus BC score to include PSAT M (.169, $p < .05$) and PSAT CR (.190, $p < .05$) for this academic school year.

Research Question 2. The combination of PSAT scores was significantly related to AP exam scores in 2010 – 2011, F (3, 174) = 4.446, $p < .01$.The model was statistically significant, thus the null hypothesis was rejected and the alternative hypothesis was retained. The multiple correlation coefficient (R) was .267 and effect size, Adj. R^2 (.055) was small. This indicated that only about 5.5% of the variance of AP Calculus BC scores in the sample could be accounted for by the PSAT scores. All PSAT scores had significant ($p < .01$) zero-order correlations with AP scores. Analyzing beta weights, however, showed that predictor variables were not statistically significant contributors to the overall variance in AP Calculus BC score.

A restricted model using 2011 – 2012 scores also showed that the linear combination of PSAT scores was also significantly related to AP exam scores, F (3, 194) = 7.007, $p < .001$. Hence, the alternative hypothesis was retained as the Null hypothesis was rejected. The multiple correlation coefficient R (.313) demonstrated a moderate relationship between the combined PSAT scores and AP scores. An effect size, Adj. R^2 of .084, indicated that approximately only 8.4 % of the variance of AP Calculus BC scores in the sample could be accounted for by the linear combination of PSAT scores. All three PSAT scores had a significant ($p < .01$) zero-order correlation with AP Calculus BC scores. Nonetheless, analyzing beta weights showed that PSAT scores were not statistically significant contributors to the overall variance in AP Calculus BC scores.

Research Question 3. Exam scores from the 2010 – 2011 and 2011 – 2012 models were analyzed using only FCAT scores as predictor variables. The combined FCAT scores were significantly related to AP exam scores in 2010 – 2011, F (3, 174) = 1.240, $p < .01$ thus rejecting the null hypothesis and retaining the alternative hypothesis. The multiple correlation coefficient R (.145) showed a combined weak relationship between FCAT scores and AP Calculus BC scores. The Adj. R^2 (.004) was small, signifying that only about 4.0% of the variance of AP scores in the sample could be accounted for by the FCAT scores. Only one FCAT score had significant ($p <$

.05) zero-order correlation with AP Calculus BC scores. Furthermore, there were no statistically significant contributors to the overall variance in AP Calculus BC scores.

Results also showed that the linear combination of FCAT scores was statistically significant for 2011 - 2012, F (3, 194) = 3.198, $p < .001$. Therefore this null hypothesis was likewise rejected and the alternative hypothesis was also retained. The multiple correlation coefficient R (.217) indicated a weak relationship between FCAT scores and AP scores. The Adj. R^2 (.032) was small, indicating that only about 3.2 % of the variance of AP scores in the sample could be accounted for by the linear combination of FCAT scores. Two test scores had a significant ($p < .01$) zero-order correlation with AP Calculus BC scores. However, analyzing respective beta weights showed that FCAT scores were not statistically significant contributors to the overall variance in AP Calculus BC score

Table 14
Summary table highlighting significant relationships with AP exam scores

	Advanced Placement Calculus BC			
Variable	*R*	Adj. R^2	Significant Test Scores	β
Full Model $_1$				
2010 - 2011	.269***	.040*	None	Not applicable
2011 - 2012	.329*	.080*	None	Not applicable
PSAT Model $_2$				
2010 - 2011	.267*	.055*	None	Not applicable
2011 - 2012	.313*	.147*	None	Not applicable
FCAT Model $_3$				
2010 - 2011	.145*	.004*	None	Not applicable
2011 - 2012	.217*	.032*	None	Not applicable

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, (2010 – 2011, *N = 178; 2011 – 2012, N = 198)*

The various multiple regression analyses performed and evaluated for AP Calculus BC were consistent in demonstrating that there no statistically significant relationships between PSAT, nor FCAT, as they related to AP exam scores. Across all models and for multiple years the combined exam scores provided weak associations. Evaluating those relationships using effect size estimates, all statistically significant relationships were negligible at best.

Overall Summary of Results

A series of multiple regression analyses were calculated, presented and analyzed for selected STEM-related AP courses for Seminole County Public Schools for available data during the 2010 – 2011 and 2011 - 2012 academic school years. Overwhelmingly, most models tested were statistically significant, indicating a linear relationship between multiple combinations of PSAT and FCAT scores with AP exam scores for these academic disciplines. However, the strength and unique contribution of relationships varied between STEM-related AP courses tested. For example, in the case of AP Biology, the most unique and significant standardized test scores related with AP scores, beyond and above the other standardized test scores, were a combination of PSAT and FCAT scores (PSAT-M, PSAT-CR and FCAT-R); The most significant standardized test scores, beyond and above the other standardized test scores, associated with AP Physics C (mechanical and electrical) exam performance were the PSAT-M scores. In the case of AP Calculus BC, there were no significant standardized test scores associated with AP exam performance in any of the models tested. Other selected AP courses also varied in terms of results.

Nonetheless, several patterns emerged. For 8 out of the 9 AP math and science courses tested such as AP Biology, AP Environmental Science and AP Statistics, there were consistent moderate to strong relationships. Only for AP Calculus BC were the relationships consistently weak.

In terms of comparison of results from models tested between both academic years (2010 – 2011 and 2011 – 2012) results were relatively consistent. The individual Multiple R values, Adjusted R^2 and beta coefficients, regardless of strength, were relative close in value (less than a 10% difference) for every value measured. For example, the AP Environmental Science results showed an R value of .646 for 2010 – 2011 and a similar R value of .696 in 2011 – 2012. A comparison of Adjusted R^2 values resulted in .415 and .483 respectively. For both academic years the PSAT M & CR were significant contributors to unique variance in the combined linear relationship of PSAT scores. The following chapter will present the significance of the findings, with suggested corresponding theoretical and practical applications for practice and research.

CHAPTER V

DISCUSSION AND RECOMMENDATIONS

This chapter summarizes the current study, discusses the findings in the context of previous research and provides recommendations related to the findings. The aim of the study was to serve as a baseline study to examine the relationships between various combinations of PSAT/NMSQT and FCAT scores with AP math and science exam scores in Seminole County Public Schools for the 2010 – 2011 and 2011 – 2012 academic school years. Multiple regression analyses were conducted in order to study the extent to which these standardized test scores were significantly related to AP performance in the sample. The intent of the study was to report the association between scores and serve as a baseline study for further research in the potential use of selected standardized scores as part of a systematic approach towards the identification of additional AP math and science students for STEM-related course placement.

The STEM-related AP courses selected for study included: (a) Biology (b) Environmental Science (c) Chemistry (d) Physics B (e) Physics C- Electrical (f) Physics C-Mechanical (g) Statistics (h) Calculus AB (i) Calculus BC. The sample sizes that were analyzed in the study ranged from 62 sets of scores for Physics C-Electrical to 831 sets of scores for Environmental Science. The analyses were divided into three sections to include: (a) Full Model testing to examine the combined relationship between PSAT and FCAT scores with AP exam scores, (b) PSAT Model testing to examine the combined relationship of only PSAT scores with AP exam scores, (c) FCAT Model testing to examine the combined relationship of only FCAT scores with AP exam scores. Each model was additionally tested to examine the relative strength and relationship of each sub-score (PSAT-M, PSAT-CR, PSAT-W, FCAT-M, FCAT-R, FCAT-W) associated with AP exam performance for each of the selected STEM-related AP courses. The results of regression analyses showed that the relationships varied distinctively, depending on the STEM-related AP course analyzed, findings are discussed in the section that follows.

Discussion of the Findings

There is a national shortage in the labor force that is required to fill positions available in STEM-related careers (George et al., 2001; Scott et al., 2009; National Academy Press, 2010). Post-secondary education serves as a transition in the American education system between high school and the workforce. Students who enroll into advanced STEM-related courses during high school are more likely to follow a STEM-related college path (Mattern, Shaw, & Ewing, 2011). Yet, there is a national shortage of students enrolling into advanced STEM-related, math and science courses prior to entering college (Scott et al., 2009). Among influential factors associated with entry into these STEM-related pipelines is the number of advanced math and science classes taken during high school (George et al., 2001; Mattern, Shaw & Ewing, 2011). Adequately identifying students for these courses, however, can be a challenge for educators (Farkas Duffett Research Group, 2009). Camara and Millsap (1997) addressed this challenge and reported that students with moderate PSAT/NMSQT scores typically perform well on corresponding AP exams. Their study suggested that PSAT/NMSQT scores can, to a non-specified degree, be considered in the process for AP course enrollment. Therefore, these researchers concluded that students who have completed the course prerequisites, yet have not alternately been considered by other methods, can be identified for further consideration with scores provided by the PSAT/NMSQT test (Camara &Millsap, 1997). Other researchers have found similar relationships between PSAT and specific AP exams (Palin, 2001; Wagner, 2001). Follow-up studies have also confirmed similar findings (Camara et al., 2006; Camara & Millsap, 1998). Extending previous findings, Beard (2007) found a predictive relationship between PSAT/NMSQT scores with FCAT using discriminant analysis. Froman et al. (2008) reported correlations between FCAT and selected AP exams from a specific sample of scores. This study, likewise, served as an additional follow-up to related research findings. The current study investigated relationships using both, the PSAT/NMSQT and FCAT exams, and analyzed those relationships using localized data from SCPS scores in Florida.

In addition, PSAT/NMSQT data is not always available for all students in Florida; this study also investigated the degree to which FCAT scores alone provided similar PSAT-based research findings. The study, furthermore, investigated the extent that a combination of selected standardized test scores, PSAT and FCAT scores together, were associated to performance on selected AP mathematics and science exams in the SCPS sample. The study provided baseline data that informed regarding the use of these standardized tests as possible AP identification tools, for STEM-related courses in the county. The likely advantage of using standardized scores as a quantitative measure for course placement is to provide identification information for students with untapped AP potential (Flug, 2010). The findings for this study regarding the relationships and prospective use for identification purpose varied per selected STEM-related AP course. Therefore, discussion of findings is treated separately for each AP course analyzed.

Findings for AP Biology

Camara and Millsap (1997) reported strongest PSAT/NMSQT correlations with AP Biology scores to be PSAT M (r = .5398) and PSAT V (r = .5678). Their follow up study, Camara and Millsap (1998) reported PSAT M (r = .540) and PSAT V (r=.568). In 2006, Camera et al, reported PSAT M (r = .585), PSAT V (r = .591), and PSAT W (r = .527). However they reported that a combined score of PSAT V + M (R = .656) actually had the strongest correlation. This study had similar findings with a combined correlation using PSAT M & CR of .670 ($p<.001$) in 2010 – 2011 and .547 in 2011 – 2012. However, extending their findings this study emphasized that a combined linear model using PSAT M, PSAT CR and FCAT R (.689) had stronger correlations in 2010 – 2011, than previous studies would have anticipated. Additionally, Adj. R^2 values had never been reported in previous studies. This study was unique in reporting a large effect size, Adj. R^2 , ranging from about 31.2% to 45.9% of the variance of AP Biology scores in the sample could be accounted for by the predictor variables, PSAT M, PSAT CR and FCAT R. Overall, the study additionally demonstrated that the individual relationships from each sub-score using either the PSAT or the FCAT were statistically significant. The use of a combination of scores (PSAT M, PSAT CR and FCAT R) increased the association between assessments. In terms of beta weights, this study established that PSAT M consistently had the strongest unique contributions to the overall prediction equations in all AP Biology models tested.

Findings for AP Environmental Science

There were no AP Environmental Science correlations reported by Camara and Millsap in their 1997 or 1998 studies. Camera et al. (2006), reported individual correlations from PSAT M (r = .591), PSAT V (r = .542), and PSAT W (r = .515). Yet it was the combined PSAT M + PSAT V that provided the strongest correlation (R = .632), according to their analyses. This study had similar zero-order correlations include PSAT M (r = .553 - .601), PSAT CR (r = .554 - .618), PSAT W (r = .481 - .528), from the 2010 – 2012 samples, respectively. Additionally, it showed that a combination of PSAT M, PSAT CR and FCAT R had the strongest correlations (R = .704, p < .01) for 2011 - 2012. Consistently, a combination of sub scores of reading and math scores, either the PSAT M + PSAT CR (R = .646 – 696, p < .01) or FCAT M + FCAT R (R = .488 - .537, p < .01), provided the strongest correlations. Additionally, the largest effect size found was by using a combination of both PSAT and FCAT scores (Adj. R^2 = .491, p < .01). Also consistent, it was established that the math and reading sub-scores on either the PSAT or FCAT provided the strongest unique contributions to the overall effect size. This finding was similar to the reported findings in study by Camera et al. (2006), in terms of PSAT scores.

Findings for AP Chemistry

Camera & Millsap (1997), reported individual correlations from PSAT M (r = .5858), PSAT V (r = .4431), and PSAT M + V (r = .5757). In their study, they concluded that PSAT M had a stronger correlation individually, than any combination of PSAT scores. Likewise, their follow up in 1998 reported similar results as PSAT M results showed the strongest correlation than any other PSAT score combination (r = .586). The PSAT M correlation results in Camera et al. (2006) once again reported the PSAT M as showing the strongest zero order correlation (r = .599) than any other combination of scores. Consistent with these findings, this study found that PSAT M (r = .513) had the strongest individual correlations and provided relatively the strongest unique contributions to overall effect size when all PSAT and FCAT scores where simultaneously entered into the Full Model (β = .334 - .458). However, adding to previous findings, this study reported the strongest correlations using PSAT M + PSAT W + FCAT M (R = .561), as compared to any other combination of scores. These findings showed that math scores from either PSAT or FCAT had the strongest and most significant contributions with performance on the AP Chemistry exam. However, FCAT M did so to a lesser degree than PSAT M.

Findings for AP Physics B

Camara and Millsap reported PSAT M to have the strongest correlations with AP Physics B scores to be PSAT M (r = .5199) in 1997 and PSAT M (r = .520) in 1998, as compared to any other combination of scores. The results from Camera et al. (2006), reported that PSAT M + V had the largest correlation coefficient (r = .541. However, when PSAT M was reported alone it had a comparable result, PSAT M (r = .540). In similar fashion, math scores from either the PSAT or FCAT consistently demonstrated the strongest relative unique contributions to all models tested. Therefore it was not surprising to find that a combination of PSAT M + FCAT M had the largest multiple R coefficients in the Full Model tested, (R = .505 - .580) in 2010 – 2011 and 2011 – 2012, respectively. The Full Models' Adj. R^2 ranged from .241 to .322, suggesting that math scores from a combination of FCAT and PSAT accounted from approximately 24% to 32% of the variance found in AP Physics B scores. However, in terms of FCAT model alone, a combination of FCAT M + FCAT R showed the highest correlation (R = .472, p < .01), with

Adj. R^2 ranging from .175 to .214 ($p < .01$), than the correlations of any individual score. These findings suggest that math scores, for the sample analyzed, served as the strongest predictors with performance on the Physics B exam. However, once again, like with AP Chemistry, FCAT math correlation did so to a lesser degree.

Findings for AP Physics C- Mechanical

In relationship with Physics C (Mechanical), scores from the PSAT M (r = .5940) in 1997 and 1998, showed the strongest correlations with AP exam scores, than any other combination of PSAT scores. A follow up study reported a consistent finding with PSAT M (r = .572) having the strongest correlation than any other test score combination from the PSAT exam (Camera et al., 2006). For this study, the findings were also consistent with previously reported results, showing that the PSAT M (r = .368 - .406) had overall, both the strongest and most significant unique contribution for all associations with AP Physics C (Mechanical) exam scores. However, the reported correlations in this study were lower than the national norms. Furthermore, in terms of the FCAT test, the findings from this study showed that there were no significant FCAT scores associated with performance on the AP Physics C (mechanical) exam.

Findings for AP Physics C- Electrical

Camera & Millsap (1997; 1998) reported individual correlations from PSAT M (r = .476) to demonstrate the strongest relationships than any other individual or combined set of PSAT scores. In 2006, PSAT M + V (r = .460) showed the strongest relationships. However, consistent with previous findings PSAT M (r = .455) also showed moderately strong relationships. In line with findings from previous research PSAT M scores in this study also showed the strongest correlations with AP Physics C (Electrical), zero-r correlation ranging from .361 - .416 and multiple R ranging from .469 - .509, with PSAT M showing the most significant unique contribution to the Full Model. Similar to Physics C (Mechanical), FCAT correlations did not significantly contribute uniquely to any models tested, with the exception of FCAT R (r = .390) in the 2010 -2011 sample.

Findings for AP Statistics

In reported findings for AP Statistics, Camara and Millsap did not state any correlations in terms of PSAT scores for 1997 or 1998. However, Camera et al. (2006) reported PSAT M + V (R = .640) as having the strongest combined correlation coefficient. In their report they also highlighted PSAT M (r = .604), when score was considered alone. A similar range was found in this study as PSAT M ranged from zero-r correlations of .555 to .622, when only PSAT test scores were considered. In terms of the Full Model, when both PSAT and FCAT scores were combined, the multiple R for 2010 – 2011 was .615. The significant scores in the model included the combination of PSAT M + CR + W + FCAT M. with a large effect size (Adj. R^2 = .370). The following year only PSAT M + W were found to be significant contributors to the Full Model. In terms of FCAT test scores, a combination of FCAT M + R, R ranging from .434 - .460 was found to be the unique and significant contributors. These finding showed that using both math and reading scores, had a stronger relationship with AP Statistics exam scores than the relationship between any one individual PSAT or FCAT test score alone.

Findings for AP Calculus AB

The relationship between PSAT M (r = .5584) and AP Calculus AB was reported to be the strongest association between assessments (Camera and Millsap, 1997; 1998). Likewise, the PSAT M score (r = .530) showed the strongest relationship in a follow-up study (Camera et al., 2006). Similarly, this study found that PSAT M (R = .461) showed the highest correlation and unique contribution when only PSAT scores were included in model testing. Adding to those findings, a combination of PSAT M + FCAT M had a larger multiple R coefficient (R = .533) than the PSAT M score being considered alone. In addition, a combination of both PSAT and FCAT scores had larger effect size values (Adj. R^2ranging from .222 to .277) as compared to the

PSAT only model (Adj. R^2ranging from .172 to .147) or FCAT only model (Adj. R^2ranging from .116 to .153). Additionally, FCAT R (r = .343) was also found to be a significant unique contributor to the FCAT only model.

Findings for AP Calculus BC

Reported relationships by Camara and Millsap (1997; 1998) included the strongest association between PSAT M with AP Calculus BC scores (r = .5087), than any other combination of analyzed scores. In 2006, Camara et al., supported previous findings with PSAT M (r = .484) showing the strongest relationship with the AP exam score in Calculus BC. Inconsistent with previous findings, however, this study showed that PSAT M zero-order correlation coefficients ranged from (r = .183 - .253), thereby showing weak associations between PSAT M scores and AP Calculus BC. Furthermore, this study found that there were no PSAT nor FCAT standardized test scores that had any significant contribution to the variance associated with AP Calculus BC performance.

Overall Findings

Hypothesis based testing of Full (PSAT and FCAT scores) and Restricted Models (PSAT or FCAT scores only) showed differential results for models tested for each AP exam course analyzed. Therefore, the following sections will aim to answer the guiding research questions by providing and analyzing overall patterns in the findings that emerged. For each model tested the research question aimed to answer the question in two parts. Part one included an analysis for the combined relationship from all the scores included in the model. The second part analyzed the research question from the perspective of unique contribution associated with each sub-score and corresponding relationship(s) with the model being tested.

Findings for Research Question 1

Based on previous research findings that reported strong positive relationships between PSAT and most AP exam scores (Camara et al., 2006; Camara and Millsap 1997; 1998; Palin, 2001; Wagner, 2001) and strong predictive relationship established by Beard (2007), between PSAT and FCAT, it was hypothesized that similar strong positive relationships would be found between the combination of PSAT and FCAT scores. Likewise, it was hypothesized that all sub-scores from both the PSAT and FCAT exams would also show strong positive relationships. Overall, all of the findings from this study supported the research hypotheses; however, it did so, to varying degrees. Unique to this current study, the findings of this study suggested that some FCAT scores for particular subjects, such as AP Biology and AP Environmental Science, increased the association in the combined predictive equation in the Full Model, as compared to using only the restricted PSAT model alone. This was the case for all selected STEM-related math and science courses analyzed, with the exception of AP Physics C (Mechanical), Physics C (Electrical) and Calculus BC. However, the degree to which it increased the Multiple R coefficient varied per STEM-related AP exam scores analyzed. The findings of this current study were unique in terms of adding FCAT scores as independent predictor variables, as literature review did not find any other empirical studies that examined FCAT, or any scores from statewide assessments, in such a manner.

Furthermore, the unique contribution from this current study also include analyses of Adj. R^2, effect size values, that highlighted the percent of the variance in AP scores (from the sample) that could be accounted for by the linear combination of PSAT and FCAT scores. This study found that Adj. R^2 values ranged from .040 (Calculus BC) to .491 (Environmental Science). These findings were aligned to conclusions drawn by other researchers that suggested multiple factors related to AP performance, other than standardized test scores, to include other quantitative measures such as GPA, class rank, number of related coursework, etc., as well as qualitative factors such as motivation and social support, etc. (ACT, 2009; Camara et al., 2006; Camara & Millsap, 1998; Gregory, 2009; Tam and Sukhatme, 2004). However, a review of pertinent literature did not reveal previous Adj. R^2 values using a combination of PSAT and FCAT scores, or other standardized test scores, as a basis for comparison with this study.

Findings for Research Question 2

Several studies, by means of national samples, have been completed using only PSAT scores; these studies established strong positive correlations between independent PSAT scores and combined PSAT scores to include, PSAT (V + M), PSAT (V + W), PSAT (V + M + W) and PSAT (2V + M) with multiple AP exam courses to varying degree (Camara et al., 2006; Camara & Millsap, 1997; 1998). These results were used in the development of an AP potential tool that helps identify possible AP students that may enroll in AP courses. Therefore, it was hypothesized that similar strong positive relationships would be found by analyzing models that only used PSAT scores from selected localized samples in Florida. Likewise, it was hypothesized that all sub-scores from the PSAT exam scores would also show strong positive relationships. Overall, alternate research hypotheses were supported for every selected STEM-related AP exam in the sample. In particular PSAT M scores were found to have the strongest relationships and most significant unique contributions to AP exam scores of all PSAT models tested. In contrast, PSAT W had the weakest relationships, wherein in many occasions they were not found to be statistically significant. Findings were consistent overall with other empirical studies (Camara et al., 2006; Camara & Millsap, 1997; 1998).

In terms of the PSAT models tested, unique to this study was a broad range of Adj. R^2 values found, going from .055 (Calculus BC) to .483 (Environmental Science). These findings were aligned to previous suggestions that other variables, other than only PSAT scores, should be taken into account in AP course placement (ACT, 2009; Camara et al., 2006; Camara & Millsap, 1998; Gregory, 2009; Tam and Sukhatme, 2004). However, the percent of the variance in AP scores (from the sample) that could be accounted for by PSAT scores have not been reported with corresponding established relationships in previous studies.

Findings for Research Question 3

The relationship between FCAT and AP scores was previously studied in a localized sample in Miami Dade County (Froman et al., 2008). That study established moderate (*r* = .44) to strong (*r* = .60) positive relationships between AP exams and FCAT scores for the 12 most popular AP exams in the selected county. Included in the study were four AP courses that were also included in this study: AP Biology, AP Environmental Science, AP Calculus AB and AP Statistics. Other researchers have linked state mandated high school exams, such as FCAT, to PSAT exam scores (Beard, 2007; College Board, 2010; Wilson, 2004). Henceforth, moderate to strong positive relationships were hypothesized to exist in the FCAT models tested for this present study. Likewise, it was hypothesized that FCAT sub-scores (FCAT M, FCAT R and FCAT W) would also have moderate to strong unique contributions to FCAT models analyzed. In a similar fashion to PSAT model testing, the Null Hypotheses were consistently rejected. Relationships between FCAT and AP exam scores were regularly statistically significant.

Paralleling research findings using only PSAT scores, math scores from the FCAT exam provided consistent correlations across multiple FCAT models analyzed. This became evident as FCAT M provided significant unique contribution to the multiple FCAT models tested, with the exception of AP Physics C (Mechanical), Physics C (Electrical) and Calculus BC. Additionally, FCAT reading scores also provided unique and significant contributions to relationships established for multiple models, except for AP Chemistry, Physics C (Electrical) and Calculus AB. Overall, the combined scores (FCAT M + FCAT R) provided the strongest relationships more consistently than any other combination of FCAT scores. FCAT writing scores were found to have the weakest relationships with AP exam scores, as depicted by zero-order correlations. Similarly, FCAT W did not provide any statistically significant contribution to any FCAT model tested. All of these findings served as baseline data and unique contributions in the current study as previous research was limited in the examination of FCAT and its relationship to STEM-related AP exam scores, both statewide and locally.

Recommendations for Future Research and Practice

The corresponding relationships between standardized test scores and performance on particular AP exams may be of interest to students, parents, educators, school administrators, researchers, test developers, administrators, counselors, policy makers, college placement advisors and others involved in the development and implementation of AP courses. This section addresses recommendations for interested individuals, and presents them from both a theoretical and practical standpoint.

Research Recommendations

In the current study, both strong and weak relationships were found among selected standardized test scores, PSAT and FCAT scores, with corresponding STEM-related AP exams. In the case where, moderate to strong positive relationships were established by the baseline data, such as AP Biology, AP Environmental Science and AP Statistics, further research is recommended to rationalize construction of expectancy tables that estimate the probability of successful performance on those selected STEM-related AP exams, as has been created by the PSAT-based research that led to the development of the *AP Potential* advisement tool. The construction of expectancy tables using FCAT scores, or similar statewide assessments would help guide practitioners in the adequate use of these test scores for potential student identification and placement.

Furthermore, weak correlation coefficients were also established between the selected standardized test scores and certain STEM-related AP exam scores, such as AP Calculus BC. These findings suggest a need for the further research into other set of available quantitative data that may help in adequately identifying students for these STEM-related AP courses as the need for course identification and placement still remains.

Figure 1 below summarizes the challenges of identifying and placing students in AP courses. The flowchart is proposed to help researchers and practitioners to conceptualize a rationale to conduct further study of an active and systematic approach to identification and placement of students in AP courses in Florida and elsewhere:

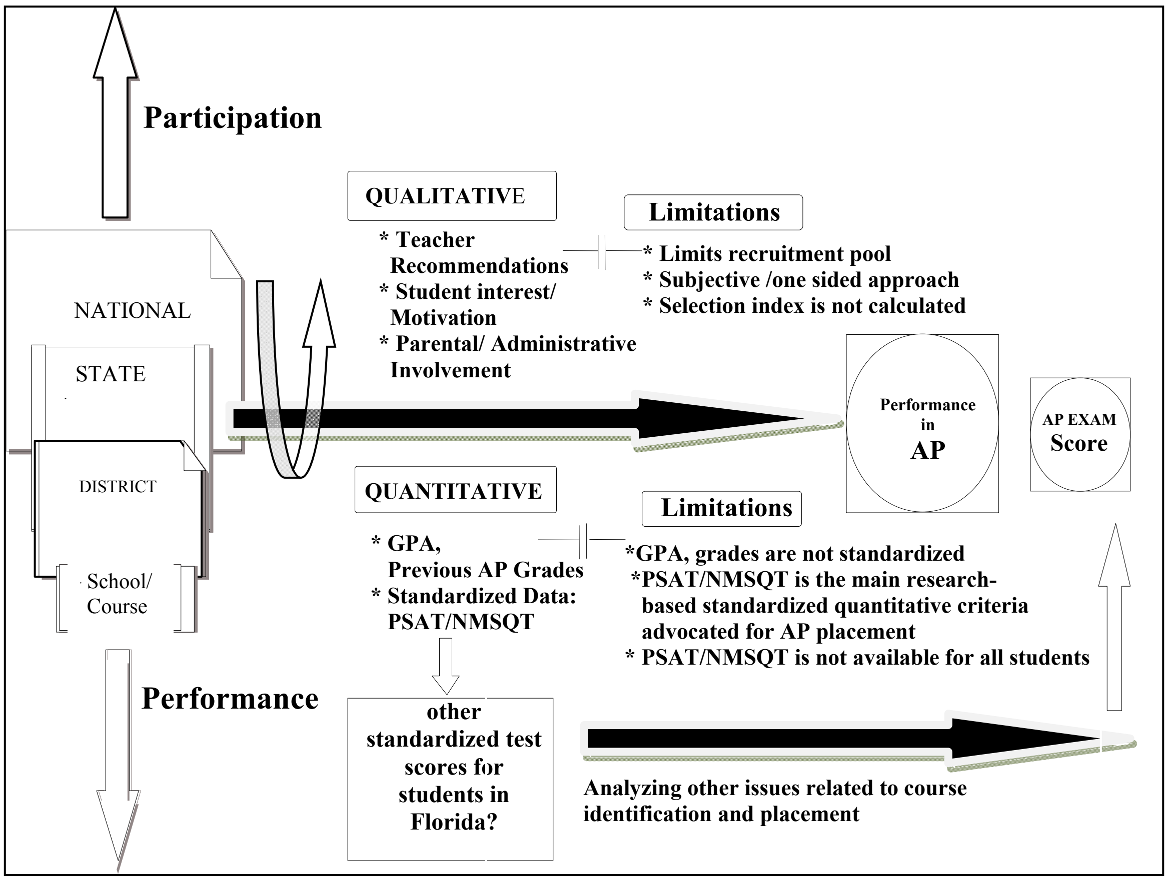

Figure 1. A conceptual flowchart developed by the author, which outlines variables to consider for the development of a coherent rationale and approaches to conduct further research regarding the identification and placement of students in AP courses.

Figure 1 highlights the challenge faced at the national, state, district, school, and classroom levels to balance increased participation with AP exam performance. The best case scenario would be one in which the forces between participation and performance were not in opposition, as researchers have expressed can be a concern when students are haphazardly placed into AP courses (College Board, 2001; FDR, 2009; Klopfenstein, 2003). In other words, highly efficient AP programs would be those wherein performance, as measured by AP examination pass rates were high, even though AP participation continues to increase.

One aspect of attempting to have a more efficient systematic approach towards AP student identification and placement, depicted in Figure 1, includes using qualitative criteria such as recommendations from other teachers, counselors, administrators, parental requests, or student interest. Indeed, many factors including student motivation, interest and willingness to put forth the extra effort should be considered in making placement decisions. However, using this option alone has limitations. For example, this qualitative only option limits the recruitment pool to students who themselves or through other individuals have already expressed interest for the course. However, using only this option may leave out students whom no one has yet to identify. Therefore, further researches exploring these issues are recommended for further study.

Likewise, the extent to which quantitative measures, such as grade point average, class rank, previous AP grades, number of AP exams previously taken, etc. is an important aspect for research. Included in these quantitative variables are readily available sets of scores from standardized tests, such as PSAT and FCAT that were presented in this current study. Flug (2010) points out that there are advantages to using standardized test scores, as opposed to other quantitative measures, in order to identify students for AP course placement. One of the advantages identified by Flug (2010) is the discovery of students with untapped potential that would not have otherwise been identified.

Future research should examine the relationships that exist between updated FCAT and PSAT standardized test scores as they relate to AP course performance. Henceforth, it is recommended that a longer longitudinal tracking of relationships between these selected standardized test scores and AP course exam scores is conducted. Furthermore, since AP courses periodically undergo significant academic and content level changes, further research regarding the relationships between updated AP courses and selected standardized test scores is recommended.

The current study can also be replicated using different localized and/or randomized samples in Florida. Syverson (2007) stated, institutions wanting to use standardized tests in the student selection process should have a localized data analysis supporting the predictive value of scores for their specific demographics. Replication of the study would assist in clarifying the extent to which findings like the ones in this study may also be found in other particular settings. In this case, other districts in Florida may research the relationships that exist between these particular selected standardized test scores, FCAT and PSAT with their particular AP exam score results for their specific demographics. Similarly, since scenarios can exist where particular students pass an AP course but do not achieve a score of 3 or higher on the AP exam, and vice versa, studies can also investigate the relationship that exists between standardized test scores and performance on the AP course grade, as measured by the letter grade earned in that particular class.

In addition other standardized test scores that have a similar potential for use in AP course identification may be researched using a similar study design as this current dissertation. Such is the case with Florida's Postsecondary Education Readiness Test (PERT). The primary purpose of PERT is to serve as a common placement test to adequately assess the academic skills in math, reading and writing of high school students. PERT is aligned with the Postsecondary Readiness Competencies identified by faculty in Florida as a pre-requisite to successfully complete entry-level college credit coursework. However, the extent to which PERT scores can be used for AP course identification and placement, to include STEM-related courses, has not been reported in empirical research.

There is a current movement proposed by the National Governors Association Center for Best Practices (NGACBP), towards national standards known as the Common Core State

Standards (CCSS). Florida high school students, therefore, may soon begin to be assessed using other mandatory statewide standardized tests. In fact, field tests are currently being legislated and developed by the Partnership for Assessment of Readiness for College Careers (PARCC). Field testing may begin as early as the 2014 – 2015 academic school years. If fully implemented, the extent to which PARCC scores can be used for AP course placement, to include STEM-related is also recommended for further investigation.

Practice Recommendations

The purpose of this study was to examine the degree to which a nationwide standardized test, PSAT/NMSQT, in conjunction with and compared to, a state-mandated standardized test, FCAT, can be used to identify potentially successful AP students for STEM-related courses using a systematic and active approach. Researchers have highlighted the importance of practicing a systematic approach in course selection procedures. Analyses of procedures associated with course placement in mathematics and science suggested that scores on standardized tests were used differently across schools. In the context of one study, "Average" schools had a relaxed approach regarding using scores for placement policies and more emphasis was placed on students' and parents' choice. In "Excellent" schools educators had a more systematic and active approach in placing students into appropriate courses (Spade, Columba, & Vanfossen, 1997). Utilizing a systematic and active approach one can use the findings of this study to in an attempt to adequately use the quantitative data that is available. However, the results of the correlational analyses varied per STEM-related AP subject evaluated.

A comprehensive record review of students, therefore, has the potential to be supplemented with scores from the criterion referenced statewide assessment, FCAT, as part of a proposed systematic approach for advanced course placement. Benefits of using these scores include having an assessment that is a mandatory exam for all students in Grades 8 – 10, the grade levels prior to when most students take the PSAT/NMSQT. An added benefit is that if a student is absent, make-up and retake sessions are mandatory. Henceforth, to supplement available qualitative data based on personal recommendations, scores from the national norm-referenced PSAT/NMSQT coupled with scores from this criterion-referenced state test, have the potential to serve as a practical quantitative data-driven tool for early identification and advising of students into AP math and science courses . This study suggests that both PSAT and FCAT test scores can be used in the student identification process. Nonetheless, the validation and degree of such use needs further examination before fully implementing into regular practice.

Limitations of Findings

There are several limitations should be kept in mind in interpreting the results of the study. The study was an ex post facto research, defined as research in which all the independent variables are non-manipulative (Ridenour, Lenz and Newman, 2008). According to Gay and Airasian (2003) ex post facto research is not considered true experimental research as it does not meet the strict guidelines necessary to categorize it as such. For example this type of research fails to meet the criterion for random assignment of participants from a single pool (Gay & Airasian, 2003). Since in this type of research the independent variables cannot be manipulated, internal validity cannot be controlled. Henceforth, causation cannot be inferred. Yet, in ex post facto research, the inability to control independent variables, although it decreases internal validity, has a tendency to have greater generalizability as the variables are conducted in a natural setting. As Newman et al. (2006) explain, although total internal validity is not achievable, ex post facto studies are likely to possess a high degree of external validity.

Another limitation of ex post facto research is that it cannot control for the confounding effects of self-selection (Ridenour et. al, 2008). The study represents only students from SCPS who selected to challenge themselves with AP courses in STEM-related AP subjects. However, the results of this study, to the extent that the academic school years and population studied are similar to other years and other student populations, the findings may be generalizable.

Conclusion

Studies concerning strength, direction and degree of relationships between national assessments with AP achievement, are limited, especially in the STEM-related AP courses. Likewise, studies regarding the use of mandated statewide assessments as a basis for student AP course identification and course enrollment are also narrow. Researchers from the American College Testing (ACT), nonetheless, affirm that college readiness standards may not be included in the state's assessment tests, however this quality alone does not exclude statewide assessment scores from indicating college readiness. Instead, they explain, it is necessary to compare the degree to which the statewide assessment scores and other assessments correlate (ACT, 2005).

The findings from the current study have suggested significant relationships exist between PSAT/NMSQT scores, FCAT scores and a combination of the two with STEM-related AP exam scores from the selected sample, to varying degrees. This information provided valuable baseline data from Seminole County Public Schools, concerning the relationships between a national norm-reference test and AP performance, as well as the relationships between a statewide assessment and corresponding AP scores during the 2010 – 2012 academic school years. The findings also highlighted the degree of variance that each standardized test added to the predictive association of selected STEM-related AP math and science performance. The findings have practical applications for educators, as it provided baseline data that suggested that in some cases PSAT, FCAT, or a combination of both data sets, can serve as a reference point in the AP course identification and selection procedures. However, in doing so, educators must be well informed regarding relationships that exist between data sets being referenced and for each particular AP course for which a student may be considered. This is because similar data sets do not inform educators in the same manner for all STEM-related AP courses. For example, just because a particular student had high PSAT writing scores, according to this current study's baseline data, that PSAT score would be weakly associated with performance on the AP Biology examination, even though AP Biology course has a writing component to its assessment. Instead, the baseline data suggested that educators should look at either students' PSAT math and critical reading or FCAT math and reading scores, or better yet, a combination of both sets of scores, as a stronger predictor of performance on the AP Biology exam. Furthermore, although the baseline data suggest that PSAT and/or FCAT scores may perhaps be used in the student identification procedures, it is recommended that these scores not be used as a single criterion for student placement. This became clearly evident, as baseline data showed that even in the cases where the relationship between standardized test scores and AP exam scores were strong, the variance associated with relationship never accounted for more than 50% in any of the STEM-related AP exams included in this study. Therefore, it is strongly recommended that more research is conducted, for both quantitative and qualitative measures, in the student identification and AP course selection process. By the same rationale, it is also recommended that standardized test scores not be used as a single criterion basis for exclusion or inclusion for STEM-related AP courses.

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APPENDICES

Table 15
Relationship of AP Scores to PSAT/NMSQT and FCAT scores for Biology 2010 - 2011

Variable	Zero-Order *r*							B	*SE B*	β
	FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP			
PSAT M							.620*	.082	.012	.502*
PSAT CR						.464*	.508*	.038	.012	.216**
PSAT W					.620*	.507*	.460*	.001	.012	.007
FCAT M				.353*	.422*	.625*	.412*	-.188	.115	-.121
FCAT R			.558*	.491*	.536*	.423*	.469*	.359	.128	.192**
FCAT W		.188**	.283*	.188**	.038	.140***	.148***	.109	.088	.067
								Intercept =		-5.108
Mean	4.066	4.094	4.175	49.797	52.580	54.981	2.608	**F =**		30.824*
SD	.879	.767	.925	8.6398	8.169	8.7379	1.435	***R*** **=** .689	***Adj. R²*** **=**	.474

* $p \le 0.001$, ** $p \le 0.01$, *** $p \le 0.05$, *(N = 212)*

Table 16

Relationship of AP Scores to PSAT/NMSQT and FCAT scores for Biology 2011 - 2012

Variable	FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP	B	*SE B*	β
	Zero-Order *r*									
PSAT M							.464*	.040	.012	.232*
PSAT CR						.553*	.485*	.038	.014	.217***
PSAT W					.678*	.531*	.440*	.020	.011	.131
FCAT M				.412*	.443*	.563*	.340*	.038	.116	.022
FCAT R			.422*	.389*	.519*	.359*	.369*	.142	.117	.129**
FCAT W		.011	.055	.070	.082	.046	.066	.050	.047	.055
								Intercept =		-3.551
Mean	4.376	4.070	4.288	50.277	53.509	54.23	2.502	**F =**		19.983*
SD	1.591	.7927	.8245	9.238	8.112	8.258	1.437	**R**= .559	***Adj. R*²** =	.312

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 271)*

Table 17
Relationship of AP Scores to PSAT/NMSQT scores for Biology 2010-2011

Variable	Zero-Order *r* PSAT W	PSAT CR	PSAT M	AP	B	*SE B*	β
PSAT M				.620*	.077	.010	.471*
PSAT CR			.464*	.508*	.043	.012	.247*
PSAT W		.620*	.507*	.460*	.011	.011	.067
						Intercept =	-4.489
Mean	49.797	52.580	54.981	2.608		**F =**	56.510*
SD	8.6398	8.169	8.7379	1.435	**R=** .670	***Adj. R^2* =**	.441

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 212)*

Table 18
Relationship of AP Scores to PSAT/NMSQT scores for Biology 2011-2012

Variable	Zero-Order *r* PSAT W	PSAT CR	PSAT M	AP	B	*SE B*	β
PSAT M				.464*	.044	.011	.252*
PSAT CR			.553*	.485*	.045	.013	.255*
PSAT W		.678*	.531*	.440*	.021	.011	.133
						Intercept =	-3.336
Mean	50.277	53.509	54.229	2.502		**F =**	37.973*
SD	9.238	8.112	8.258	1.437	**R=** .547	***Adj. R^2* =**	.291

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 271)*

Table 19
Relationship of AP Scores to FCAT scores for Biology 2010-2011

Variable	Zero-Order r FCAT W	FCAT R	FCAT M	AP	B	*SE B*	β
FCAT M				.412*	.330	.115	.213**
FCAT R			.558*	.469*	.646	.135	.345*
FCAT W		.188**	.283*	.148***	.038	.102	.023
						Intercept =	-1.572
Mean	4.066	4.094	4.175	2.608		**F =**	23.504*
SD	.879	.767	.925	1.435	**R=** .503	***Adj. R^2* =**	.242

* $p \le 0.001$, ** $p \le 0.01$, *** $p \le 0.05$, *(N = 212)*

Table 20
Relationship of AP Scores to FCAT scores for Biology 2011-2012

Variable	Zero-Order r FCAT W	FCAT R	FCAT M	AP	B	*SE B*	β
FCAT M				.340*	.390	.113	.224*
FCAT R			.496*	.343*	.431	.118	.238*
FCAT W		-.089	-.021	.039	.058	.051	.064
						Intercept =	-1.177
Mean	4.376	4.070	4.288	2.502		**F =**	16.957*
SD	1.591	.7927	.8245	1.437	**R=** .400	***Adj. R^2* =**	.151

* $p \le 0.001$, ** $p \le 0.01$, *** $p \le 0.05$, *(N = 271)*

Table 21

Relationship of AP Scores to PSAT/NMSQT and FCAT scores for Environmental Science 2010-2011

Variable	Zero-Order *r* FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP	B	*SE B*	β
PSAT M							.553*	.046	.005	.321*
PSAT CR						.484*	.554*	.045	.006	.290*
PSAT W					.675*	.488*	.481*	.011	.006	.071
FCAT M				.438*	.440*	.584*	.438*	.084	.048	.200*
FCAT R			.502*	.500*	.570*	.354*	.404*	.078	.048	.057
FCAT W		.219*	.138*	.198*	.179*	.090***	.122*	.010	.041	.007
									Intercept =	-3.291
Mean	4.062	3.761	3.867	47.221	49.387	51.057	2.483		**F =**	99.519*
SD	.810	.8875	.891	8.0299	7.845	8.3835	1.334	**R=** .651	***Adj. R^2* =**	.419

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 820)*

Table 22

Relationship of AP Scores to PSAT/NMSQT and FCAT scores for Environmental Science 2011-2012

Variable	Zero-Order *r* FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP	B	*SE B*	β
PSAT M							.601*	.049	.006	.314*
PSAT CR						.541*	.618*	.053	.006	.333*
PSAT W					.701*	.543*	.528*	.008	.006	.052
FCAT M				.428*	.443*	.623*	.482*	.101	.052	.068
FCAT R			.562*	.487*	.557*	.415*	.465*	.118	.047	.084***
FCAT W		.192*	.148*	.197*	.160*	.100**	.130*	.013	.038	.009
									Intercept =	-3.811
Mean	4.060	3.812	3.916	46.099	49.128	50.143	2.521		**F =**	134.616*
SD	.8636	.9175	.8685	8.3695	8.095	8.2297	1.2873	**R=** .704	***Adj. R^2* =**	.491

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 831)*

Table 23

Relationship of AP Scores to PSAT/NMSQT scores for Environmental Science 2010-2011

Variable	Zero-Order *r*				B	*SE B*	β
	PSAT W	PSAT CR	PSAT M	AP			
PSAT M				.553*	.051	.005	.353*
PSAT CR			.484*	.554*	.050	.006	.322*
PSAT W		.675*	.488*	.481*	.014	.006	.091***
						Intercept =	-3.253
Mean	47.221	49.387	51.057	2.445		**F =**	194.848*
SD	8.0299	7.845	8.3835	1.2097	**R=** .646	***Adj. R^2* =**	.415

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 820)*

Table 24

Relationship of AP Scores to PSAT/NMSQT scores for Environmental Science 2011-2012

Variable	Zero-Order *r*				B	*SE B*	β
	PSAT W	PSAT CR	PSAT M	AP			
PSAT M				.601*	.056	.005	.361*
PSAT CR			.541*	.618*	.059	.006	.374*
PSAT W		.701*	.543*	.528*	.011	.006	.070
						Intercept =	-3.723
Mean	46.099	49.128	50.143	2.521		**F =**	259.004*
SD	8.3695	8.095	8.2297	1.287	**R=** .696	***Adj. R^2* =**	.483

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 831)*

Table 25
Relationship of AP Scores to FCAT scores for Environmental Science 2010-2011

Variable	Zero-Order *r* FCAT W	FCAT R	FCAT M	AP	B	*SE B*	β
FCAT M				.438*	.425	.048	.313*
FCAT R			.502*	.404*	.329	.049	.241*
FCAT W		.219*	.138*	.122*	.039	.047	.026
						Intercept =	-.594
Mean	4.062	3.761	3.867	2.445		**F =**	84.823*
SD	.810	.8875	.891	1.2097	**R=** .488	***Adj. R^2* =**	.235

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N =820)*

Table 26
Relationship of AP Scores to FCAT scores for Environmental Science 2011-2012

Variable	Zero-Order *r* FCAT W	FCAT R	FCAT M	AP	B	*SE B*	β
FCAT M				.482*	.475	.053	.321*
FCAT CR			.562*	.465*	.392	.050	.280*
FCAT W		.192*	.148*	.130*	.043	.045	.029
						Intercept =	-1.010
Mean	4.060	3.812	3.916	2.521		**F =**	111.802*
SD	.8636	.9175	.8685	1.287	**R=** .537	***Adj. R^2* =**	.286

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 831)*

Table 27
Relationship of AP Scores to PSAT/NMSQT and FCAT scores for Chemistry 2010-2011

Variable	Zero-Order *r*							B	*SE B*	β
	FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP			
PSAT M							.506*	.053	.013	.334*
PSAT CR						.600*	.333*	-.017	.014	-.109
PSAT W					.710*	.626*	.447*	.034	.013	.231**
FCAT M				.492*	.491*	.569*	.424*	.326	.130	.200**
FCAT R			.567*	.427*	.526*	.425*	.242*	-.122	.124	-.075
FCAT W		.284*	.219*	.243*	.253*	.147**	.173**	.112	.095	.073
									Intercept =	-2.726
Mean	4.211	4.139	4.287	50.856	54.321	57.153	2.483		**F =**	15.465*
SD	.868	.817	.8168	9.105	8.7737	8.421	1.334	**R=** .561	***Adj. R^2* =**	.294

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 209)*

Table 28

Relationship of AP Scores to PSAT/NMSQT and FCAT scores for Chemistry 2011-2012

Variable	FCAT W	FCAT R	FCAT M	PSAT W	PSATC R	PSAT M	AP	B	*SE B*	β
	Zero-Order *r*									
PSAT M							.513*	.082	.013	.458*
PSAT CR						.449*	.300*	.011	.013	.066
PSAT W					.622*	.478*	.293*	-.002	.014	-.013
FCAT M				.413*	.364*	.500*	.303*	.036	.158	.017
FCAT R			.582*	.494*	.498*	.423*	.279*	.047	.132	.027
FCAT W		.250*	.250*	.284*	.190**	.127***	.166**	.128	.087	.088
									Intercept =	-3.547
Mean	4.124	4.201	4.479	50.513	54.111	57.756	2.585		**F =**	14.581*
SD	.9615	.8065	.6629	7.9985	8.203	7.7976	1.400	**R=** .527	***Adj. R^2* =**	.259

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 234)*

Table 29
Relationship of AP Scores to PSAT/NMSQT scores for Chemistry 2010-2011

Variable	Zero-Order r				B	*SE B*	β
	PSAT W	PSAT CR	PSAT M	AP			
PSAT M				.506*	.063	.012	.395*
PSAT CR			.600*	.333*	-.014	.013	-.093
PSAT W		.710*	.626*	.447*	.039	.013	.265**
						Intercept =	-2.305
Mean	50.856	54.321	57.153	2.483		**F =**	27.556*
SD	9.105	8.7737	8.421	1.334	**R=** .536	***Adj. R^2* =**	.277

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 209)*

Table 30
Relationship of AP Scores to PSAT/NMSQT scores for Chemistry 2011-2012

Variable	Zero-Order r				B	*SE B*	β
	PSAT W	PSAT CR	PSAT M	AP			
PSAT M				.513*	.084	.012	.468*
PSAT CR			.449*	.300*	.013	.013	.077
PSAT W		.622*	.478*	.293*	.004	.013	.021
						Intercept =	-3.165
Mean	50.513	54.111	57.756	2.585		**F =**	28.249*
SD	7.9985	8.203	7.7976	1.400	**R=** .519	***Adj. R^2* =**	.260

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 234)*

Table 31
Relationship of AP Scores to FCAT scores for Chemistry 2010-2011

Variable	Zero-Order *r* FCAT W	FCAT R	FCAT M	AP	B	*SE B*	β
FCAT M				.424*	.676	.125	.414*
FCAT R			.567*	.242*	-.028	.127	-.017
FCAT W		.284*	.219**	.173**	.134	.101	.087
						Intercept =	-.866
Mean	4.211	4.139	4.287	2.483		**F =**	15.653*
SD	.868	.817	.8168	1.334	**R=** .432	***Adj. R^2*** **=**	.174

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N =209)*

Table 32
Relationship of AP Scores to FCAT scores for Chemistry 2011-2012

Variable	Zero-Order *r* FCAT W	FCAT R	FCAT M	AP	B	*SE B*	β
FCAT M				.303*	.420	.163	.199**
FCAT CR			.582*	.279*	.249	.134	.143
FCAT W		.250*	.250*	.166**	.117	.094	.080
						Intercept =	-.825
Mean	4.124	4.201	4.479	2.585		**F =**	9.822*
SD	.961	.8065	.6629	1.400	**R=** .337	***Adj. R^2*** **=**	.102

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 234)*

Table 33

Relationship of AP Scores to PSAT/NMSQT and FCAT scores for Physics B 2010-2011

Variable	Zero-Order *r* FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP	B	*SE B*	β
PSAT M							.514*	.043	.010	.283*
PSAT CR						.544*	.451*	.021	.011	.152
PSAT W					.736*	.564*	.431*	.010	.010	.075
FCAT M				.413*	.439*	.529*	.447*	.317	.103	.197**
FCAT R			.544*	.553*	.598*	.448*	.370*	.005	.090	.004
FCAT W		.236*	.219*	.162**	.157**	.107***	.113***	.004	.069	.003
									Intercept =	-2.459
Mean	4.082	3.978	4.287	50.000	52.943	57.821	3.018		**F =**	22.961*
SD	.8998	.9250	.7564	9.076	8.7518	8.1229	1.2187	**R=** .580	R^2 =	.336

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 279)*

Table 34

Relationship of AP Scores to PSAT/NMSQT and FCAT scores for Physics B 2011-2012

Variable	FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP	B	*SE B*	β
	Zero-Order *r*									
PSAT M							.435*	.035	.010	.237*
PSAT CR						.553*	.358*	.008	.012	.049
PSAT W					.705*	.550*	.356*	.012	.011	.082
FCAT M				.352*	.382*	.508*	.398*	.292	.107	.174**
FCAT R			.546*	.443*	.514*	.366*	.345*	.151	.099	.098
FCAT W		.229*	.168*	.262*	.239*	.097***	.125***	.023	.069	.017
									Intercept =	-2.066
Mean	4.066	4.103	4.363	50.150	53.559	56.750	2.938		**F =**	17.850*
SD	.9125	.7910	.7256	8.3401	7.8459	8.1321	1.217	**R**= .505	R^2 =	.255

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 320)*

Table 35

Relationship of AP Scores to PSAT/NMSQT scores for Physics B 2010-2011

Variable	Zero-Order *r*				B	*SE B*	β
	PSAT W	PSAT CR	PSAT M	AP			
PSAT M				.514*	.054	.009	.362*
PSAT CR			.544*	.451*	.026	.011	.189***
PSAT W		.431*	.564*	.736*	.012	.010	.087
						Intercept =	-2.106
Mean	50.000	52.943	57.821	3.018		**F =**	41.033*
SD	9.076	8.7518	8.1229	1.2187	**R=** .556	***Adj. R^2* =**	.302

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 279)*

Table 36

Relationship of AP Scores to PSAT/NMSQT scores for Physics B 2011-2012

Variable	Zero-Order *r*				B	*SE B*	β
	PSAT W	PSAT CR	PSAT M	AP			
PSAT M				.435*	.047	.009	.317*
PSAT CR			.553*	.358*	.017	.011	.110***
PSAT W		.705*	.550*	.356*	.015	.011	.104
						Intercept =	-1.429
Mean	50.150	53.559	56.750	2.938		**F =**	28.704*
SD	8.340	7.8459	8.132	1.217	**R=** .463	***Adj. R^2* =**	.207

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 320)*

Table 37

Relationship of AP Scores to FCAT scores for Physics B 2010-2011

Variable	Zero-Order *r* FCAT W	FCAT R	FCAT M	AP	B	*SE B*	β
FCAT M				.447*	.563	.103	.349*
FCAT R			.544*	.370*	.240	.084	.182**
FCAT W		.236*	.219*	.113***	-.008	.075	-.006
						Intercept =	-.317
Mean	4.082	3.978	4.287	3.018		**F =**	26.301*
SD	.8998	.925	.756	1.2187	**R=** .472	***Adj. R^2*** **=**	.214

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N =279)*

Table 38

Relationship of AP Scores to FCAT scores for Physics B 2011-2012

Variable	Zero-Order *r* FCAT W	FCAT R	FCAT M	AP	B	*SE B*	β
FCAT M				.398*	.498	.102	.297*
FCAT R			.546*	.345*	.269	.095	.175**
FCAT W		.229*	.168*	.125**	.047	.070	.035
						Intercept =	-.531
Mean	4.066	4.103	4.363	2.938		**F =**	23.606*
SD	.9125	.791	.7256	1.217	**R=** .428	***Adj. R^2*** **=**	.175

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 320)*

Table 39

Relationship of AP Scores to PSAT/NMSQT and FCAT scores for Physics C Mechanical 2010-2011

Variable	Zero-Order *r*							B	*SE B*	β
	FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP			
PSAT M							.368*	.040	.017	.264***
PSAT CR						.263**	.225**	-.012	.019	-.099
PSAT W					.762*	.410*	.344*	.030	.019	.248
FCAT M				.201***	.156	.402*	.223***	.075	.205	.041
FCAT R			.363*	.599*	.598*	.193***	.234**	.071	.158	.057
FCAT W		.296*	.288*	.280**	.339*	.012	.142	.102	.139	.075
									Intercept =	-.888
Mean	4.238	4.095	4.457	52.781	54.486	61.838	3.552		**F =**	3.920*
SD	.838	.9149	.6206	9.3736	9.0947	7.589	1.143	**R**= .281	***Adj.R***^{2} =	.079

* $p \le 0.001$, ** $p \le 0.01$, *** $p \le 0.05$, *(N = 105)*

Table 40

Relationship of AP Scores to PSAT/NMSQT and FCAT scores for Physics C Mechanical 2011-2012

Variable	Zero-Order *r*							B	*SE B*	β
	FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP			
PSAT M							.406*	.055	.017	.358**
PSAT CR						.536*	.247**	.009	.017	.066
PSAT W					.686*	.568*	.204***	-.017	.016	-.131
FCAT M				.412*	.307*	.524*	.293*	.163	.178	.096
FCAT R			.443*	.488*	.515*	.373*	.243**	.126	.138	.096
FCAT W		.139	.105	.088	.090	.124	.063	.000	.098	.000
									Intercept =	-.507
Mean	4.187	4.154	4.504	52.634	56.073	61.041	3.675		**F =**	4.432*
SD	.978	.8687	.6699	8.6349	8.494	7.4376	1.134	**R=** .432	***Adj. R^2* =**	.144

$p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 123)*

Table 41

Relationship of AP Scores to PSAT/NMSQT scores for Physics C Mechanical 2010-2011

Variable	Zero-Order *r* PSAT W	PSAT CR	PSAT M	AP	B	*SE B*	β
PSAT M				.368*	.041	.015	.270**
PSAT CR			.263**	.225**	-.007	.018	-.057
PSAT W		.762*	.410*	.344*	.034	.018	.277
						Intercept =	-.355
Mean	52.781	54.486	61.838	3.552		**F =**	7.484*
SD	9.3736	9.0947	7.5894	1.143	**R=** .426	***Adj. R^2* =**	.158

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 105)*

Table 42

Relationship of AP Scores to PSAT/NMSQT scores for Physics C Mechanical 2011-2012

Variable	Zero-Order *r* PSAT W	PSAT CR	PSAT M	AP	B	*SE B*	β
PSAT M				.406*	.062	.016	.408*
PSAT CR			.536*	.247**	.012	.016	.089
PSAT W		.686*	.568*	.204***	-.012	.016	-.088
						Intercept =	-.181
Mean	52.634	56.073	61.041	3.675		**F =**	8.099*
SD	8.6349	8.494	7.4376	1.134	**R=** .412	***Adj. R^2* =**	.149

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 123)*

Table 43

Relationship of AP Scores to FCAT scores for Physics C Mechanical 2010-2011

Variable	Zero-Order *r* FCAT W	FCAT R	FCAT M	AP	B	*SE B*	β
FCAT M				.223*	.274	.193	.149
FCAT R			.363*	.234*	.206	.131	.165
FCAT W		.296*	.288*	.142*	.069	.139	.051
						Intercept =	1.192
Mean	4.238	4.095	4.457	3.552		**F =**	2.893***
SD	.838	.9149	.6206	1.143	**R=** .281	***Adj.*** R^2 **=**	.052

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N =105)*

Table 44

Relationship of AP Scores to FCAT scores for Physics C Mechanical 2011-2012

Variable	Zero-Order *r* FCAT W	FCAT R	FCAT M	AP	B	*SE B*	β
FCAT M				.293*	.389	.164	.230***
FCAT R			.443*	.243**	.181	.127	.138
FCAT W		.139	.105	.063	.022	.102	.019
						Intercept =	1.079
Mean	4.187	4.154	4.504	3.675		**F =**	4.510**
SD	.978	.8687	.6699	1.134	**R=** .320	***Adj.*** R^2 **=**	.079

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 123)*

Table 45
Relationship of AP Scores to PSAT/NMSQT and FCAT scores for Physics C Electrical 2010-2011

Variable	Zero-Order r							B	*SE B*	β
	FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP			
PSAT M							.361**	.041	.023	.237***
PSAT CR						.322**	.374*	.021	.028	.142
PSAT W					.764*	.361**	.372*	.003	.025	.023
FCAT M				.129	.080	.340**	.227***	.187	.321	.075
FCAT R			.240***	.600*	.537*	.185	.391*	.418	.268	.236
FCAT W		.202	.083	.284***	.367**	.073	.145	.025	.201	.015
									Intercept =	-3.453
Mean	4.306	4.274	4.581	54.129	55.468	62.258	3.177		**F =**	3.199**
SD	.7807	.7052	.4975	9.787	8.3543	7.2359	1.248	**R=** .509	***Adj. R^2* =**	.178

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 62)*

Table 46
Relationship of AP Scores to PSAT/NMSQT and FCAT scores for Physics C Electrical 2011-2012

Variable	Zero-Order r							B	*SE B*	β
	FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP			
PSAT M							.416*	.069	.024	.461**
PSAT CR						.613*	.176	-.023	.026	-.148
PSAT W					.683*	.584*	.214***	-.004	.024	-.030
FCAT M				.388*	.267	.526*	.273**	.078	.241	.045
FCAT R			.390*	.438*	.375*	.283**	.199***	.158	.206	.099
FCAT W		.133	-.008	.097	.084	.079	.188	.217	.156	.155
									Intercept =	-1.069
Mean	4.042	4.181	4.444	50.514	54.681	60.819	3.500		**F =**	3.060***
SD	.879	.775	.7099	8.304	7.8108	8.2468	1.233	**R=** .469	***Adj. R^2* =**	.148

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 72)*

Table 47

Relationship of AP Scores to PSAT/NMSQT scores for Physics C Electrical 2010-2011

Variable	Zero-Order *r*				B	*SE B*	β
	PSAT W	PSAT CR	PSAT M	AP			
PSAT M				.361**	.043	.022	.251***
PSAT CR			.322**	.374**	.028	.027	.187
PSAT W		.764*	.361**	.372**	.018	.023	.139
						Intercept =	-2.028
Mean	54.129	55.468	62.258	3.177		**F =**	5.215**
SD	9.787	8.354	7.2359	1.248	**R=** .461	***Adj. R^2 =***	.172

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 62)*

Table 48

Relationship of AP Scores to PSAT/NMSQT scores for Physics C Electrical 2011-2012

Variable	Zero-Order *r*				B	*SE B*	β
	PSAT W	PSAT CR	PSAT M	AP			
PSAT M				.416*	.073	.022	.487*
PSAT CR			.613*	.176	-.022	.025	-.139
PSAT W		.683*	.584*	.214***	.004	.023	.025
						Intercept =	.087
Mean	50.514	54.681	60.819	3.500		**F =**	5.093**
SD	8.304	7.8108	8.2468	1.2333	**R=** .428	***Adj. R^2 =***	.147

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 72)*

Table 49
Relationship of AP Scores to FCAT scores for Physics C Electrical 2010-2011

Variable	Zero-Order *r*				B	*SE B*	β
	FCAT W	FCAT R	FCAT M	AP			
FCAT M				.227**	.350	.308	.140
FCAT R			.240**	.391*	.610	.221	.344**
FCAT W		.202	.083	.145	.102	.195	.064
						Intercept =	-1.472
Mean	4.306	4.274	4.581	3.177		**F =**	4.118**
SD	.7807	.705	.4975	1.248	**R=** .419	***Adj. R^2*** =	.133

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N =62)*

Table 50
Relationship of AP Scores to FCAT scores for Physics C Electrical 2011-2012

Variable	Zero-Order *r*				B	*SE B*	β
	FCAT W	FCAT R	FCAT M	AP			
FCAT M				.273**	.423	.216	.244
FCAT CR			.390*	.199***	.127	.199	.080
FCAT W		.133	-.008	.188	.252	.162	.180
						Intercept =	.069
Mean	4.042	4.181	4.444	3.500		**F =**	2.985***
SD	.879	.775	.7099	1.233	**R=** .341	***Adj. R^2*** =	.077

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 72)*

Table 51

Relationship of AP Scores to PSAT/NMSQT and FCAT scores for Statistics 2010-2011

Variable	Zero-Order r FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP	B	*SE B*	β
PSAT M							.555*	.046	.008	.321*
PSAT CR						.552*	.488*	.024	.009	.167*
PSAT W					.704*	.563*	.482*	.017	.008	.117**
FCAT M				.423*	.400*	.546*	.425*	.175	.074	.117**
FCAT R			.423*	.462*	.535*	.378*	.344*	.021	.066	.016
FCAT W		.175*	.462*	.219*	.148*	.132*	.165*	.063	.056	.046
									Intercept =	-2.656
Mean	4.119	3.979	4.208	49.988	52.196	56.401	3.110		**F =**	41.849*
SD	.8777	.9056	.8169	8.5136	8.389	7.699	1.141	**R=** .615	***Adj. R^2* =**	.370

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 419)*

Table 52

Relationship of AP Scores to PSAT/NMSQT and FCAT scores for Statistics 2011-2012

Variable	Zero-Order *r*							B	*SE B*	β
	FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP			
PSAT M							.622*	.072	.007	.480*
PSAT CR						.550*	.450*	.010	.009	.059
PSAT W					.691*	.528*	.461*	.021	.008	.134**
FCAT M				.408*	.415*	.547*	.407*	.085	.079	.052
FCAT R			.552*	.505*	.538*	.408*	.350*	.052	.077	.033
FCAT W		.282*	.199*	.224*	.221*	.149*	.108***	-.037	.055	-.026
									Intercept =	-2.910
Mean	4.145	3.932	4.186	48.363	51.039	53.934	2.909		**F =**	51.690*
SD	.9204	.8447	.8073	8.4369	8.0219	8.7271	1.316	**R=** .646	***Adj.*** $\boldsymbol{R^2}$ **=**	.409

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 441)*

Table 53

Relationship of AP Scores to PSAT/NMSQT scores for Statistics 2010-2011

Variable	Zero-Order *r* PSAT W	PSAT CR	PSAT M	AP	B	*SE B*	β
PSAT M				.555*	.054	.007	.374*
PSAT CR			.552*	.488*	.026	.008	.180*
PSAT W		.704*	.563*	.482*	.021	.008	.144**
						Intercept =	-2.304
Mean	56.401	52.196	49.988	3.110		**F =**	79.547*
SD	1.2146	8.4778	8.4014	8.5136	**R=** .604	***Adj. R²* =**	.361

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 419)*

Table 54

Relationship of AP Scores to PSAT/NMSQT scores for Statistics 2011-2012

Variable	Zero-Order *r* PSAT W	PSAT CR	PSAT M	AP	B	*SE B*	β
PSAT M				.622*	.076	.007	.506*
PSAT CR			.550*	.450*	.012	.009	.072
PSAT W		.691*	.528*	.461*	.022	.008	.144**
						Intercept =	-2.896
Mean	48.363	51.039	53.934	2.909		**F =**	102.543*
SD	8.4369	8.0219	8.727	1.316	**R=** .643	***Adj. R²* =**	.409

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 441)*

Table 55
Relationship of AP Scores to FCAT scores for Statistics 2010 - 2011

Variable	Zero-Order *r*				B	*SE B*	β
	FCAT W	FCAT R	FCAT M	AP			
FCAT M				.425*	.488	.074	.328*
FCAT R			.472*	.344*	.237	.067	.177*
FCAT W		.175*	.202*	.165*	.094	.062	.068
						Intercept =	-.274
Mean	4.119	3.979	4.208	2.909		**F =**	37.112*
SD	.8777	.9056	.8169	1.316	**R**= .460	***Adj. R***^{2} =	.206

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 419)*

Table 56
Relationship of AP Scores to FCAT scores for Statistics 2011-2012

Variable	Zero-Order *r*				B	*SE B*	β
	FCAT W	FCAT R	FCAT M	AP			
FCAT M				.407*	.502	.084	.308*
FCAT R			.552*	.350*	.282	.082	.181*
FCAT W		.282*	.199*	.108***	-.006	.064	-.004
						Intercept =	-.280
Mean	4.145	3.932	4.186	2.909		**F =**	33.835*
SD	.920	.8447	.807	1.316	**R**= .434	***Adj. R***^{2} =	.183

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 441)*

Table 57

Advanced Placement Scores Relationship to PSAT/NMSQT and FCAT scores for Calculus AB 2010-2011

Variable	Zero-Order r							B	*SE B*	β
	FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP			
PSAT M							.511*	.075	.009	.381*
PSAT CR						.521*	.356*	.014	.010	.078
PSAT W					.711*	.508*	.334*	.005	.009	.030
FCAT M				.354*	.363*	.546*	.375*	.231	.083	.117**
FCAT R			.428*	.486*	.580*	.360*	.275*	.051	.075	.029
FCAT W		.190*	.209*	.179*	.189*	.112**	.083***	-.018	.063	-.010
									Intercept =	-3.288
Mean	4.152	3.877	4.206	49.769	51.514	57.060	3.082		**F =**	42.509*
SD	.833	.8765	.7746	8.543	8.243	7.774	1.523	**R**= .533	***Adj. R^2* =**	.277

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 652)*

Table 58

Advanced Placement Scores Relationship to PSAT/NMSQT and FCAT scores for Calculus AB 2011-2012

Variable	Zero-Order *r*							B	*SE B*	β
	FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP			
PSAT M							.434*	.057	.008	.282*
PSAT CR						.517*	.371*	.026	.009	.142**
PSAT W					.680*	.484*	.327*	.008	.008	.047
FCAT M				.367*	.381*	.494*	.317*	.189	.082	.092***
FCAT R			.487*	.462*	.528*	.355*	.273*	.055	.070	.032
FCAT W		.232*	.205*	.230*	.210*	.119*	.098**	-.004	.055	-.002
									Intercept =	-2.663
Mean	4.052	4.043	4.356	50.098	52.438	57.323	3.414		**F =**	37.298*
SD	.899	.868	.7157	8.272	8.1646	7.271	1.477	**R=** .477	***Adj. R^2* =**	.222

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, ($N = 765$)

Table 59

Relationship of AP Scores to PSAT/NMSQT scores for Calculus AB 2010-2011

Variable	Zero-Order *r* PSAT W	PSAT CR	PSAT M	AP	B	*SE B*	β
PSAT M				.356*	.018	.009	.099***
PSAT CR			.711*	.334*	.007	.009	.439*
PSAT W		.508*	.521*	.511*	.086	.008	.040
						Intercept =	-3.124
Mean	49.769	51.514	57.060	3.082		**F =**	81.321*
SD	8.5430	8.243	7.774	1.523	**R=** .522	***Adj. R^2 =***	.270

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 652)*

Table 60

Relationship of AP Scores to PSAT/NMSQT scores for Calculus AB 2011-2012

Variable	Zero-Order *r* PSAT W	PSAT CR	PSAT M	AP	B	*SE B*	β
PSAT M				.434*	.065	.008	.320*
PSAT CR			.517*	.371*	.030	.008	.163*
PSAT W		.680*	.484*	.327*	.011	.008	.061
						Intercept =	-2.413
Mean	50.098	52.438	57.323	3.414		**F =**	71.419*
SD	8.272	8.1646	7.271	1.477	**R=** .469	***Adj. R^2 =***	.217

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 765)*

Table 61

Relationship of AP Scores to FCAT scores for Calculus AB 2010-2011

Variable	Zero-Order *r* FCAT W	FCAT R	FCAT M	AP	B	*SE B*	β
FCAT M				.375*	.622	.079	.316*
FCAT R			.428*	.275*	.246	.070	.142*
FCAT W		.190*	.209*	.083***	-.017	.068	-.010
						Intercept =	-.416
Mean	4.152	3.877	4.206	3.082		**F =**	40.152*
SD	.833	.8765	.7746	1.523	**R=** .396	***Adj. R²* =**	.153

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 652)*

Table 62

Relationship of AP Scores to FCAT scores for Calculus AB 2011-2012

Variable	Zero-Order *r* FCAT W	FCAT R	FCAT M	AP	B	*SE B*	β
FCAT M				.340*	.496	.081	.240*
FCAT R			.496*	.343*	.260	.067	.153*
FCAT W		-.089	-.021	.039	.022	.058	.013
						Intercept =	.115
Mean	4.052	4.043	4.356	3.414		**F =**	34.317*
SD	.899	.868	.7157	1.477	**R=** .345	***Adj. R²* =**	.116

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 765)*

Table 63

Advanced Placement Scores Relationship to PSAT/NMSQT and FCAT scores for Calculus BC 2010-2011

Variable	Zero-Order *r* FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP	B	*SE B*	β
PSAT M							.183**	.015	.014	.092
PSAT CR						.400*	.247*	.022	.015	.175
PSAT W					.752*	.416*	.224*	.009	.015	.071
FCAT M				.320*	.264*	.405*	.091	.000	.158	.000
FCAT R			.379*	.559*	.571*	.296*	.135***	-.035	.120	-.028
FCAT W		.261*	.269*	.132***	.147***	.037	.014	-.022	.100	-.017
									Intercept =	-1.729
Mean	4.354	4.107	4.534	53.815	55.242	62.129	4.169		**F =**	2.217***
SD	.872	.8987	.612	8.444	8.728	6.793	1.112	**R**= .269	***Adj. R^2* =**	.040

* $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$, *(N = 178)*

Table 64

Advanced Placement Scores Relationship to PSAT/NMSQT and FCAT scores for Calculus BC 2011-2012

	Zero-Order *r*									
Variable	FCAT W	FCAT R	FCAT M	PSAT W	PSAT CR	PSAT M	AP	B	*SE B*	β
PSAT M							.258*	.028	.013	.169
PSAT CR						.373*	.260*	.027	.013	.190
PSAT W					.647*	.379*	.184**	-.003	.012	-.023
FCAT M				.271*	.251*	.349*	.170**	.123	.147	.064
FCAT R			.341*	.409*	.491*	.231*	.172**	.074	.124	.049
FCAT W		.280*	.141***	.216*	.229*	.087	-.003	-.100	.090	-.079
									Intercept =	.673
Mean	4.167	4.313	4.626	53.692	56.359	61.303	4.172		**F =**	3.864*
SD	.888	.749	.580	8.367	7.976	6.8345	1.1178	**R**= .329	***Adj. R^2* =**	.080

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 198)*

Table 65
Relationship of AP Scores to PSAT/NMSQT scores for Calculus BC 2010-2011

Variable	Zero-Order *r*				B	*SE B*	β
	PSAT W	PSAT CR	PSAT M	AP			
PSAT M				.183**	.015	.013	.092
PSAT CR			.400*	.247*	.021	.014	.164
PSAT W		.752*	.416*	.224*	.008	.015	.062
						Intercept =	1.641
Mean	53.815	55.242	62.129	4.169		**F =**	4.446**
SD	8.444	8.728	6.793	1.112	**R=** .267	***Adj. R^2* =**	.055

* $p \le 0.001$, ** $p \le 0.01$, *** $p \le 0.05$, *(N = 178)*

Table 66
Relationship of AP Scores to PSAT/NMSQT scores for Calculus BC 2011-2012

Variable	Zero-Order *r*				B	*SE B*	β
	PSAT W	PSAT CR	PSAT M	AP			
PSAT M				.258*	.031	.012	.189***
PSAT CR			.373*	.260*	.028	.013	.201***
PSAT W		.647*	.379*	.184**	-.002	.012	-.018
						Intercept =	.813
Mean	53.692	56.359	61.303	4.172		**F =**	7.007*
SD	8.367	7.976	6.8345	1.1178	**R=** .313	***Adj. R^2* =**	.084

* $p \le 0.001$, ** $p \le 0.01$, *** $p \le 0.05$, *(N = 198)*

Table 67
Relationship of AP Scores to FCAT scores for Calculus BC 2010-2011

Variable	Zero-Order *r*				B	*SE B*	β
	FCAT W	FCAT R	FCAT M	AP			
FCAT M				.091	.097	.150	.053
FCAT R			.379*	.135***	.152	.102	.123
FCAT W		.261*	.269*	.014	-.042	.101	-.033
						Intercept =	3.285
Mean	4.354	4.107	4.534	4.169		**F =**	1.240
SD	.872	.8987	.612	1.112	**R**= .145	***Adj. R^2* =**	.004

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 178)*

Table 68
Relationship of AP Scores to FCAT scores for Calculus BC 2011-2012

Variable	Zero-Order *r*				B	*SE B*	β
	FCAT W	FCAT R	FCAT M	AP			
FCAT M				.170**	.249	.144	.129
FCAT R			.341*	.172**	.217	.115	.145
FCAT W		.280*	.141***	-.003	-.078	.092	-.062
						Intercept =	2.412
Mean	4.167	4.313	4.626	4.172		**F =**	3.198 ***
SD	.888	.749	.580	1.1178	**R**= .217	***Adj. R^2* =**	.032

* p ≤ 0.001, ** p ≤ 0.01, *** p ≤ 0.05, *(N = 198)*

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