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PAYMENT OF ADVANCED PLACEMENT EXAM FEES BY VIRGINIA PUBLIC
SCHOOL DIVISIONS AND ITS IMPACT ON ADVANCED PLACEMENT
ENROLLMENT AND SCORES

A **Dissertation** submitted in partial fulfillment of the requirements for the degree of
Doctor of Philosophy at Virginia Commonwealth University.

by

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ABSTRACT

PAYMENT OF ADVANCED PLACEMENT EXAM FEES BY VIRGINIA PUBLIC SCHOOL DIVISIONS AND ITS IMPACT ON ADVANCED PLACEMENT ENROLLMENT AND SCORES

By Mary Grupe Cirillo, Ph.D.

A Dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

Virginia Commonwealth University, 2010

Major Director: Dr. Charol Shakeshaft, Professor and Department Chairman,
Educational Leadership

The purpose of this study was to determine the impact of Virginia school divisions' policy of paying the fee for students to take Advanced Placement exams on Advanced Placement course enrollment, the number of Advanced Placement exams taken by students, the average scores earned and the percent of students earning qualifying scores of 3, 4, or 5 on Advanced Placement exams. The hierarchical regression models utilized Advanced Placement scores and school demographic data provided by the Virginia Department of Education combined with survey data on Advanced Placement policies and the number years that exam fees had been paid collected from school principals, directors of counseling and division officials. School level demographics considered in the analyses included school size, socioeconomic status, ethnicity and school achievement. Advanced Placement enrollment and the number of exams taken increased significantly over the period of study while the average scores and number of

qualifying scores earned by Virginia students remained unchanged. The payment of exam fees by Virginia school divisions had no impact on the change in Advanced Placement participation. Average scores and percent of qualifying scores earned on Advanced Placement science exams fell over the study period, though participation grew in line with the overall Advanced Placement participation. No significant differences in the change in Advanced Placement participation or scores were observed based on the underserved minority enrollment of schools, however both enrollment average scores and qualifying scores on Advanced Placement exams fell significantly as the percent of students qualified that for free and reduced-lunch programs at a school increased.

CHAPTER 1

INTRODUCTION

Background

The charge of “No Child Left Behind” is to teach all children at high levels, regardless of the background or preparation with which the child comes to class. A report by the American Diploma Project (Achieve, 2004) states that increasingly college and work place preparedness require the same skill set, and that students should be equipped with these skills regardless of their post secondary plans. A major challenge for schools, particularly at the middle and high school level, is to improve their content offerings and to assure that students are given opportunities to learn challenging content. This is a particular problem for low-income and minority students who are often passed through a series of watered down courses without mastering enough of the content to pass state end-of-course exams (Dougherty, Mellor, & Jian, 2006).

One rather inexpensive way for schools to introduce more challenging content is to offer Advanced Placement courses in which students are introduced to college level content at the high school level and take comprehensive exams at the end of the course which can earn students college credit. Students who participate in Advanced Placement courses and the subsequent end-of-course exams are more successful in

college than students who do not take the classes and exams regardless of the scores earned on the exams (College Board, 2008a; Dougherty, Mellor, & Jian, 2006). The experience that students have in challenging courses is one of the best indicators for future success in early college and for completing a college degree within six years (Adelman, 2006).

The College Board (2008a), the nonprofit organization that sponsors the Advanced Placement program, reported that close to 1.5 million U.S. students took in excess of 2.5 million exams in 2007, an increase of over 450 percent in the past two decades. Yet, only a small percentage of students ever take an Advanced Placement course or exam. In Virginia, which has among the highest number of students in the nation taking Advanced Placement tests, about 15% of all students ever take Advanced Placement courses and exams. Of this 15%, enrollment of African American and Hispanic students in Advanced Placement courses has remained significantly below the relative size of these cohorts in the high school population (Darity, Castellino, Tyson, Cobb, & McMillen, 2001; Klopfenstein, 2004; Solorzano & Ornelas, 2004,). Additionally, low income students seldom take advantage of Advanced Placement programs when offered at their high schools (Darity, et. al, 2001).

The issue of poor participation in challenging Advanced Placement courses is exacerbated when one examines enrollment in Advanced Placement Science courses and the scores earned on the science end-of-course exams. Advanced Placement science exams make up only 12% of the Advanced Placement exams taken by students each year, and these are taken largely by White and Asian students. African Americans

are more seriously underrepresented in Advanced Placement Science courses than other ethnic groups, making up less than 5% of the Advanced Placement science enrollment despite being almost 7% of the Advanced Placement student population and 14% of the graduating student population. Hispanics are underrepresented as well, making up only 8% of Advanced Placement Science enrollment despite being 14% of the Advanced Placement student population graduating population and 14.7% of the graduating student population nationally (College Board, 2008a). The importance of building science and math programs to prepare students for 21st century technologies continues to be a national concern, and although there is growth in student enrollment each year, the percentage of students taking challenging science courses has remained largely unchanged (College Board, 2007, 2009).

Students who typically take the most challenging courses are those who are motivated by the learning process, interested in the subject content, or are more comfortable being in class with other like-minded students, all of which are forms of intrinsic motivation. Additionally, these same students cite extrinsic motivational factors such as the increased grade point average (GPA) and chances to get into top-tier colleges as reasons for persevering in challenging courses (Hertberg-Davis & Callahan, 2008). However, for many students, the indicators of college success are insufficient by themselves to entice them to take Advanced Placement or other challenging courses when less challenging courses can be taken instead.

In attempts to attract larger student participation in the Advanced Placement programs, school divisions in all 50 states offer incentives such as extra points added to

the students' GPA, exam exemptions, and more recently, financial incentives. These incentives most often involve payment of the \$86 exam fee for each Advanced Placement exam the student is registered for, but can also include cash rewards for earning passing scores on Advanced Placement exams (Hoff, 2004; Juilleret, 1997; Manzo, 2004; Medina, 2007). These fees are largely paid for by the school systems, though federal grants have been put in place through the "Access to High Standards Act" (2001) to help school systems improve their Advanced Placement enrollment outlook (Access to High Standards Act, 2001).

Statement of Problem

In Virginia, almost half of the 132 school divisions that offer Advanced Placement programs pay the exam fee for students to take Advanced Placement exams,¹ though no research has been done to determine if this policy has positively affected enrollment in Advanced Placement courses or the scores students earn on the Advanced Placement exams. Depending upon the number of exams students take in a division, this could be a substantial amount of money. For example, one of the larger divisions in the state paid the fee for over 2,900 exams in 2008, at a cost of over \$240,000, which in the current economic climate is bound to come under some scrutiny. It is advantageous therefore, to attempt to determine the impact that these financial incentives are having on student enrollment and achievement in Advanced Placement courses and specifically in Advanced Placement science courses.

¹ Quia electronic survey data collected by the author to identify the sample.

Purpose and Research Questions

The purpose of this study was to determine the relationship between financial incentives offered to students to take Advanced Placement courses and student enrollment in Advanced Placement courses, number of students who take end-of-course Advanced Placement exams, and scores students earn on these Advanced Placement exams. The investigation included an analysis of the impact of financial incentives by several school-level factors including the size of the student population, socioeconomic status, academic achievement, and number of traditionally underserved minority students in the high school's population. Additionally, the study looked specifically at the impact of financial incentives on Advanced Placement science enrollment and exam scores compared to Advanced Placement course enrollment and exam scores as a whole.

To this end, the following research questions were addressed:

1. What is the relationship between the number of years that school divisions have paid Advanced Placement exam fees and the enrollment in Advanced Placement courses when factors including school size, socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?
2. What is the relationship between the number of years that school divisions have paid Advanced Placement exam fees and the number of Advanced Placement exams taken when factors including school size, socioeconomic

status, academic achievement, and the size of the traditionally underserved minority population are considered?

3. What is the relationship between the number of years that school divisions have paid Advanced Placement exam fees and the average scores in Advanced Placement exams when factors including school size, socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?

4. What is the relationship between the number of years that school divisions have paid Advanced Placement exam fees and the percent of qualifying exam scores (3, 4, or 5) in Advanced Placement courses when factors including school size, socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?

5. What is the relationship between the number of years that school divisions have paid Advanced Placement exam fees and the number of Advanced Placement science exams taken when factors including school size, socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?

6. What is the relationship between the number of years that school divisions have paid Advanced Placement exam fees and the percent of qualifying scores (3, 4, or 5) on Advanced Placement exams when factors including school size, socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?

7. What is the relationship between the number of years that school divisions have paid Advanced Placement exam fees and the percent of qualifying scores (3, 4, or 5) in Advanced Placement science exams when factors including school size, socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?
8. What is the relationship between the number of years that school divisions have paid Advanced Placement exam fees and the number of students enrolled in each individual Advanced Placement course when factors including school size, socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?
9. What is the relationship between the number of years that school divisions have paid Advanced Placement exam fees and the number of student in each class taking Advanced Placement exams when factors including school size, socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?

Operational Definitions

Advanced Placement program: sponsored by the College Board, this program offers 37 courses in 20 subjects, each developed by a committee composed of college faculty and AP teachers, covering information, skills and assignments found in the corresponding college course. The offerings for science include Biology, Chemistry, Physics B and C, and Environmental Science.

Advanced Placement science: Advance Placement courses in Biology, Chemistry and Physics B and Physics C. Environmental Science is excluded from this study since it alone equates to a one semester college course taught over a full year of high school.

Incentives; some form of motivation for students beyond intrinsic motivation

Financial incentives: monetary rewards offered to students for enrollment in Advanced Placement courses or passing scores on the Advanced Placement exam. These include payment of the Advanced Placement exam fee by an agent other than the student.

School size: average student enrollment in the high school over the three year period from 2006-2008.

Socioeconomic status: the average percent of students in a high school that qualify for free or reduced lunch programs in over the three year period from 2006-2008.

Student achievement: the average percent of students passing Standards of Learning Assessments over the three year period from 2006-2008.

Traditionally underserved minority groups: the percent of students in a high school that are African American or Hispanic, ethnic groups where the percent of students enrolled in Advanced Placement courses is below the representation of that group in the high school population.

Qualifying scores: Advanced Placement exam scores of 3, 4, or 5.

Students with these scores are typically considered qualified for college credit in the subject of the exam.

CHAPTER 2

REVIEW OF LITERATURE

The purpose of this section is to present the current literature related to Advanced Placement programs and the use of financial incentives to increase the enrollment of students, looking particularly at those from traditionally underrepresented groups, in Advanced Placement courses and end-of-course exams. Searches of Educational Resources Information Center (ERIC), Dow Factiva, Science Direct, JSTOR, and Lexus Nexus yielded many journal articles when the search term “advanced placement” was used. This initial search term was qualified with “and” to include the terms “college, minority, gender, science, incentives, rewards, and payment” to access articles that dealt with the specific issues that are targeted in this study. The College Board® Data and Reports web site was also accessed, providing several studies on Advanced Placement programs undertaken by academics from across the nation.

The section begins with a review of the history of the Advanced Placement program and the reasons for its growth, and follows with its impact on college readiness. It then turns to review the underrepresentation of minorities and students of low socioeconomic status in Advanced Placement courses. This is followed by a look at the literature on Advanced Placement Science enrollment and the underrepresentation

by minorities in these courses. The review concludes with a brief look at behavior modification and goal theory as it pertains to the use of financial incentives for participation in Advanced Placement courses and exams.

History of AP

The Advanced Placement (AP) program was instituted soon after World War II when many in education had become concerned with the growing gap between secondary and post-secondary education. The initial program was the result of a study by researchers at Harvard, Princeton and Yale along with three elite prep schools to identify this gap and make recommendations on how to narrow it, namely by encouraging high schools to hire engaging teachers who could support motivated seniors in independent study and college level work. A second group, the Committee on Admissions with Advanced Standing, recruited college professors to produce course curricula and achievement tests that would reward successful students with college credit for their efforts. In 1955, after a three year pilot study, the program was offered to the College Board for sponsorship and administration, where it has resided since under the name the College Board Advanced Placement Program (College Board, 2003).

The growth of the Advanced Placement program has been nothing short of phenomenal over its history and especially over the past two decades. The number of schools offering Advanced Placement courses has increased by an average of 4% each year until 2007 when there was a 13% drop in schools offering Advanced Placement courses. This drop in schools offering Advanced Placement occurred the first year that

the College Board required teachers of all Advanced Placement courses to go through an audit process in order to retain the AP[®] brand on their advanced courses (Cech, 2007). The audit process is discussed in more detail below.

The number of students involved in taking Advanced Placement exams continues to increase by an average of 11% annually and shows no signs of slowing down even as fewer schools are authorized to offer the courses. More telling still, the total number of Advanced Placement exams is growing at an even faster rate, averaging 12% annually over the past 20 years and appears to be accelerating, as more students opt to take multiple exams (College Board, 2007).

Why AP[®]?

The growth of Advanced Placement Programs has been a result of several driving forces in education. First and foremost the frequent national alarms about the lack of rigor in the American educational system, particularly at the secondary school level, have resulted in a new awareness and scrutiny by all stake holders. Parents have become more selective shoppers of educational opportunities for their children which in turn has sent educators scrambling to show that the programs offered at their schools provide students with challenging courses that will prepare them for post secondary education and/or a place in the workforce. In addition, the use of Advanced Placement courses and scores by colleges in their admissions process has made the program a focus of competition among high schools throughout the nation.

Beginning in 1999, Jay Matthews from the *Washington Post* began to publish an annual “Best High Schools in America” article using his AP/IB “Challenge Index”

which ranked high school quality based solely on the number of Advanced Placement or International Baccalaureate exams taken by students at the school as a ratio of the graduating seniors. This ranking system was picked up by *Newsweek* in 2003, launching it to national status (Matthews, 2007b). The result was a new emphasis on Advanced Placement courses, which are much easier to institute at a school than International Baccalaureate program since the latter requires a change to the curriculum throughout the school and significant investment in teacher training (International Baccalaureate Organization, 2008). Since the index makes no accommodation for success in the class or on the exam, schools rushed to enroll more and more students into Advanced Placement courses regardless of their level of preparation (Cech, 2007; Matthews, 2007a). As of 2007, all major school systems in northern Virginia pay for students to take the Advanced Placement and International Baccalaureate exams and require students to take the exams (Matthews, 2007b). Taking the “Challenge Index” to its illogical conclusion, the “best high school” could be one that requires all of its students to take one or more Advanced Placement exams regardless of their ability to succeed, punishing the students who do not succeed by failing them in these courses, thereby reducing the number of graduates. Many of the schools on *Newsweek’s* list have lower than average graduation rates and significant achievement gaps among typically underrepresented groups (Mead & Rotherham, 2006) raising questions about the validity of the index.

As the role of the Advanced Placement program changes from a means for bright, motivated students to get a jump on college while still in high school, to an important

admissions criterion used by most selective colleges as an indicator of achievement and probable success in college (National Association of College Admissions Counselors, 2005), the question of equal access by all high school students becomes an important one. Federal legislation through the “No Child Left Behind” Act (No Child Left Behind Act, 2001) requiring states to put rigorous standards in place and to assess student progress has been considered only a first step in preparing students for success beyond high school. .

AP[®] and College Readiness

Of the almost 3 million students who graduated from high school in 2007, about 2 million or 67% have enrolled in college (Bureau of Labor Statistics, 2008). Unfortunately, if past trends continue, over half of these students will fail to ever complete their degree, with one third of them never making it to their sophomore year (Pennington, 2002). In addition, 76% of all post-secondary institutions now find it necessary to offer remedial courses in reading, writing and mathematics for students entering college without the requisite skills (National Center for Education Statistics, 2008). These sad statistics point to the significant misalignment that exists between secondary student preparation and post secondary admissions and placement standards. Often the state mandated standards demand that most students meet a baseline competence in a number of curriculum areas, but these are seldom sufficient preparation for the rigors of college study (Kirst, 1998).

Yet the rigor of a student’s high school program is by far the most important indicator of future success in earning a bachelor’s degree in college, trumping

socioeconomic status and family education (Adelman, 1999). Adelman's analysis of a two longitudinal studies of high school cohorts, one scheduled to graduate from high school in 1982, the other a decade later, determined that the completion of more than one Advanced Placement course was among the minimum achievement standards met by students ranked in the highest level of academic curriculum intensity. Ninety five percent of the students in this level completed a bachelor's degree, and 41% went on to complete masters or professional degrees as well. On the other hand, students who take remediation classes in college are only about half as likely to complete their degree as students who require no remediation on the college level (National Center for Education Statistics, 2008).

Rigor is a concept that can be difficult to standardize across school divisions, states, or the nation. A rigorous course in a school with a low socioeconomic population, where family education level is low, may be very different than a course in a school where the population has higher socioeconomic status, consisting of largely college educated parents. The unfortunate truth is that just because a course is called advanced or honors, does not mean that students are learning on an advanced level. Issues such as grade inflation, where students receive advanced credit for a course for which they have not sufficiently mastered the content, make it difficult for colleges to use grades in admissions decisions (Dougherty, Mellor, & Jian, 2006). Advanced Placement courses offer college level coursework for students while still in high school, which can be instituted in schools without a large financial investment or teacher development. In the past ten years, school divisions have moved to improve the

perceived rigor of their offerings by adding Advanced Placement to their curriculum, often so quickly that teachers may have been asked to take on teaching a course without sufficient background or preparation for the task at hand. In an attempt to assure the rigor of Advanced Placement courses, the College Board instituted an auditing process beginning in 2007 for each of its courses. Only courses that clearly follow the prescribed curriculum are authorized to use the AP registered trademark on their course announcements and more importantly, on student transcripts (College Board, 2008b). However, there is no oversight of the process to assure that teachers are following the approved syllabus.

In addition, no measure of the students' success is included in the College Board's determination of course rigor (Geiser & Santelices, 2004). Although studies comparing AP students to non-AP students have consistently shown that AP students perform better in college (Adelman, 1999; College Board, 2007; Morgan & Ramist, 1998), there is an element of self selection that must be considered. For example, some of these studies fail to consider important characteristics of AP students, namely their drive, persistence, and innate ability, or the rigor of their non-AP program, especially in math and science (College Board, 2003). One can assume that because the Advanced Placement Program was instituted for bright, motivated students, these students should have all of the requisite skills necessary to perform well in college, whether they have taken Advanced Placement courses or not (Gonzalez, O'Connor, & Miles, 2001). Klopfenstein and Thomas (2005) examined the first semester GPA and persistence to the second year of over 28,000 high school graduates who enrolled in the University of

Texas system in the fall of 1999 comparing the mean characteristics of courses taken, SAT scores, and class rank as well as parent education attainment and socioeconomic status. Their study indicated that taking Advanced Placement classes are no more likely to assure success in the first year of college than non-AP courses taught at an honors level. In fact, the simulated “mean” student from Klopfenstein’s data took no Advanced Placement classes, yet completed the first year of college with a C+ average and returned for the second year of study. Keeping in mind that typically only the most selective colleges put significant weight on Advanced Placement courses in their admissions decisions and that most students accepted at four year institutions of higher learning have never taken an Advanced Placement course or exam yet still manage to find success in college (Klopfenstein & Thomas, 2005), the addition of Advanced Placement courses by schools are but one option for preparing students for postsecondary education.

Several studies have indicated that scores earned on Advanced Placement exams are among the best indicators of college success even after normalizing for academic ability, school quality and family circumstances (Dougherty, Mellor, & Jian, 2006; Klopfenstein, 2004; Geiser & Santelices, 2004) For example, Geiser and Santelices (2004) using four years of admissions and college transcript data from the University of California Corporate Student System found that while Advanced Placement and honors coursework had essentially no predictive value on college success, performance on the end of course exam was one of the strongest predictors of college success. Dougherty et al (2006), examining the high school preparation of students in the 1988 eighth grade

class who graduated from Texas public colleges and universities by the spring of 2003, found that after accounting for student ability, socioeconomic status, and school quality, students who had taken and passed Advanced Placement courses and exams had on average a 5 year graduation rate that was 30% higher than students who had not taken an Advanced Placement course. By contrast, students who took an Advanced Placement class but did not pass the exam had a 5 year graduation rate 19% higher than non Advanced Placement students. Those students who took an Advanced Placement class, but not the exam had a 5 year graduation rate still 10% above those who never took an Advanced Placement course. These data suggest that exposure to Advanced Placement curriculum increases the probability of college success and that taking the exam improves that probability. Of course, student motivation, a major factor in the self selection of Advanced Placement and in college success (R. Morgan & Maneckshana, 2000), is impossible to control in empirical studies.

Some have suggested that the lack of correlation between the completion of Advanced Placement courses and college success is an indication of lack of rigor in the classes (McCauley, 2007). One possible reason for the lack of Advanced Placement course rigor may be that the growth of Advanced Placement in schools is the result of loosening the admission standards for entrance into the class in order to increase student enrollment (Santoli, 2002). If students are enrolling in Advanced Placement classes without the requisite knowledge or skills, even the most skilled Advanced Placement teacher would be unable to make up students' deficit and complete the required coursework in time for an exam in May. This may also be a reason for the number of

students who take the Advanced Placement course but never sit for the end-of-course exam. Yet as the disparity in Advanced Placement enrollment by underserved groups is highlighted, school system officials are under pressure to open enrollment for members of these groups, without consideration of their readiness for the challenging content.

Underrepresented in AP®

The College Board (2008) reported that 1,464,254 U.S. students took 2,533,431 exams in 2007 up from 262,081 students taking 369,207 exams two decades before. This is an enrollment increase of almost 4.6 times and an increase in the number of exams taken of over 5.9 times the level in 1988, indicating that many more students are taking Advanced Placement exams and they are taking more than one exam on average. Yet the enrollment of African American and Hispanic students in Advanced Placement courses has remained significantly below the relative size of these cohorts in the high school population (Darity, Castellino, Tyson, Cobb & McMillen, 2001; Klopfenstein, 2004; Solorzano & Ornelas, 2004).

Solorzano and Ornelas (2004) analyzed the lack of access and availability of Advanced Placement courses for African American and Hispanic students in California high schools, and minority student enrollment in Advanced Placement classes in Los Angeles Unified School District. They found that, in a state where the Hispanic population is expected to be the majority of the student population by 2009, enrollment by Latina/o students in Advanced Placement courses is significantly limited. In the 2000- 2001 school year, California's top 50 high schools in terms of Advanced Placement course availability had a Hispanic enrollment of 16% in Advanced

Placement classes while the Hispanic population at these schools was 38%. The same schools recorded a 5% African American enrollment in Advanced Placement courses although the school African American population was 8%.

Gaining access to Advanced Placement for minority groups in low-income urban school districts where few, if any, Advanced Placement courses are offered (Klopfenstein & Thomas, 2005) becomes an additional problem. This can be due to a number of factors. Often school districts cannot afford to fund an Advanced Placement course if there are only a few students willing to accept the challenge of taking the course. Parents are often unaware of the programs, so may not advocate for their children to make sure Advanced Placement programs are available. Additionally, many schools in low-income areas have difficulty recruiting qualified teachers to teach the courses (Geiser & Santelices, 2004).

This problem of reduced access to Advanced Placement courses has several possible repercussions for students' chances of future college success. First, many schools provide additional points on the students' grade point average (GPA) for each Advanced Placement course they take, so students who are not enrolled in these courses will have lower GPAs making admission to the college of their choice more difficult. Second, since more selective colleges are using enrollment in Advanced Placement courses as evidence of ability to succeed on the college level, members of these underrepresented cohorts are less likely to gain admission to these schools. Third, the rigor of Advanced Placement courses and the subsequent exams are considered among the best preparation for the rigors of college (Klopfenstein, 2004), without which

members of underrepresented groups might be less able or less likely to complete a college degree. Finally, Adelman (2006) found that students who earn 6 college credits while still in high school are more than twice as likely to complete a college degree, than those who enter college with no earned credits. A student who takes two Advanced Placement courses and passes the exam with a score of 3 or better would earn those college credits at most colleges and universities.

In addition to issues of enrollment in Advanced Placement classes, those minority students who do enroll in Advanced Placement classes are finding it difficult to succeed on the exams. College Board's 4th Annual AP Report to the Nation (2008) reports that on a national level, African Americans made up 7.4% of the population of students taking Advance Placement exams, but only 3.3% of students scoring a 3 or higher (considered a passing score eligible for college credit or course exemption at most colleges) on them. In the same study, Hispanic students, who made up 14.0% of students taking Advanced Placement exams in 2007 nationally, had 13.6% of the scores of 3 or higher (Dillon, 2007). In contrast, white students, who made up 61.7% of the student population taking Advanced Placement exams, received 66.3% of the scores of 3 or above. Asian students who made up 10.4% of the student population taking Advanced Placement exams earned 15.7% of the scores 3 or above. The results for Hispanic and Asian students may be slightly skewed by the language exams for which they are already fluent. For example, Hispanic students make up 14.6% of the Advanced Placement exam population, but 55.2% of those taking the AP Spanish language exam and 78.0% of the AP Spanish literature exam population. Asian

students who make up 10.4% of the student population made up 89.4% of the Chinese language and culture exam population and 63.2% of the Japanese language exam population. This in no means negates their accomplishment with these languages, but merely points to an area where their native culture gives them an advantage that other students may not enjoy.

Examining the average scores for students from underrepresented groups does not improve the picture. Overall, the mean AP grade for all students on all exams was 2.83 out of 5. Once again, a 3, 4, or 5 on the exam are considered passing scores, where the student qualifies for college credit, a 2 is considered “possibly qualified” and a 1 is “not recommended” for college credit by the College Board. African American students averaged a 1.91 on all exams, while Hispanic students averaged a 2.44 on all exams. In contrast, the average for white students was 2.95 and for Asian students the average was 3.05, revealing a significant disparity between these groups and their Black and Hispanic classmates. Once again, the reason may be that many of the students in these underrepresented groups come to Advanced Placement classes without the requisite knowledge and skills to be successful, so the course becomes one of remediation to get students to a higher level of achievement (Taliaferro & DeCuir-Gunby, 2008) rather than concentration on college level curriculum. Additionally, Advanced Placement course curricula have been noted for their breadth of topics rather than their depth in a few topics, putting students with insufficient preparation at an even greater disadvantage.

AP[®] Sciences

The issues of underrepresentation noted above are exacerbated when one examines enrollment in Advanced Placement sciences. African Americans and Hispanics are more seriously underrepresented in Advanced Placement Math and Science courses than in all other subjects. In the United States in 2007, only 5.6% of students taking Advanced Placement Biology exams, 4.4% of students taking AP Chemistry exams, and 3.8% of students taking Physics B exams were African American. Hispanic students made up 14.6% of the population of students taking Advanced Placement exams in 2007, but only 8.6% of those taking the AP Biology exam, 6.8% of those taking the AP Chemistry exam and 3.9% of students taking the AP Physics B exam (Darity, Castellino, Tyson, Cobb, & McMillen, 2001; Dougherty, Mellor, & Jian, 2006; Klopfenstein & Thomas, 2005; Morgan & Klaric, 2007). In contrast, White students took 61.7% of the total Advanced Placement exams, took 60.5% of the AP Biology exams, 61.0% of the AP Chemistry exams and 60.6% of the Physics B exams while Asian students who were 5.5% of the student population, took 17.8% of the AP Biology exams, 20.9% of the AP Chemistry exams and 19.0% of the AP Physics B exams.

Additionally, members of these groups who have attempted Advanced Placement science courses and exams have found success, measured by a score of 3 or above, elusive. For example in 2007, African American students had average scores of only 1.95, 1.71, and 1.71 respectively, on the AP Biology, AP Chemistry and AP Physics B exams, and Hispanic students averaged scores of 2.16, 1.97, and 1.95

respectively on the same exams, all of which are considered failing scores and lower than the average score on all exams for each ethnic group (College Board, 2008a). Compare these scores to those of White students who made up 59% of the AP Biology, 60% of the AP Chemistry and 62% of the AP Physics B exam participants with average scores of 3.09, 2.82, and 2.90 respectively. White students scored lower than the average of all exams on both the Chemistry and Physics B exams. Asian students made up 20% in AP Biology, 22% in AP Chemistry and 19% in AP Physics B and once again outscored all other groups on average with 3.32, 3.12, and 2.95 respectively on the Advanced Placement science exams, scoring lower than their overall average only on the Physics B exam.

Gender is also an issue when science Advanced Placement exam participants are considered. Female students make up 56% of the students taking Advanced Placement exams, so overall, males are underrepresented in Advanced Placement programs. However, in Advanced Placement science, a different trend appears. Females made up 58% of students taking the AP Biology exam but only 47% of the Chemistry exam participants and 35% of the Physics B exam participants. The gender gap in Physics is still quite apparent despite the attention that the issue has received over the past decade and more (Klopfenstein, 2004).

Advanced Placement science courses and exams warrant an additional focus for several reasons. Over the past decade, Asia has emerged as a strong leader in its ability to attract and train students in science and technology, overtaking both the United States

and the European Union in the total number of science and technology degrees conferred. These Asian countries, specifically China and Japan, have shown a particularly strong presence in engineering (National Science Foundation, Division of Science Resources Statistics, 2008). For example, in the 2004 the United States conferred a total of 1,407,009 bachelor's degrees, of which 235,781 or 17% were in science and engineering. Although this represents a 14% increase over the number of science and engineering bachelor's degrees conferred in 1985 when the science and technology degrees were 21% of all bachelor's degrees conferred, the percent of total degrees conferred has decreased by 4%. In comparison, China conferred 1,196,290 bachelor's degrees, over 2 million fewer than the United States, but 610,705 science and engineering degrees, or about 375,000 more than the United States. Even more importantly, 51% of all degrees conferred in China and 24% of all degrees conferred in Japan are in the areas of science and engineering compared to 17% in the United States (National Science Foundation, Division of Science Resources Statistics, 2008).

The United Kingdom and Germany also confer a larger percentage of bachelor's degrees in science and engineering than the United States. The United Kingdom conferred 76,150 science and engineering degrees out of a total 292,090 degrees, or about one fourth of the total, while Germany conferred 66,342 science and engineering degrees out of a total 207,802 degrees conferred or almost 30% of its total. Although all of the countries included in the comparison are showing decreases in the number of science and engineering degrees as a percent of the total degrees conferred over the past

20 years, only the United Kingdom is declining at a rate exceeding 10%, while all others are declining at less than half that rate.

For the United States to remain competitive, it will have to find ways to engage its young people in serious scientific study and to open doors to them to pursue that study. One way of increasing the percentage of students in science and engineering is to increase the number of women and minorities who choose these specialties as their major in college and continue on to a career in the field (Bystydzienski, 2006). The benefits of doing so are two-fold. First, in terms of sheer numbers, women represent over half of the college population, so increasing the representation of that cohort taps a large pool of human capital that could raise American presence in these fields. Second, the demands of developing new technologies require the varied abilities and perspectives of multiple viewpoints so the involvement of all representative groups of citizens would indeed enhance the nation's technical prowess and speed technical advance (College Board, 2008a).

A student's precollege experience with science is a key variable that will influence her/his motivation to continue in the discipline. Advanced science courses such as offered by the Advanced Placement Program should be considered vital in the role of increasing students' interest and motivation to study science as well as providing the added incentive of earning college credit in the discipline while still in high school. Studies examining aspects of academic ability, conclude that students with high math and science scores such as SAT's, calculus and other high school math scores are significantly more likely to choose science or engineering majors than those who have

high reading scores (Blickenstaff, 2005; Hazari & Tai., 2007; Ordovensky Staniec, 2004). Therefore, previous success in science and related subject areas provides the motivation many students need to pursue science in college. With these studies in mind, school systems across the nation are being charged with finding ways to entice more students into rigorous math and science courses such as those in the Advanced Placement program and to provide the means for these students to be successful once they are enrolled.

Unfortunately, the charge to improve enrollment and achievement in advanced science in high school has not necessarily been a rousing success in either motivating students (especially in underrepresented groups) to continue their science education in college or in preparing students to succeed in science classes once they got there.

Sadler and Tai (2007) have published one of the few studies on Advanced Placement science achievement that was not sponsored by the College Board. Using survey data from about 8,600 college students in 55 randomly selected colleges, Sadler and Tai estimated that in 2004, one in five college freshmen had taken an Advanced Placement science exam and that within that group, students performed better on the corresponding introductory science class in college than those who had not taken an Advanced Placement science class in high school.

Once students were matched according to SAT scores, mathematics grades and science grades in high school, parent education, race, and kind of high school the student attended, however, the differences became much less apparent. Students who

had taken the Advanced Placement science class and scored a 1 on the exam did no better in the introductory college course than students who had taken the regular course in high school (mean score 79.18 for regular course vs. 78.11 for AP score of 1) . Students who scored a 2 on the Advanced Placement science exam did no better than those who had completed an honors class in that science in high school (mean score of 81.98 for honors vs. 82.11 for AP score of 2), and students who scored a 3 on the Advanced Placement science exam did no better than students who had taken the Advanced Placement science course but not the exam (mean score of 85.21 for no exam vs. 84.30 for AP score of 3). Students who scored 4 (mean score of 87.15) or 5 (mean score of 89.77) on the Advanced Placement science exam scored on average 3.4 and 4.6 points higher than the average score in the college introductory science class which still puts the average Advanced Placement student at a B for the course since the overall average of all students in the course was an 80.5 (Sadler & Tai, 2007). Considering that most students who have earned a 4 or 5 on the exam would have been given college credit and/or exempted from the introductory course at most universities, one would have to assume that the majority of the students who passed the Advanced Placement exams were not included in the population. Additionally, Advanced Placement scores were reported by the students themselves, allowing the possibility that not all students reported truthfully.

Student motivation to continue in science beyond their Advanced Placement course is another important factor in improving the numbers of science degrees that are awarded. Hertberg-Davis and Callahan (2008) interviewed 200 gifted students in

Advanced Placement and International Baccalaureate classes and found that though many students enjoyed the academic challenge and the opportunity to study with other motivated students like themselves, there were significant drawbacks. Most noted were the strenuous work load and lecture-heavy structure of the classes which put tremendous pressure on most students and were not conducive to retaining some qualified students. Minority students in particular found the atmosphere unwelcoming because they were often the only student of their ethnic background in the class. In a previous study, Kyberg, Hertsberg-Davis and Callahan (2007) interviewed teachers, administrators and students at two schools that had seen significant shifts in the school demographics over seven years and one school that has been historically African American, found that minority students were more likely to be successful in Advanced Placement classes when the belief in the student's ability to succeed was pervasive and consistent across the staff, and when the school constructed a "scaffolding" (pg 173) of flexible support to meet students' needs for remediation, improved in-depth understanding and feelings of self-esteem and self worth.

Motivated to Learn, Motivated to succeed

Behavior modification via the use of rewards and punishments has become so deeply rooted in our society, it is viewed as common sense (Blickenstaff, 2005; Buck, Kostin, & Morgan, 2002; Bystydzienski & Bird, 2006). The primary premise of the theory is that if you offer an incentive, whether financial, gifts, or grades, people will act the way you want them to. The other side of this theory states that people will avoid behaviors that produce punishment, which runs the gamut from physical pain to the loss

of a promised reward. A low grade for a student can be seen as a punishment in that the “A” is held up as a reward for performance, which can be taken away if the performance does not measure up to teacher set standards.

Yet Kohn refutes the strongly-held belief in the power of incentives to change behavior (Kohn, 1993) providing evidence from over a dozen studies that the use of external motivations such as cash actually reduce any initial intrinsic motivation for the task and reduce achievement on task related assessments. One such study, in which undergraduate students were asked to choose the pattern that was least like the other patterns on the page, found that students promised a reward for the activity performed significantly worse than students who were not offered the reward (Viestri, 1971). Pittman, Emery and Boggiano (1982) in a review of the available research noted that people offered rewards:

chose easier tasks, are less efficient in using the information available to solve novel problems, tend to be answer-oriented and more illogical in their problem-solving strategies. They seem to work harder and produce more activity, but the activity is of lower quality, contains more errors, and is more stereotyped and less creative than the work of comparable non-rewarded subjects working on the same problem.

Based on these studies, offering rewards for the pursuit of more challenging academic work may succeed in increasing enrollment, but is unlikely to improve the very skills and mastery that students are there to gain, and unlikely to make them successful on the end-of-course exams.

Students who take on the challenge of rigorous coursework such as that offered by the Advanced Placement program may be motivated to do so for several possible reasons. Hertberg-Davis and Callahan (2008) interviewed approximately 200 teachers, 300 students, 25 building-level administrators, and 8 Advanced Placement or International Baccalaureate program coordinators over a period of 4 years and found that students choose to enroll in these challenging courses because of their intrinsic interest in the subject matter and the opportunity afforded by the advanced curriculum to delve deeply into topics of interest to them along with other like-minded classmates. Most also noted the extrinsic rewards for taking the course, such as improved chances of admittance to competitive colleges, skipping introductory courses in college, and preparedness for the rigors of college, all intrinsic motivations.

Students are often put off by the workload of challenging courses which can be quite daunting (Blickenstaff, 2005). Students interviewed in the Hertberg-Davis study spoke of sleep deprivation, constant stress, and a diminished social life. Students in the study who consequently dropped the Advanced Placement or International Baccalaureate courses for “regular” level found that the rigor was absent and their classes could be redundant and boring, but that their quality of life improved.

For minority and low income students, the motivation for taking rigorous coursework is even lower. Many come from families where they will be the first to attend college, so they may not have the push from parents or the understanding of the benefits that rigorous coursework holds. Hertberg-Davis et. al. (2008) found that students coming to Advanced Placement courses for the first time without the requisite

background skills (writing, study, time-management skills) were seldom given the chance to catch up to their classmates. In an earlier study Kyberg, Hertberg-Davis and Callahan (2007) interviewed 75 gifted minority students in three urban high schools and found that gifted minority students often felt isolated because they take classes that are attended mostly by white students. In addition, schools in low income or high minority areas tend to offer fewer advanced courses so these students, if they have access at all, are less prepared for the rigor of Advanced Placement courses (Sadler & Tai, 2007).

Are Financial Incentives the Answer?

In order to increase enrollment of students in Advanced Placement classes, schools have offered incentives in many forms. Some schools in all 50 states and the District of Columbia offer some form of grade incentive for participation in Advanced Placement, International Baccalaureate (IB) or dual enrollment courses (Kohn, 1993). Grade incentives offer students additional points in their Grade Point Average (GPA) for completion of more rigorous courses. For example, if an A in a non-AP course is worth 4 quality points, the same grade in an AP, IB, or dual enrollment course may be worth 5 quality points. Additionally, some colleges recalculate students' GPA to include additional credit for Advanced Placement courses (Hertberg-Davis & Callahan, 2008) leaving those students without access to these courses at a possible disadvantage in the college admission process. However this process is far from universal with some Virginia schools removing weighted credit before calculating student GPA (VCU Honors College bulletin, 2009)

In order to increase access to Advanced Placement courses by minority and low income students, Congress enacted the “Access to High Standards Act” as part of the “No Child Left Behind” legislation (Lichten, 2000). This act provides funds through grants for teacher training, exam fees, materials and supplies supporting the development and expansion of Advanced Placement programs. State and local governments are also investing heavily in Advanced Placement programs, by paying for exam fees and offering teacher professional development, though funds for some of these programs have not been as available as first hoped (Geiser & Santelices, 2004; Jeong, 2009).

The use of financial incentives can be a means to offset the cost of exams for students, or more likely the parents who actually pay the fees, which at \$86 per exam can be prohibitive. College Board itself offers a fee reduction of \$22 for those who can document financial hardship (College Board, 2008a), and some school divisions pay all or part of the fee for their students. These incentives, meant to remove barriers and entice students to take more rigorous coursework and the culminating national tests attached to them, can be costly for local and state school agencies with little available research that supports their success (Geiser & Santelices, 2004).

Paying the fee for Advanced Placement exams also provides school divisions with the ability to require students to take the exams. So, rather than use the fee as an incentive, it is being used by many school divisions in Virginia and elsewhere as a stick that attempts to force students to sit for an exam they may feel unprepared or unwilling to take. Once students are registered for the exam, they are required to pay a penalty, or

lose the weighted credit for the course if they do not sit for the exam (Matthews, 2007a).

A few school divisions offer cash incentives for passing scores on the exams, thus rewarding students for their performance (Jeong, 2009; Matthews, 2007a). The first program of its kind in Texas involved 10 schools with a minority-majority and/or low income population. This program offers between \$100 and \$500 cash to students for passing scores (3, 4, or 5) on an Advanced Placement exam, and additional cash incentives to Advanced Placement teachers if their students pass the exams (Jackson, 2008). The program also includes important elements such as teacher training by College Board and curricular reforms in earlier grades that prepare students for the Advanced Placement program. In the first year of the program (1996), Advanced Placement enrollment increased 171% (data only available in percents), and by 2002 the schools were achieving a pass rate of 132 per 1000 students compared to 86 per 1000 in Texas as a whole and 80 per 1000 in the U.S. Part of the program's success is attributed to the incentives for teachers and the training and support that the teachers receive (Access to High Standards Act, 2001). This program and others like it are largely funded by grants and donations from private corporations, and have produced enough early success to be expanded to over 50 schools in Texas and adopted in some schools in New Mexico and New York City. Additionally, similar programs have recently been started in Alabama, Connecticut, Kentucky, Massachusetts, Virginia and Washington (Jackson, 2008; Klopfenstein, 2004; Klopfenstein & Thomas, 2005).

The program instituted in 31 schools with large high-risk populations in New York City offered a \$1,000 cash reward for a score of 5 on an Advanced Placement English, math or science exam, \$750 for a score of 4, and \$500 for a 3 on an exam. The program produced modest gains in its first year with an additional 345 Advanced Placement tests being taken in those subjects (up from 4,275 to 4,620) however the number of passing scores declined by 5 from 1,481 to 1,476 (Hoff, 2004; Juilleret, Dubrowsky, Ridenour, McIntosh, & Caprio, 1997). Students received more scores of 5 than the previous year, but the number of 4's and 3's decreased. Although there was disappointment by the creators of the incentive program, the fact remains that the program increased enrollment by 8% in one year while the passing percentage remained essentially flat. If the program's aim is to target enrollment to persuade more students to sign up for Advanced Placement classes, then it was a success and the money was properly allocated. If, however, the main concern is the scores that the students earn on the exams, then it might be more appropriate to allocate funds to improving enrollment in pre-AP classes that adequately prepare students for the rigors of Advanced Placement classes or to teacher training (Jackson, 2008). On the other hand, if younger students see that money is being paid for specific scores, they may enroll in rigorous preparatory courses on their own to help assure a cash reward when they get to their junior or senior year in high school.

Jeong (2009) examined state-wide Advanced Placement incentive programs using the Education Longitudinal Study of 2002 found that there was little benefit from these programs in terms of Advanced Placement exam participation or performance.

Although some of the reports and studies are promising, no studies to date have examined specifically how Advanced Placement science courses and exams fare compared to the program as a whole or to other academic subject areas. Advanced Placement sciences are a particularly rigorous group of courses (College Board, 2007), which unlike English, History or Math courses, recommend that students have taken a year of the same subject prior to enrollment in the Advanced Placement course. This relegates the Advanced Placement Sciences to elective status, since the student has already taken the science requirements for her/his diploma. Additionally, the work of this “pre AP” year is also challenging, and for many students who have not had a firm science foundation previous to it, “pre-AP” is the only year of the subject they are willing to take. Other students, who have traditionally not been tracked into honors courses, when faced with the decision to take an Advanced Placement course, are less likely to attempt an Advanced Placement science course and are less likely to be successful if they do attempt it without the “pre AP” preparation. Although financial incentives are attractive to students, that alone may not be sufficient to entice students into these most rigorous courses when they can receive the same financial incentive in other subject areas with only a one year commitment.

Waiving course fees or offering cash awards removes the financial barrier for some students who may want to take an Advanced Placement course or entice students who may not otherwise be motivated to take on the course rigor, but does nothing to improve the preparation that students need to succeed in Advanced Placement classes. Financial incentives for Advanced Placement exams or rewards for AP scores are used

in many school systems to entice students to take these rigorous courses and have increased enrollment overall (Hoff, 2004; Juilleret, 1997; Manzo, 2004; Medina, 2007), but specific support structures and teacher training are equally important to give students from low income and minority backgrounds a fighting chance of success (Jackson, 2008).

Summary

The charge of “No Child Left Behind” is to teach all children at high levels, regardless of the background or preparation with which that child comes to class. A report by the American Diploma Project (Gootman, Gebeloff, & Hu, 2008) states that college and work place preparedness increasingly require the same skill set, and that students should be equipped with these skills regardless of their post secondary plans. A major challenge for schools, particularly at the middle and high school level, is to improve their content offerings and to assure that children are given opportunities to learn challenging content. This is a particular problem for low-income and minority students who are often passed through a series of watered down courses without mastering enough of the content to pass state end-of-course exams (Kyberg, Hertberg-Davis, & Callahan, 2007).

Students who participate in Advanced Placement courses and the subsequent end-of-course exams have been shown to be more successful in college than students who do not take the classes and exams regardless of the scores received on the exam (College Board, 2008; Dougherty, Mellor, & Jian, 2006). The experience that students have in challenging courses is one of the best indicators for future success in early

college, and for completing a college degree within six years (Adelman, 2006).

Students who typically take the most challenging courses are those who are motivated by the learning process, interested in the subject content, or are more comfortable being in class with other like-minded students, all forms of intrinsic motivation. In addition, these same students cite extrinsic motivational factors such as the increased GPA and chances to get into top-tier colleges as reasons for persevering in challenging courses (Achieve, 2004). However, for many students and parents, the indicators of college success are insufficient by themselves to entice them to take Advanced Placement or other challenging courses when less challenging courses can be taken instead. The use of financial awards could be the added incentive needed to raise enrollment in rigorous courses by underrepresented groups, though to make students successful in those courses once they enroll will require additional resources for teacher development, student remediation, and support services.

The institution of financial incentives paid for by the school division in order to increase Advanced Placement enrollment is an expensive proposition that has taken root across the state of Virginia and elsewhere. Yet the impact of these incentives has yet to be measured. This study will evaluate the impact of these financial incentives on Advanced Placement course enrollment and exam scores in Virginia school divisions, looking particularly at the impact on Advanced Placement science courses. The study will address the enrollment of typically underrepresented groups in Advanced Placement courses as a function of the institution of financial incentives and evaluate the success of these groups on the end-of-course exams.

CHAPTER 3

METHODOLOGY

This chapter provides a description of the research design, the sample used in each of the two phases of the study and the population from which each is drawn. This is followed by a discussion of the variables examined, and the sources of the data that was collected in each phase. Finally, the methodology that was used for data collection and strategies for data analysis of each phase are discussed.

Research Design

The research design for this quantitative study is nonexperimental, ex post facto in nature, examining changes in Advanced Placement enrollment, the number of Advanced Placement test takers, and Advanced Placement exam scores earned by students over a three year period as a function of the number of years a financial incentive has been in place.

Phase I

Research Questions

Seven research questions were addressed in this phase of the study. These were

1. What is the relationship between the number of years that school divisions have paid Advanced Placement exam fees and the enrollment in Advanced

Placement courses when factors including school size, socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?

2. What is the relationship between the number of years that school divisions have paid Advanced Placement exam fees and the number of Advanced Placement exams taken when factors including school size, socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?

3. What is the relationship between the number of years that school divisions have paid Advanced Placement exam fees and the average scores on Advanced Placement exams when factors including school size, socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?

4. What is the relationship between the number of years that school divisions have paid Advanced Placement exam fees and the percent of qualifying scores (3, 4, or 5) on Advanced Placement exams when factors including school size, socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?

5. What is the relationship between the number of years that school divisions have paid for Advanced Placement exam fees and the number of Advanced Placement science exams taken when factors including school size,

socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?

6. What is the relationship between the number of years number that school divisions have paid Advanced Placement exams fees and the average scores on Advanced Placement science exams when factors including school size, socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?

7. What is the relationship between the number of years that school divisions have paid for Advanced Placement exam fees and the percent of qualifying science scores (3, 4, or 5) on Advanced Placement exams when factors including school size, socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?

Sources of Data

Both primary and secondary data on Advanced Placement policies and enrollment in Advanced Placement courses were collected from school divisions and high schools in Virginia. Secondary data about Advanced Placement enrollment, College Board test and scores data, and high school demographic data were also provided by the Virginia Department of Education. Bringing data from several sources together allowed the examination of trends in Advanced Placement enrollment and average scores across the Commonwealth of Virginia and provided comparisons among

schools with similar demographic factors based on the number of years financial incentives had been offered.

Sample

The population for the study was Virginia high schools offering at least one Advanced Placement course. Although payment of Advanced Placement exam fees is typically a division level decision, the makeup of the student population of each high school within a division can be quite different which can markedly change the impact of the incentive. It is appropriate, therefore, to examine the impact on the high school level where other explanatory factors can be examined more closely.

The sample was nonprobability and purposive in nature in that the participating high schools have an Advanced Placement program in place. Table 1 lists the sample size and percent of schools included for each of the variables used in the study. Of the 325 comprehensive high schools for which the state of Virginia reports data on Advanced Placement enrollment, 300 schools (92%) from 105 divisions reported data all three years of the study and were included in the reports received by the state of Virginia from the College Board. Any school that did not report Advanced Placement enrollment data and/or were not included in the College Board reports for any of the three years were scrubbed from the dataset. The College Board data for the state of Virginia indicated that over the same time period, students from 215 schools (62%) took Advanced Placement science exams, however, only 194 schools had sufficient enrollment in Advanced Placement science courses (more than 10 students) to report average score data.

Table 1

Number and Percent of Schools Reporting on Each Variable

Variable	n	% of total sample
High Schools	300	100%
Years of exam fee payment	264	88%
Exam requirement reported	242	81%
% underserved students	300	100%
% eligible for free/reduced lunch program	292	97%
School size	300	100%
Achievement (average SOL scores)	298	99%
AP Enrollment 2007/08	298	99%
# AP tests taken, 2008	300	100%
# AP science tests taken, 2008	215	72%
Average AP scores, 2008	285	95%
Average AP science scores, 2008	194	65%
# Qualifying AP scores, 2008	300	100%
# Qualifying AP science scores, 2008	300	100%

Information on Advanced Placement exam fee payment policies were received from 264 schools representing 88% of the sample, 107 (41%) of these do not pay for Advanced Placement exam fees, and 152 schools (59%) pay for Advanced Placement

exam during the study period. Of the 300 schools in the study, responses from 242 schools on the policy of requiring students to take Advanced Placement exams indicated that 97 schools (40%) require students to take the exam, while the other 144 schools (60%) do not have this requirement.

The use of Virginia schools for the study was also purposive. Virginia ranks among the top states in the nation in the number of Advanced Placement exams taken by its students (College Board, 2008), so was of interest to determine how the enrollment in Advanced Placement courses is distributed throughout the state.

Variables & regression models

The explanatory variables and outcomes for each research question are outlined in Table 1 below. The linear regression model used for the student enrollment outcome was

$$E_1 = \iota + \phi_1 + \phi_2 + \phi_3 + \phi_4 + \phi_5 + \phi_6 + error$$

where

E_1 , ENROLL = the change in the number of students taking at least one Advanced Placement courses from the 2005/2006 school year to the 2007/2008 school year (year 3 minus year 1) as a ratio of the average high school enrollment.

ι , INCENTIVE = the number of years that financial incentives have been in place ranging from 0 to 10 years.

ϕ_1 , SIZE = size of the division measured as the average number of students in

the school over the three year period from 2006 to 2008

ϕ_2 , SES = socioeconomic status as indicated by the percent of students in the school that qualify for free or reduced-price lunch

ϕ_3 , *ACADEMICS* = the academic achievement of the students in the school as measured by the average percent of students passing the Virginia Standards of Learning tests in the school over the same three year time period

ϕ_4 , *MINORITY* = the size of the traditionally underserved Advanced Placement population measured as the percent of Black and Hispanic students enrolled at the school averaged over the same three year time period.

ϕ_5 , EXAMREQ = whether the Advanced Placement exam was required or optional for the students at the school.

ϕ_6 , ENROLL 05/06 = the Advanced Placement enrollment at the beginning of the study period, the first year examined in the study

error, sum of squares error/degrees of freedom

The linear regression model for the exams taken outcome variable is

$$E_2 = \iota + \phi_1 + \phi_2 + \phi_3 + \phi_4 + \phi_5 + \phi_6 + \phi_7 + error$$

where

E_2 , TESTS = the number of Advanced Placement exams taken in 2008 as reported to the Virginia Department of Education by the College Board.

The explanatory variables are the same as in outcome E_1 except for ϕ_7 , TESTS06, the number of Advanced Placement tests taken in 2006, the first year examined in the study.

The linear regression model for the average scores outcome variable is

$$E_3 = \iota + \phi_1 + \phi_2 + \phi_3 + \phi_4 + \phi_5 + \phi_8 + error$$

where

E_3 , SCORES = the average exam scores for the 2007/2008 exam period.

The explanatory variables are the same as in outcome E_1 except for ϕ_8 , SCORES06 = the average exam score in 2006, the first year examined in the study.

The linear regression model for the average scores outcome variable is

$$E_4 = \iota + \phi_1 + \phi_2 + \phi_3 + \phi_4 + \phi_5 + \phi_9 + error$$

where

E_4 , QUALSCORE = the percent of exam scores in 2008 with scores of 3, 4, or 5.

The explanatory variables are the same as in outcome E_1 except for ϕ_9 , QUALSCORE06 = the average exam score in 2006, the first year examined in the study.

The last three indicators in phase I examine the number of students taking Advanced Placement science exams and average Advanced Placement science exam scores, and the number of qualifying science scores earned in 2008. The linear regression model for the science exam takers outcome variable is

$$E_5 = \iota + \phi_1 + \phi_2 + \phi_3 + \phi_4 + \phi_5 + \phi_{10} + error$$

where

E_5 , SCITESTS = the Advanced Placement science exams taken in 2008.

The explanatory variables are the same as in outcome E_1 except for ϕ_{10} , SCITESTS06 = the number of Advanced Placement science exams taken in 2006, the first year examined in the study.

The linear regression model for the science exam scores outcome variable is

$$E_6 = \iota + \phi_1 + \phi_2 + \phi_3 + \phi_4 + \phi_5 + \phi_{11} + error$$

where

E_6 , SCISCORES = average scores on Advanced Placement science exams in 2008.

The explanatory variables are the same as in outcome E_1 except for ϕ_{11} , SCISCORES06, the average scores on Advanced Placement science exams in 2006.

The linear regression model for the qualified science scores outcome variable is

$$E_7 = \iota + \phi_1 + \phi_2 + \phi_3 + \phi_4 + \phi_5 + \phi_{12} + error$$

where

E_7 , QUALSCISCORE = the percent of exam scores in 2008 with scores of 3, 4, or 5.

The explanatory variables are the same as in outcome E_1 except for ϕ_{12} , QUALSCISCORE06 = the average exam score in 2006, the first year examined in the study.

The reliability of Advanced Placement exam scores has been evaluated by Bridgeman, Morgan and Wang (1996). The reliability of each component (multiple choice and free response) was measured individually, the multiple choice component using Kuder-Richardson formula 20 and the free response section using Coefficient alpha. The composite reliability for each exam was calculated by combining the component reliabilities. The composite reliability ranged from 0.87 for the AP Psychology exam to 0.94 for the AP German Language exam. Additionally, recommendations for improving the reliability of the exam scores, including increasing the number of free response essays and increasing grader training, have been implemented since this evaluation was made. Therefore, Advanced Placement exam scores are a reliable measure of student success in these courses.

Phase II

Research Questions

The two research questions for phase II are

8. What is the relationship between the number of years that school divisions have paid for Advanced Placement exam fees and the number of students enrolled in each individual Advanced Placement course when factors including school size, socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?
9. What is the relationship between the number of years that school divisions have paid for Advanced Placement exam fees and the number of students in each class taking Advanced Placement exams when factors including school

size, socioeconomic status, academic achievement, and the size of the traditionally underserved minority population are considered?

Sample

The sample used to examine student enrollment by course was a subset of Virginia school divisions that have kept data on individual course enrollment by high school over the past three years from 2006 through 2008. This differs from the enrollment statistic that the Virginia Department of Education requires divisions to report, which is the number of students enrolled in at least one Advanced Placement course, a statistic that does not account for students taking multiple Advanced Placement courses. Knowing individual course enrollment and comparing that to the number of students that take the Advanced Placement exam in that course is a good indicator of the impact of using division resources to pay the exam fees for the students. However, only a small number of school divisions keep this data over three years, so the high schools in those school divisions who agreed to provide the data, made up the sampling population for this part of the analysis.

Variables & regression models

The regression model for the course enrollment outcome variable is

$$O_i = \alpha + \phi_1 + \phi_2 + \phi_3 + \phi_4 + \phi_5 + \phi_6 + error$$

where

O_i , COURSE = the course enrollment in Advanced Placement courses in the 2007/2008.

Explanatory variables are the same as in Phase I above.

The regression model for the Advanced Placement exams outcome variable is

$$O_2 = \iota + \phi_1 + \phi_2 + \phi_3 + \phi_4 + \phi_5 + \phi_6 + error$$

where

O_2 , RATIOTEST = the ratio of Advanced Placement tests taken by Advanced Placement course enrollment for 2008.

Explanatory variables are the same in Phase I as above except for ϕ_6 , RATIOTEST06 = the ratio of Advanced Placement tests taken by Advanced Placement course enrollment for 2006.

Table 2

Variables by Research Question

Research Questions	Variables	Variable name	Operational Definition	Type	
Phase I & II All	Explanatory variable	INCENTIVE	Number of years with financial incentive	Continuous	
		School level factors	SIZE	School size = Average student enrollment over three years from 2006-2008	Continuous
			SES	Socioeconomic Status = % students eligible for free or reduced lunch program	Continuous
			ACADEMICS	Academic achievement = Average percentage of students passing the Virginia SOL test	Continuous
			MINORITY	Size of underserved ethnic groups = % Black and Hispanic students of total school enrollment	Continuous
Phase I 1 2 3 4 5 6 7	Outcome variables	EXAMREQ	Students required to take AP exam (Y/N)	Dichotomous	
		ENROLL	Enrollment in AP courses in 2007/08	Continuous	
		TESTS	Number of AP tests taken in 2007/08	Continuous	
		SCORES	Average scores on AP exams 2007/08	Continuous	
		QUALSCORE	Percent of qualifying scores (3, 4, or 5) on 2008 AP exams	Continuous	
		SCITESTS	Number of AP science exams taken in 2008	Continuous	
		SCISCORES	Average scores on AP science exams 2007/08	Continuous	
QUALSCISCORE	Percent in qualifying AP scores of 3, 4, or 5 on exams	Continuous			

Phase II				
1	Outcome Variables	COURSE	AP course enrollment 2008	Continuous
2		RATIOTESTS	Ratio of AP tests taken to AP course enrollment 2008	Continuous

Procedure

The viability and size of the sample was identified using a short electronic survey which was emailed to 134 school division superintendents in the state of Virginia. The survey requested information on whether a financial incentive is offered for Advanced Placement exams and if so, the form of the incentive. The choices given were paying the exam fee, paying cash incentive to students based on the score on the exam, paying financial incentives to Advanced Placement teachers, and other. Respondents were given the opportunity to check all that apply and to expand on the “other” designation. A copy of the survey is attached as Appendix 1.

An updated second survey was sent via email to the principals and/or guidance directors at each high school in Virginia to elaborate on the financial incentive policy at the school. A copy of this survey is attached in Appendix 2.

Institutional Review Board approval was applied for on April 27, 2009 and received on August 11, 2009. Requests were then sent to all Virginia school division superintendents via email for approval to survey school personnel. Division level reviews were required and completed for 15 of the school divisions. Emails to school principals and/or guidance directors were sent as approvals were received from the division offices. Follow up emails were used from both the first survey and the second

survey to improve response rate and to retrieve missing information from the initial response.

The Virginia Department of Education was contacted and agreed to provide school level data including school enrollment for the three year period to be examined, the percent of students qualifying for free or reduced-price lunch programs, the Standards of Learning (SOL) End-of-Course (EOC) test scores for the school, and the percent of African American and Hispanic students served by the school. The Virginia Department of Education also provided total student enrollment by school, the number of Advanced Placement exams taken by students in each school by subject, and the average scores on Advanced Placement exams by subject for each school for the three years beginning in the 2005-2006 school year and ending in the 2007-2008 school year, data which were compiled by the College Board.

Information was gathered from Virginia public high schools by means of a short electronic survey using Quia, an on-line teacher aid. The data collected from the high schools included whether Advanced Placement exam fees are paid for by the division or school, the year in which that policy was instituted, any additional types of financial incentives that are offered, whether the incentives are offered to students, teachers or both and whether students are required to take the Advanced Placement exams in courses in which they are registered. Additional data to be gathered include grade-point incentives awarded for Advanced Placement courses and Advanced Placement recruitment and enrollment policies. In addition, the division research offices were

contacted to request access to the Advanced Placement student enrollment data by course for the three years from 2006 to 2008.

The information received from all sources was organized in Excel spreadsheets where the data were matched, calculations made to determine average school size, average SOL test scores, percent of students eligible for free or reduced lunch programs, percent of Black and Hispanic students in the school population. Missing data in enrollment, average scores, and percent qualifying scores were assumed to be the average of the data for that school from years that were reported. Schools with fewer than 10 exams on any Advanced Placement exam were not reported by the state. Based on the recommendation of the personnel at the Department of Education, random numbers between one and nine were generated for these schools to approximate the Advanced Placement exams taken. Forty five percent of the courses offered in Virginia public schools result in ten or fewer students sitting for the Advanced Placement exams at the culmination of the course.

These data were then transferred to SPSS version 17 where data analysis was conducted and appropriate reports were generated. All school and division names were coded and no identifying information was included in the reports generated from the study.

Data Analysis

Descriptive statistics were generated for each variable to determine the size of the sample, the mean and standard deviation for each outcome variable. Paired t-tests

were used to determine the change in each outcome variable from the 2005/06 school year to the 2007/08 school year.

Analysis of Variance (ANOVA) was used to compare means and establish associations between variables. Statistically significant results were then analyzed using Tukey and Bonforoni post hoc tests. Hierarchical regression analyses were performed on each of the outcome variables as outlined above with the principle explanatory variable, years that Advanced Placement exam fees have been paid (1), being entered after the outcome variable from 2005/2006 (ϕ_6) through (ϕ_{12}), which was used to evaluate the change in the outcome over the three years examined in the study, and the preexisting school based explanatory variables, school size (ϕ_1), socioeconomic status (ϕ_2), student achievement (ϕ_3) and ethnicity (ϕ_4). The exam requirements (ϕ_5) was entered after the payment variable. Each demographic variable was entered individually to determine which variables contributed most significantly to the model. These variables were then entered in sequence based on that contribution. Hierarchical regression modeling was added to the analysis because it allowed the researcher to determine the levels in which the data were entered into the model (Stockburger, 1998).

The original outcome variable, the ratios of the outcome in 2008 to the same outcome in 2005, resulted in no meaningful contributions from any of the explanatory variables regardless of the order in which the variables were entered into the model. Therefore, the outcomes were changed to the values from 2007/08 and the matching

outcomes from 2005/06 were then added as an explanatory variable to each model. These variables resulted in statistically significant models, but the size of the contributions from the 2005/06 outcomes, which was at least 48% if no other variable was present, overwhelmed any small contributions from the other explanatory variables regardless of the order in which the variables were entered.

Limitations

Some possible limitations of the study include factors that could affect the Advanced Placement enrollment or scores earned on Advanced Placement exams in unpredictable ways. Possible factors would include changes in teachers for Advanced Placement courses, changes in the Advanced Placement “gate keeping” process for enrollment in Advanced Placement, or the addition or removal of Advanced Placement courses. Advanced Placement teachers are typically well known within a school, so a teacher’s reputation as being “easy”, for example, could increase enrollment but have a negative effect on scores, or the reverse could be true. A new teacher in an Advanced Placement course is an unknown factor that can affect scores or enrollment in ways that are impossible to predict. Gate keeping by teachers and guidance counselors, which sets required grade or course minimums before a student is recommended or permitted to register for an Advanced Placement course, has been routine (Finn & Winkler, 2009). Any changes in the policies for enrollment in Advanced Placement courses could significantly change the course enrollment or average scores from one year to the next. Finally, significant changes in Advanced Placement enrollment can come from redistricting across a division or the opening of a new school within a division. These

changes may offset each other across a state with over 300 high schools, but there is no way to insure these factors are not threatening the validity of the study.

Researcher prospective

As a high school science teacher and a department chairperson who has spent the past fifteen years working largely with high school students and fellow teachers, I have developed a passion for the process of engaging students in learning. I have used whatever tools, tricks, and treats I can find to keep my students involved in their learning and striving for deeper understanding. Additionally, I spend considerable time sharing what I have learned with other teachers so more students can find that love of learning that so often eludes them in high school. I have spent nine of my fifteen years teaching an Advanced Placement science course, either Advanced Placement Biology or Advanced Placement Chemistry, and have witnessed firsthand the policy change from having students pay for their Advanced Placement exam fees to payment of the exam fees by the school division.

The goals of this policy change in my school division were two-fold: first, to increase overall enrollment in Advanced Placement courses in the division and second, to be able to require students who are in Advanced Placement courses to take the end-of-course exam in May. Both of these are positive goals for the students, so I became interested to see what the results of the policy change would be.

Although I only witnessed two years of the new policy in my own classroom, I had seen no change in either enrollment or average scores. I thought this might have

something to do with the fact that Advanced Placement Chemistry is considered to be among the most rigorous of the courses and exams sponsored by the College Board. Since many students find Chemistry to be very difficult anyway, they would be unlikely to attempt the Advanced Placement Chemistry course but might try an Advanced Placement course in another subject. It was through a conversation with my principal about this that led me to the idea of investigating the use of financial incentives as my dissertation topic. This information will enable administrators to make decisions on the future use of financial incentives in the face of a slowing economy and possibly severe budget cuts.

CHAPTER 4

FINDINGS

This study was conducted to determine the impact of Virginia school divisions' policy of paying the fee for students to take Advanced Placement exams on: (1) Advanced Placement course enrollment, (2) the number of Advanced Placement exams taken by students, (3) the average scores earned on Advanced Placement exams, and (4) the percent of students earning qualifying scores (exam scores of 3, 4, or 5) over the 3 year period from the 2005/2006 school year to the 2007/2008 school year. A second goal of the study was to examine the relationship that paying for Advanced Placement exams fees by Virginia school divisions had specifically on: (1) the number of Advanced Placement science (Biology, Chemistry and Physics B and C) exams taken, (2) the average science exam scores and (3) the percent of qualifying science scores earned.

The number of schools that pay the Advanced Placement exam fees for students has steadily increased over the past eight years, from 14.6% in 2001 to 59.7% in 2008 as detailed in Table 3. The findings in this chapter describe the impact of paying Advanced Placement exam fees for each of seven research questions. The school-level demographic factors considered were: (1) school size, measured as the average school

enrollment over the three year study period; (2) socioeconomic status, measured by the percent of students eligible for free or reduced lunch programs; (3) ethnicity, measured as the percent of African American and Hispanic students in the student body over the three year study period; and (4) school achievement, measured by the percent of students passing the Standards of Learning tests over the three year study period.

Table 3

Number of Virginia High Schools Paying AP Exam Fees by Year

Year	Number of schools w/exam payment policy	% of total HS
2000/2001	37	14.6
2001/02	46	18.2
2002/03	61	24.1
2003/04	82	32.4
2004/05	97	38.3
2005/06	108	42.7
2006/07	117	46.2
2007/08	151	59.6

Advanced Placement enrollment

Advanced Placement enrollment is defined by the state of Virginia as the number of students who are enrolled in at least one Advanced Placement course. Table

4 addresses the question of whether there are differences in Advanced Placement enrollment over the three year period examined in the study using paired t-tests to compare year to year ('05 to '06, and '06 to '07) as well as the total change over the course of the study ('05 to '07). The means did increase from 177.86 in 2005 to 197.88 in 2006 and again to 204.55 in 2007. This represents a 15.0% ($SD = 78.537$) increase in means over the three years examined by the study.

Table 4

Paired t-tests on AP Enrollment by Year

Enrollment year	Mean	N	Mean Difference	Std. Deviation	Mean Error	t	Sig.
2007/08 2005/06	204.55 177.86	286	26.692	78.537	6.270	5.748	.000
2007/08 2006/07	204.55 197.88	286	6.671	44.033	2.604	2.562	.011
2006/07 2005/06	197.88 177.86	286	20.021	61.965	3.664	5.464	.000

This result then raises the question, is Advanced Placement enrollment related to the payment of exam fees? Table 5 details the comparison of means that addresses this question and indicates that schools that paid exam fees in 2008 had 71.4% higher Advanced Placement enrollment than schools that did not pay these fees, a statistically significant difference ($F = 14.579, p = .000.$) but with little practical significance ($eta^2 = .055$).

Table 5

AP Enrollment by Payment/Nonpayment of Exam Fees

Enrollment 2007/08	Mean	N	Std. Deviation	Mean Difference	F	Sig.
w/ fee paid	264.03	151	268.312	110.02	14.579	.000
w/o fee paid	154.01	102	136.744			

(eta² = .055)

Since enrollment was higher in schools when fees were paid the next question to ask is whether Advanced Placement enrollment grew at different rates for schools that paid exam fees verses those that did not. To answer this question, paired t-tests were run on the data set split by whether schools had paid exam fees or not. The results, detailed in Table 6, indicate that both groups grew Advanced Placement enrollment significantly over the period from 2005/2006 to 2007/2008, though there was no difference in the growth based on the payment of exam fees. Schools that paid exam fees grew enrollment by 15.7% ($t = 4.572, p = .000$) while schools that did not pay exam fees grew Advanced Placement enrollment by 16.0% ($t = 3.985, p = .000$) over the same period.

Table 6

Paired t-tests on AP Enrollment by Payment of Exam Fees

Enrollment year	Mean	N	Mean Difference	Std. Deviation	Std. Mean Error	t	Sig.
Fees paid							
2007/08	264.03	151	35.914	96.524	7.855	4.572	.000
2005/06	228.12						
No fees paid							
2006/07	197.88	102	21.255	53.868	5.334	3.985	.000
2005/06	177.86						

To further examine the relationship of fee payment and Advanced Placement enrollment, the number of years the exam fees had been paid was evaluated by dividing the fee payment variable into three groups: schools that did not pay exam fees, schools that paid exam fees for one to three years, meaning the fee payment policy was instituted during the years examined in the study, and schools that paid exam fees for four or more years, meaning that fee payment had been in place prior to the years examined in the study. An ANOVA was run on the Advanced Placement enrollment for 2007/08, the final year in the study since the number of years that schools have paid the exam fees is calculated as of 2007/08. The results, shown in Table7 indicate that there is a significant difference between schools that have paid exam fees for four or more years and both schools that paid exam fees for one to three years and schools that did not pay exam fees ($F(2,250) = 17.025, p = .000$), but no significant difference

between schools that paid fees for one to three years and schools that did not pay exam fees.

Table 7

ANOVA on AP Enrollment by Years Exam Fees Paid

Years paying exam fee	Mean Enrollment	Mean Difference	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
0	154.01				
1-3	162.17				
4+	320.74				
0	1-3	-8.157	36.586	-96.34	80.02
	4+	-166.732*	30.831	241.04	-92.42
4+	0	166.732*	30.831	92.42	241.04
	1-3	158.576*	36.911	69.61	247.54

(*significant at $p < .05$)

Now that it has been determined that those schools in which exam fees have been paid for four or more years are more likely to have higher enrollment than schools that paid for one to three years or than schools that did not pay for exam fees, the impact of other school-level influences on enrollment in Advanced Placement courses was investigated. For this investigation, a hierarchical regression was run, the results of which are detailed in Table 8. The regression equation which includes all of the variables for the model is

$$E_i = H\phi_6 + A\phi_1 + B\phi_2 + C\phi_3 + D\phi_4 + F1 + G\phi_5 + e,$$

where $E_i = 07/08$ enrollment in Advanced Placement courses

H = 05/06 enrollment in Advanced Placement courses

A = average school enrollment

B = percent of students eligible for free or reduced-price lunch program

C = percent of students passing SOL end-of-course exams

D = percent of Black and Hispanic students

F = number of years exam fees were paid

G = Advanced Placement exam required where 1 = yes and 0 = no.

and e = error.

Table 8

Relationship of AP Enrollment by School-Level Variables

	B	SEB	Beta	R ²	ΔR ²	Sig.
Step 1 H 05/06 Enrollment	.911	.039	.809	.871	.871	.000
Step 2 A Size	.021	.012	.064	.887	.004	.000
Step 3 B SES	-2.175	.523	-.129	.891	.016	.006
Step 4 C Achievement	-.178	1.557	-.003	.891	.000	.734
Step 5 D Ethnicity	-.093	.324	-.009	.892	.000	.898
Step 6 F Fees paid	-.576	2.168	-.008	.896	.001	.268
Step 7 G Exam required	39.837	12.997	.082	.880	.004	.002

(N = 226)

The full model, $R^2 = .880$, $F(7, 218) = 269.042$, $p = .000$ is statistically significant, however the results indicate that the only variable that contributed meaningfully to the outcome was the 2005/2006 Advanced Placement enrollment, $R^2 = .871$, $F(1, 224) = 1516.532$, $p = .000$. Hierarchical regressions run on the percent change in enrollment using the same school-level factors was significant, $F(6, 219) = 4.115$, $p = .001$, however the R^2 for the complete model was only .101, and none of the individual factors contributed meaningfully to the result.

Advanced Placement Exams Taken

The number of Advanced Placement exams taken increased significantly each year from 2005/06 through 2007/08 as would be expected from the increase in Advanced Placement enrollment seen previously. Table 9 details the paired t-tests which indicate an increase in the number of Advanced Placement exams taken of 24.2% (SD = 208.732) over the three year period.

Table 9

Paired t-tests on Number of AP Exams Taken by Year

Year Exams Taken	Mean	N	Mean Difference	Std. Deviation	Std. Mean Error	t	Sig.
2007/08 2005/06	467.28 376.12	286	91.157	208.732	12.343	7.386	.000
2007/08 2006/07	467.28 426.80	286	40.483	93.351	5.520	7.334	.000
2006/07 2005/06	426.80 376.12	286	50.675	152.625	9.025	5.4615	.000

This result raises the question of whether the payment of exam fees produced differences in the number of Advanced Placement exams taken. To answer this question, a comparison of means was run on the number of Advanced Placement exams taken in 2007/08 for schools that paid exam fees verses those that do not. The results, detailed in Table 10, indicates that 135% more Advanced Placement exams were taken in schools that paid exam fees ($F(1, 251) = 19.108, p = .000, \eta^2 = .071$) however the groups were not homogeneous, violating an assumption of an ANOVA (Welch statistic

= 25.577, $p = .000$), and the low measure of association ($\eta^2 = .071$) might indicate an increase in the possibility of Type I error.

Table 10

Number of AP Exams Taken by Exam Fee Payment

Exams Taken 2007/08	Mean	N	Std. Deviation	Mean Difference	F	Sig.
w/ fee paid	656.44	151	830.115	376.80	19.108	.000
w/o fee paid	279.64	102	317.373			

($\eta^2 = .071$)

Additionally, these results must be considered based on the enrollment size of schools that pay exam fees. Table 11 details the breakdown of schools that pay exam fees by school enrollment and indicate that larger schools are much more likely to pay exam fees than smaller schools. Only 39.13% of schools in the lowest quartile by school enrollment pay exam fees while 75% of schools in the highest quartile by school enrollment pay those fees.

Table 11

Percent of Schools Paying Exam Fees by School Enrollment

School enrollment (by quartile)	% schools that pay exam fees
≤ 628	39.13
629 – 1204	51.52
1205 – 1784	65.22
1785+	75.00

When normalizing the number of Advanced Placement exams taken by the size of the school enrollment, a very different picture of exams taken emerges. The comparison of means detailing these results is shown in Table 12. In small schools with an enrollment of 1204 or fewer, there is no difference in the number of Advanced Placement exams taken between schools that pay exam fees and those that do not, while in larger schools with enrollment above 1204, the difference is significant ($F = 4.247, p = .043$ & $F = 4.326, p = .041$)

Table 12

AP Exams Taken by School Enrollment

Avg. enrollment		Mean AP exams taken	Std. Deviation	F (sig.)
≤ 628	no fees paid	62.93	52.848	.635 (.430)
	fees paid	47.39	79.624	
629-1204	no fees paid	220.59	240.635	.089 (.767)
	fees paid	201.53	276.452	
1205-1784	no fees paid	340.38	281.392	4.247 (.043)
	fees paid	690.44	803.985	
1785+	no fees paid	640.72	392.555	4.326 (.041)
	fees paid	1117.54	942.161	

Since the number of Advanced Placement exams taken was higher in schools that paid exam fees for their students, the next question to ask is if the number of exams taken grew faster for these schools as well. To answer this question, the number of Advanced Placement exams taken in 2005/06 was subtracted from the exams taken in

2007/08 to produce a new outcome variable which was used in the comparison of means detailed in Table 13. This result indicates that growth in schools that paid exam fees was significantly higher than in schools that did not pay exam fees ($F(1, 251) = 10.313, p = .001$).

Table 13

Change in Number of AP Exams by Fee Payment

Exams Taken 2007/08	Mean	N	Std. Deviation	Mean Difference	F	Sig.
w/ fee paid	133.3311	151	260.0323	87.9193	10.313	.001
w/o fee paid	45.4118	102	112.8800			

($\eta^2 = .039$)

The next question that was asked is whether there is a relationship between the number of years that exam fees were paid and the number of Advanced Placement exams that were taken. An ANOVA run on the exams taken in 2007/08 based on the number of years exam fees were paid divided into three levels; 1) fees not paid, 2) fees paid 1 to 3 years and 3) fees paid for four or more year, is shown in Table 14. As with Advanced Placement enrollment, the number of Advanced Placement exams taken is significantly larger in schools that have paid exam fees for four or more years, while no significant difference is seen between schools that paid exam fees for one to three years and schools that did not pay exam fees ($F(2,250) = 20.177, p = .000$). This once again

indicates that it takes several years of exam payment to reap the rewards in both increased enrollment and increased number of Advanced Placement exams taken.

Table 14

ANOVA on Number of AP Exams Taken by Years

	Years paying exam fee	Mean	Mean Difference	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
2007	0	279.64				
	1-3	341.50				
	4+	831.76				
	0	1-3	-61.863	109.170	-324.98	201.26
		4+	-552.126*	91.998	-773.86	-330.39
	4+	0	552.126*	91.998	330.39	773.86
		1-3	490.263*	110.139	224.81	775.72

(*significant at $p < .05$)

Once it has been determined that those schools that paid exam fees had significantly higher number of Advanced Placement exams taken than schools that did not pay exam fees, the investigation then turned to the impact of other school-level influences on the number of Advanced Placement exams taken. For this investigation, a hierarchical regression was run, the results of which are detailed in Table 15. The regression equation which includes all of the variables for the model is

$$E_2 = H\phi_7 + A\phi_1 + B\phi_2 + C\phi_3 + D\phi_4 + F1 + G\phi_5 + e,$$

where E_2 = number of Advanced Placement exams taken in 07/08

H = number of Advanced Placement exams taken in 05/06

A = average school enrollment

B = percent of students eligible for free or reduced-price lunch

C = percent of students passing SOL end-of-course exams

D = percent of Black and Hispanic students

F = number of years exam fees were paid

G = Advanced Placement exam required where 1 = yes and 0 = no.

and e = error.

The full model was statistically significant, $F(7, 218) = 396.280, p = .000$, though the only variable that contributed meaningfully to the outcome was the number of Advanced Placement exams taken in 2005/2006, $R^2 = .914, F(1, 224) = 2377.437, p = .000$. Regression analysis on the percent change in the number of Advanced Placement exams taken from 2005/06 to 2007/08 with the same school-level factors was significant, $F(6, 219) = 2.358, p = .032$, however the R^2 for the full model was only .061 indicating no meaningful contribution by the school-level factors.

Table 15

Relationship of Number of AP Exams by School-Level Variables

	B	SEB	Beta	R ²	ΔR^2	Sig.
Step 1 H 05/06 AP Exams Taken	1.038	.030	.882	.914	.914	.000
Step 2 A Size	.030	.027	.030	.916	.002	.039
Step 3 B SES	-4.250	1.333	-.083	.924	.008	.000
Step 4 C Achievement	2.333	3.941	-.014	.924	.000	.451
Step 5 D Ethnicity	-.264	.823	-.008	.924	.000	.785
Step 6 F Fees paid	-1.893	5.621	-.008	.924	.000	.351
Step 7 G Exam required	95.786	33.099	.065	.927	.003	.004

(N = 225)

Advanced Placement Science Exams Taken

The number of Advanced Placement science exams taken increased over the three years from an average of 34.30 in 2005/06 to 41.71 in 2007/08, an increase of 22.5%, just slightly less than the overall increase in Advanced Placement exams taken over that time period. The increase in science exams taken was significant year to year as well as over the three year period examined in the study as seen in Table 16.

Table 16

Paired t-tests on Number of AP Science Exams by Year

Year Exams Taken	Mean	N	Mean Difference	Std. Deviation	Std. Mean Error	t	Sig.
2007/08 2005/06	41.71 34.30	286	7.409	27.633	1.634	4.534	.000
2007/08 2006/07	41.71 38.92	286	2.797	17.601	1.041	2.688	.008
2006/07 2005/06	38.92 34.30	286	4.612	20.093	1.188	3.882	.000

To determine if the number of Advanced Placement science exams taken was different for schools that paid for exam fees than schools that did not, a comparison of means was run, the results of which are detailed in Table 17. Schools that pay exam fees gave 85.5% more Advanced Placement science exams than schools that did not pay the fees. The result is significant ($F(1, 251) = 4.947, p = .027$) though the η^2 is only .019 implying that the association between the payment of fees and the number of Advanced Placement science exams taken may not appear to be as strong as the result indicates. This is once again due to the fact that 75% of schools with high enrollment (over 1785 students) pay exam fees while only 39% of schools with low enrollment (less than 628) do so.

Table 17

Number of AP Science Exams by Fee Payment

Exams Taken 2007/08	Mean	N	Std. Deviation	Mean Difference	F	Sig.
w/ fee paid	55.19	151	109.924	25.44	4.947	.027
w/o fee paid	29.75	102	42.800			

($\eta^2 = .019$)

To determine if the growth in the number of science exams taken was different for schools that paid exam fees than for schools that did not over the three years from 2005/06 to 2007/08, the percent change in science exams taken was calculated and a comparison of means run based on whether exam fees had been paid or not. The change in the number of Advanced Placement exams taken in schools that paid exam fees (49.3030, SD = 182.37) was not significantly different from that of schools that did not pay exam fees (54.57, SD = 156.93), $F(1, 191) = .043, p = .836$.

The next question asked was whether the number of years that exam fees had been paid related to the number of Advanced Placement science exams taken. The ANOVA run on the data divided into three levels, exam fees not paid, exam fees paid for one to three years, and exam fees paid for four or more years produced similar results to those of total number of exams taken. Schools that have paid exam fees for four or more years had significantly higher number of Advanced Placement science exams taken than either schools that did not pay exam fees and schools that paid those fees for one to three years ($F(2, 250) = 5.980, p = .003$). These results are detailed in

Table 18.

Table 18

ANOVA on Number of AP Science Exams by Years Fees Paid

	Years paying exam fee	Mean	Mean Difference	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
2007	0	29.75				
	1-3	29.96				
	4+	69.23				
	0	1-3	-.208	14.840	-35.98	35.56
		4+	-39.472*	12.506	-69.61	-9.33
	4+	0	39.472*	12.506	9.33	69.61
		1-3	39.264*	14.972	3.18	75.35

(*significant at $p < .05$)

The question of whether the school level influences related significantly to the number of Advanced Placement science exams taken was addressed next with hierarchical regression analyses as detailed in Table 19. The regression equation which includes all variables is

$$E_5 = H\phi_7 + A\phi_1 + B\phi_2 + C\phi_3 + D\phi_4 + Ft + G\phi_5 + e,$$

where E_5 = number of Advanced Placement science exams taken in 07/08

H = number of Advanced Placement science exams taken in 05/06

A = average school enrollment

B = percent of students eligible for free or reduced-price lunch

C = percent of students passing SOL end-of-course exams

D = percent of Black and Hispanic students

F = number of years exam fees were paid

G = Advanced Placement exam required where 1 = yes and 0 = no.

and e = error.

The full model is significant, $F(7, 218) = 375.666, p .000$, however only the science exams taken in 2005/06 contribute meaningfully to the model, $F(1, 225) = 2564.071, p = .000$. Hierarchical regression analysis on the percent change in number of Advanced Placement science exams taken was significant when all school factors were included ($F(6, 170) = 2.645, p = .018$) however the R^2 for the full model was only .085 indicating no meaningful relationships exist.

Table 19

Relationship of Number of AP Science Exams by School-Level Variables

	B	SEB	Beta	R ²	ΔR^2	Sig.
Step 1 H 05/06 AP Science Exams Taken	1.108	.026	.929	.920	.920	.000
Step 2 A Size	.005	.003	.037	.921	.001	.090
Step 3 B SES	-.135	.178	-.020	.922	.002	.030
Step 4 C Achievement	.098	.527	.004	.922	.000	.666
Step 5 D Ethnicity	-.141	.109	-.033	.923	.000	.267
Step 6 F Fees paid	-.250	.723	.008	.923	.000	.839
Step 7 G Exam required	5.594	4.418	.029	.923	.001	.207

(N = 177)

Average scores on Advanced Placement exams

No significant change was seen in the average scores on Advanced Placement exams between the three years from 2005/06 to 2007/08. The mean score in 2007/08 was 2.66335 (SD = .64313) compared to 2.6287 (SD = .65505) in 2005/06. To determine if the payment of exam fees by a school division produced significant differences in the average scores on Advanced Placement exams, a comparison of

means was run on the 2007/08 average scores. The average scores for schools that paid exam fees was 2.5932 (SD = .66614), compared to the mean of 2.7283 (SD = .59607) for schools that did not pay exam fees but this was not a statistically significant difference ($F(1,245) = 2.651, p = .105$).

The data were then divided into three groups to determine if the number of years that exam fees had been paid produced differences in the average scores on Advanced Placement exams. An ANOVA run on average scores for 2007/08 divided into three groups, schools that did not pay exam fees, schools that paid exam fees from one to three years, and schools that paid exam fees for four or more years, exhibited a significant difference as seen in Table 20. Schools that did not pay exam fees had a significantly higher average scores than schools that paid exam fees for one to three years ($F(2, 244) = 3.949, p = .021$) though no significant difference was seen when compared to schools that paid fees for four or more years.

Table 20

ANOVA on Average Scores on AP Exams by Years Fees Paid

	Years paying exam fee	Mean	Mean Difference	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
2007/08	0	2.7283				
	1-3	2.4342				
	4+	2.6819				
	0	1-3	.29412*	.10784	-96.34	80.02
		4+	.04636	.09100	241.04	-92.42
	4+	1-3	.24777	.10863	.070	-.0141

(*significant at $p < .05$)

Similarly, the change in average scores, calculated by subtracting the average score from 2005/06 from that of 2007/08, produced a significant change in scores when the data, divided as above, are examined. However in this case, the significant increase in average scores was seen between the schools that had paid exam fees for four or more years and the schools that had paid fees from one to three years ($F(2, 244) = 3.673, p = .027$) as detailed in Table 21.

Table 21

ANOVA on Change in Average Scores on AP Exams by Years Exam Fees Paid

	Years paying exam fee	Mean Change Score	Mean Difference	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
2007/08	0	-.0111				
	1-3	-.1753				
	4+	.0478				
Within subjects	0	1-3	.16416	.08235	-.0343	.3627
		4+	-.05893	.06949	-.2264	.1086
	4+	1-3	.22310*	.08295	.0231	.4231

(*significant at $p < .05$)

To determine if there was a relationship between average scores on Advanced Placement exams and other school-level influences, a hierarchical regression was run, the results of which are detailed in Table 22. The regression equation which includes all of the variables for the model is

$$E_3 = H\phi_6 + A\phi_1 + B\phi_2 + C\phi_3 + D\phi_4 + F\phi_1 + G\phi_5 + e,$$

where E_3 = average score in 07/08 Advanced Placement exams

H = average score in 05/06 Advanced Placement exams

A = average school enrollment

B = percent of students qualified for free or reduced-price lunch

C = percent of students passing SOL end-of-course exams

D = percent of Black and Hispanic students

F = number of years exam fees were paid

G = Advanced Placement exam required where 1 = yes and 0 = no.

and e = error.

The full model is statistically significant, $R = .473$, $F(7, 212) = 27.504$, $p = .000$, however only the average scores from 2005/06 contribute significantly to the model, $R^2 = .414$, $F = 154.064$, $p = .000$. Hierarchical regressions run on the percent change in average scores with the same group of school-level factors was not significant, $F(6, 213) = 1.922$, $p = .079$.

Table 22

Relationship of Average Scores on Advanced Placement Exams by School Level Variables

	B	SEB	Beta	R ²	ΔR ²	Sig.
Step 1 H 05/06 Average Scores	-.552	.062	.525	.414	.414	.000
Step 2 A Size	4.009E-5	.000	.052	.414	.000	.735
Step 3 B SES	-.003	.003	-.076	.444	.030	.001
Step 4 C Achievement	-.017	.009	.118	.462	.018	.008
Step 5 D Ethnicity	-.004	.002	-.135	.472	.010	.044
Step 6 F Fees paid	.012	.013	.064	.473	.001	.576
Step 7 G Exam required	-.087	.076	-.070	.476	.003	.254

(N = 226)

Average scores on Advanced Placement science exams

To determine the difference in average scores on Advanced Placement science exams over the three year period examined in the study, paired t-tests were run on the average science scores for 2007/08 and 2005/06. The average scores on Advanced Placement science exams decreased significantly from 2.7045 in 2005/06 to 2.4682 in 2007/08 (N = 199, t = -4.207, p = .000). When the paired t-tests were split based on

whether schools paid for exam fees or not, a significant decrease was seen in schools that do not pay exam fees ($t = -3.905, p = .000$), while schools that paid exam fees showed no significant change in average science scores ($t = -1.473, p = .144$) over that time period. Examining the means from 2007/08 to determine if any differences existed between schools that paid exam fees and those that did not found that the average science scores in schools paid exam fees was 2.4530 (SD = .92685) was not significantly different from a mean of 2.295 (SD = .88126) in schools that did not pay exam fees, ($F(1,197) = .032, p = .858, \eta^2 = .000$).

The next question to ask was whether the number of years that exam fees had been paid impacted the average scores on Advanced Placement science exams. An ANOVA run on the data divided into three levels shows that the only significant difference appears between schools that have paid exam fees for four or more years and those that paid exam fees between one and three years, $F(2,196) = 4.807, p = .009$. These results are detailed in Table 23.

Table 23

ANOVA on Average AP Science Scores by Years Exam Fees Paid

	Years paying exam fee	Mean Science Scores	Mean Difference	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
2007/08	0	2.4295				
	1-3	2.1192				
	4+	2.6469				
	0	1-3	.31028	.16743	-.0940	.7146
		4+	-.21747	.14258	-.5618	.1268
	4+	1-3	.52775*	.17051	.1160	.9395

(*significant at $p < .05$)

The question of whether the change seen in Advanced Placement science scores differed based on the number of years exam fees had been paid was then analyzed using an ANOVA, producing different results than those seen when the scores from 2007/08 were examined. The decrease in science scores was significant ($F(2, 172) = 5.003, p = .008$) between schools that paid exam fees for four or more years and schools that did not pay exam fees. No significant difference was seen between schools that paid exam fees for one to three years and either of the other two groups. These results are detailed in Table 24.

Table 24

ANOVA on Change in Average AP Science Scores by Years Exam Fees Paid

	Years paying exam fee	Mean Difference	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
2007/08	0 1-3	-.05550	.15443	-.4206	.3096
	4+	-.39410*	.13099	-.7038	-.0844
	4+ 1-3	.33859	.15565	-.0294	.7066

(*significant at $p < .05$)

Next, the question of whether a relationship exists between the scores earned on Advanced Placement science exams and school-level influences was evaluated using a hierarchical regression as detailed in Table 25. The regression equation which includes all of the variables for the model is

$$E_6 = H\phi_6 + A\phi_1 + B\phi_2 + C\phi_3 + D\phi_4 + F1 + G\phi_5 + e,$$

where E_6 = average score in 07/08 Advanced Placement science exams

H = average score in 05/06 Advanced Placement science exam

A = average school enrollment

B = percent of students qualified for free or reduced-price lunch

C = percent of students passing SOL end-of-course exams

D = percent of Black and Hispanic students

F = number of years exam fees were paid

G = Advanced Placement exam required where 1 = yes and 0 = no.

and $e = \text{error}$.

The full model is statistically significant, $R = .441$, $F(7, 153) = 17.249$, $p = .000$, however only the average scores from 2005/06 contribute significantly to the model, $R^2 = .312$, $F = 72.226$, $p = .000$. Hierarchical regressions run on the percent change in average science scores with the same group of school-level factors was significant, $R^2 = .080$, $F(6, 154) = 2.224$, $p = .044$ but no single school-level factor contributed meaningfully to the model.

Table 25

Relationship of Average Scores on AP Science Exams by School Level Variables

	B	SEB	Beta	R ²	ΔR ²	Sig.
Step 1 H 05/06 Average Science Scores	.514	.070	.492	.312	.312	.000
Step 2 A Size	.000	.000	.226	.388	.076	.000
Step 3 B SES	-.009	.006	-.142	.406	.017	.034
Step 4 C Achievement	.018	.017	.084	.416	.011	.093
Step 5 D Ethnicity	.001	.004	.030	.417	.010	.764
Step 6 F Fees paid	.038	.022	.138	.419	.001	.411
Step 7 G Exam required	-.302	.124	-.174	.441	.022	.016

(N = 160)

Qualifying Advanced Placement Scores

Advanced Placement qualifying scores are scores of 3, 4, or 5 on the Advanced Placement exams. To determine if the percent of qualifying scores earned at schools on Advanced Placement exams changed significantly, paired t-tests were run for 2007/08 and 2005/06. No significant change in qualifying scores was observed ($t = -1.762, p = .079$). Dividing the data by whether schools paid exam fees or not and

rerunning the paired t-test again produced no significant changes between schools that paid for exam fees and those that did not. Schools that paid exam fees saw a decrease in qualifying scores of 2.1597% (SD = 13.6097) compared to a decrease of 1.9345 (SD = 11.9949) in schools that did not pay exam fees, an insignificant difference.

To determine if the number of years that exam fees have been paid, an ANOVA was run on the percent qualifying scores in 2007/08 with the data divided into three groups; schools that did not pay exam fees, schools that paid exam fees from one to three years, and schools that paid exam fees for four or more years. No significant differences in qualifying scores are seen between these groups ($F(2, 210) = 1.963, p = .143$).

Next, the relationship between qualifying scores on Advanced Placement exams and school-level factors was examined by running a hierarchical regression. The regression equation that includes all of the variables examined is

$$E_4 = H\phi_6 + A\phi_1 + B\phi_2 + C\phi_3 + D\phi_4 + F_1 + G\phi_5 + e,$$

- where
- E_4 = percent qualifying scores on 07/08 Advanced Placement exams
 - H = percent qualifying scores on 05/06 Advanced Placement exams
 - A = average enrollment
 - B = percent of students on free or reduced-price lunch
 - C = percent of students passing SOL end-of-course exams
 - D = percent of Black and Hispanic students
 - F = number of years exam fees were paid

G = Advanced Placement exam required where 1 = yes and 0 = no.

and e = error.

The full model is statistically significant, $R^2 = .697$, $F(7, 192) = 62.979$, $p = .000$, however only the qualifying scores in 2005/06, $R^2 = .616$, $F = 318.033$, $p = .000$, contributed meaningfully to the model. The results from this analysis are detailed in Table 26. Hierarchical regressions run on the change in percent qualifying scores with the same group of school-level factors was not significant, $R^2 = .080$, $F(6, 185) = .364$, $p = .901$.

Table 26

Relationship of Qualifying AP Scores by School Level Variables

	B	SEB	Beta	R ²	ΔR ²	Sig.
Step 1 H 05/06 Qualifying Scores	24.927	1.849	.639	.616	.616	.000
Step 2 A Size	.003	.002	.097	.631	.015	.006
Step 3 B SES	-.291	.092	-.190	.678	.047	.000
Step 4 C Achievement	.611	.266	.125	.691	.013	.005
Step 5 D Ethnicity	-.020	.058	-.021	.692	.000	.601
Step 6 F Fees paid	.250	.367	.036	.692	.000	.987
Step 7 G Exam required	-3.600	2.049	-.083	.697	.005	.080

(N = 160)

Qualifying Advanced Placement Science Scores

The percent of students earning qualifying scores on Advanced Placement science exams decreased by 6.88% from 55.52% (SD = 25.559) in 2005/06 to 48.64% (SD = 24.645) in 2007/08. The decrease was significant in both schools that did not pay exam fees which decreased 8.35% ($t = -2.784, p = .008$) and for schools that paid exam fees which decreased 4.98% ($t = -2.131, p = .036$).

To determine if the percent of students earning qualifying scores on Advanced Placement science exams was related to the number of years that fees were paid by schools an ANOVA was run on the data using the years of payment in three levels, 0 years, 1 to 3 years, and 4 or more years. The results, detailed in Table 27 indicate a significantly higher percent of students earned qualified scores on Advanced Placement science exams in schools that paid fees for four or more years than in schools that have paid fees for one to three years, $F(2, 131) = 5.012, p = .008$. However there was no significant difference seen between either of the groups of schools that paid fees and schools that did not pay fees.

Table 27

ANOVA on Qualifying AP Science Scores by Years Fees Paid

	Years paying exam fee	Mean %	Mean Difference	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
2007	0	45.0660				
	1-3	36.1647				
	4+	53.4943				
	0	1-3	8.90125	5.64620	-4.7914	22.5939
		4+	-8.42838	5.02476	-20.6140	3.7572
	4+	0	8.42838	5.02476	-3.7572	20.6140
	1-3	17.32963*	5.51041	3.9663	30.6930	

(*significant at $p < .05$)

Next, the question of whether a relationship exists between the percent of students earning qualified scores on Advanced Placement science exam scores and

other school level factors was addressed. For this investigation, a hierarchical regression was run, the results of which are detailed in Table 26. The regression equation which includes all of the variables for the model is

$$E_7 = H\phi_6 + A\phi_1 + B\phi_2 + C\phi_3 + D\phi_4 + F\phi_5 + G\phi_6 + e,$$

where E_7 = Percent qualifying scores on 07/08 Advanced Placement science exams

H = Percent qualifying scores on 05/06 Advanced Placement science exams

A = average school enrollment

B = percent of students on free or reduced-price lunch

C = percent of students passing SOL end-of-course exams

D = percent of Black and Hispanic students

F = number of years exam fees were paid

G = Advanced Placement exam required where 1 = yes and 0 = no.

and e = error.

The full model is significant, $R^2 = .530$, $F(7, 98) = 15.773$, $p = .000$, though once again only the 05/06 outcome contributes meaningfully to the model, $R^2 = .474$, $F(1, 104) = 95.551$, $p = .000$. The results of this analysis are detailed in Table 28.

Hierarchical regressions run on the change in percent qualifying science scores from 2005/06 to 2007/08 using the same group of school-level factors showed no significant results, $R^2 = .012$, $F(6, 186) = .364$, $p = .901$.

Table 28

Relationship of Qualifying AP Science Scores by School Level Variables: Full Model

	B	SEB	Beta	R ²	ΔR ²	Sig.
Step 1 H 05/06 Qualifying Science Scores	.614	.075	.630	.479	.479	.000
Step 2 A Size	.005	.003	.116	.497	.018	.058
Step 3 B SES	-.028	.208	-.015	.506	.009	.180
Step 4 C Achievement	-.088	.555	-.015	.508	.002	.503
Step 5 D Ethnicity	-.177	.133	-.142	.516	.008	.200
Step 6 F Fees paid	1.110	.719	.142	.522	.006	.277
Step 7 G Exam required	-5.271	4.045	-.105	.530	.008	.196

(N = 105)

Ancillary results

The results of each regression analysis indicated a significant relationship between the outcome variable and socioeconomic status measured by the percent of students on free or reduced-price lunch programs. Although the impact of socioeconomic status was small in each case, an additional examination of its impact seems in order.

When schools were divided into quartiles based on the percent of students eligible free or reduced-price lunch programs, Advanced Placement enrollment, exams taken and average scores decreased significantly as the percent of students on these lunch programs increased. Advanced Placement enrollment in 2007 was 8.8 times higher in schools with fewer than 16% of their students eligible for free or reduced-price lunch programs than schools with greater than 41% of their students eligible for these programs, $F(3, 247) = 39.364, p = .000$. These data are detailed in Table 29.

Table 29

AP Enrollment by Socioeconomic Status

% Free or Reduced Lunch	Mean AP Enrollment	Std. Dev.	N
16% or less	483.22	304.454	27
17 – 28	291.40	240.376	89
29– 40%	127.58	135.515	127
41% or more	54.91	72.242	35

($\eta^2 = .301$)

Similarly, the change in Advanced Placement enrollment from 2005/06 to 2007/08 was significantly higher in the schools with low free and reduced lunch price eligibility as seen in Table 30.

Table 30

Change in AP Enrollment by Socioeconomic Status

	% Free & Reduced Price lunch		Mean Difference	Std. Error	95% Confidence Interval Lower Bound Upper Bound	
w/fee payment	<= 16	17-28	65.0455*	23.023	3.459	126.632
		29-40	110.106*	21.707	52.042	168.170
		41+	138.652*	28.473	62.489	214.816
	17-28	29-40	45.065	17.161	-.843	90.964
		41+	74.607*	36.911	6.253	140.961
	29-40	41+	28.546	23.982	-35.603	92.696

*Significant at .05 level

The trend seen in Advanced Placement enrollment is repeated when the number of Advanced Placement exams taken is examined as seen in Table 31. The number of exams taken in 2007/08 was 13 times higher in the quartile with 16% or fewer students eligible for free and reduced-price lunch programs than in the lowest quartile with 41% or more students eligible for these programs, $F(3,247) = 33.461, p = .000$.

Table 31

Number of AP Exams Taken by Socioeconomic Status

% Free or Reduced Lunch	Mean AP Exams Taken	Std. Dev.	N
16% or less	1321.44	1085.668	27
17 – 28	670.92	735.682	89
29– 40%	247.72	333.293	127
41% or more	101.80	175.122	35

($\eta^2 = .268$)

Finally, the average scores earned by students on Advanced Placement exams is significantly higher in schools with fewer than 16% of its students on free or reduced-price lunch programs than for schools with higher percentages of students from low socioeconomic backgrounds. The average scores in 2007/08 were 47.1% lower in the quartile with 16% or fewer students on school lunch programs than for schools in the quartile with 41% or more students on school lunch programs, $F(3,267) = 20.987$, $p = .000$. These data are detailed in Table 32.

Table 32

Average Scores on AP Exams by Socioeconomic Status

% Free or Reduced Lunch	Mean AP Exams Taken	Std. Dev.	N
16% or less	3.0607	.49150	27
17 – 28	2.8854	.49161	89
29– 40%	2.4985	.60884	127
41% or more	2.1217	.76434	35

($\eta^2 = .191$)

Limitations

Multicollinearity exists when several of the explanatory variables in a regression model are highly correlated causing them to overlap and become redundant in the model (Agresti, 1997). Table 33 details the correlation among the explanatory variables used in the regression models. None of the variables used regression models were highly correlated, and the tests for multicollinearity performed on each regression model determined that all tolerances were well within the range to rule out collinearity (tolerance range = .551 – 1.000).

Table 33

Correlation Matrix among School-Level Factors

	School size	SES	Achievement	Under-served minority	Payment of exam fees
SES	-.355**				
Achievement	----	-.515**			
Underserved minority	.235**	.456**	-.401**		
Payment of exam fees	.342**	-.151*	.267**	.153*	
Exam requirement	.371**	-.226**	.135*	.187**	.526**

** Correlation is a significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

The regression models all indicated that some factors, particularly school size and socioeconomic status were statistically significant in helping explain the outcome, however none of the school-level variables produced any meaningful associations.

The use of average Standards of Learning (SOL) scores for Virginia high schools turned out to be a poor indicator of student enrollment and achievement in Advanced Placement courses, which might have been improved by using the average SAT scores for the school instead as the measure of student achievement.

The survey question asking if students were required to take Advanced Placement exams was set up with a simple yes/no response frame. In hindsight this

question should have been set up as a Likert scale response which might have given a truer picture of how schools approach the exam requirement. Many school administrators commented that they cannot require students to take the exam without paying the exam fee, but students are highly encouraged to take the exam. Others commented that they tell students that they are required, when they have no way to enforce that requirement. These were counted as not requiring the exam which obviously did not tell the entire story. It would have improved the variable if the question had given respondents a scale that would better assess how the exam requirement is used at each school.

Finally, phase II of the study was unable to be completed due to the fact that only two Virginia school divisions, representing only eight high schools were able to provide the data on Advanced Placement course enrollment by high school and course, both of which paid the Advanced Placement exam fees. With such a low sample size, it was impossible to complete an analysis from these data. Schools have not as a rule kept course enrollment data by school and course, but use the state Department of Education enrollment statistics (number of students enrolled in at least one Advanced Placement course) instead, making the data for phase II as it was envisioned unavailable.

CHAPTER 5

DISCUSSION, CONCLUSIONS & RECOMMENDATIONS

Payment of Advanced Placement exam fees has been used over recent years by an increasing number of school divisions in Virginia and elsewhere as a way of encouraging Advanced Placement course enrollment and exam taking. Since the institution of the “One Hundred Best High Schools in America” articles in Newsweek magazine in 2003 which uses the number of Advanced Placement and International Baccalaureate exams taken as a ratio of graduating seniors as the single determinant (Mathews, 2007b), school divisions have accelerated the institution of policies that will earn their high schools a place on that list. As a result, the number of Virginia high schools that paid the fees for students to take Advanced Placement exams increased each year from just below 14% in 2001 to almost 60% in 2008.

Each exam taken by a student carries a fee of \$86. Given that the average school that paid Advanced Placement exam fees gave 657 exams, the cost to the school would be \$56,500, a sum that could pay the salary for an additional full time teacher. In a slow economy when tax revenues are decreasing and school divisions are under increased pressure to reduce budgets, it was prudent to determine the impact that these policies have had, and whether the costs were justified by the outcome.

Discussion

The purpose of this study was to determine what, if any, relationship existed between the policy of paying the Advanced Placement exam fees and Advanced Placement course enrollment, the number of Advanced Placement exams taken and the scores earned on those exams. Secondly, the impact of paying the Advanced Placement exam fees on Advanced Placement science exams and scores was examined because of the focus on improving American students' desire and readiness to pursue science degrees in their post-secondary education and in their ultimate careers (Dubrowsky et. al., 1997).

Participation in Advanced Placement courses increased significantly in Virginia schools over the three years examined in this study (2005/06 to 2007/08) as did the number of Advanced Placement exams taken. Additionally, schools that paid exam fees had significantly higher enrollment in 2007/08, and subsequently had significantly more Advanced Placement exams taken than schools that did not pay exam fees. However, the growth in enrollment over the three year period of the study was not significantly different based on whether exam fees had been paid or not, a finding that is underscored by the lack of meaningful association between the payment of fees and Advanced Placement enrollment. Furthermore, the regression analyses indicate that neither fee payment nor requiring students enrolled in Advanced Placement courses to take the exams had any meaningful impact on the change in Advanced Placement enrollment or in the number of Advanced Placement exams taken in Virginia schools.

The 2007/08 Advanced Placement enrollment and subsequently the number of exams taken were significantly higher in schools that had been paying the exam fees for four years or more than it was for schools that had instituted the fee payment policy more recently or schools that did not pay exam fees. These results appear to indicate that most Virginia schools are working to increase Advanced Placement enrollment and are successful at doing so. The fact that schools who have paid exam fees for longer time periods have higher Advanced Placement enrollment is probably a result of the longer focus on the Advanced Placement program since the rate of growth is essentially the same for all schools, whether fees were paid or not.

Another factor to be considered is that schools with higher enrollment are more likely to pay exam fees and have been doing so for longer than small schools. Fifty four percent of schools with enrollment of 1785 or more paid exam fees for four years or more, compared to just 24% of schools with enrollment of less than 1205. Schools with larger enrollment would be more likely to offer numerous Advanced Placement courses since they have the students to fill these classes and can make the decision to staff these courses. Additionally, larger schools have a larger teacher population, making it more likely that there are teachers willing to and capable of facilitating these rigorous courses already employed at the school (McCauley, 2007, Paek, P. L., et. al., 2005).

Neither average scores on Advanced Placement exams nor the percent of students earning qualifying scores on Advanced Placement exams changed significantly over the three years examined in the study, a result that is can be considered positive,

given the fact that Advanced Placement enrollment and the number of Advanced Placement exams taken had increased quite significantly over that time period. This indicates that Advanced Placement programs in Virginia have been able to grow while keeping standards high and while adequately preparing students for the Advanced Placement exams.

This result also indicates that there are a number of students that have not previously chosen to take Advanced Placement courses, but are capable of doing so. Adding these students to existing programs would typically involve larger class sizes or giving the available Advanced Placement teachers additional sections of the course they already teach, thereby achieving the expansion without impacting scores the way it might should an inexperienced teacher be given the assignment. Additionally, these experienced teachers would likely have more success with students coming into Advanced Placement without the requisite content knowledge or study skills necessary to thrive in Advanced Placement courses (Paek, P. et al., 2005). Schools with strong Advanced Placement programs would find it easier to recruit and retain good teachers with strong content knowledge (Finn & Winkler, 2009). If new Advanced Placement teachers are hired there is a better possibility of having experienced Advanced Placement teachers available to mentor the new teacher and lend support through those difficult first years. All of these possibilities give schools with an established Advanced Placement program the ability to grow the program without impacting scores.

The only negative results from the study were found in the average scores and the percent qualified scores on Advanced Placement science exams which both decreased significantly over the three years examined in the study. The decrease in average science scores was found exclusively in schools that did not pay exam fees, while schools that did pay the fees showed no significant drop in scores. The decrease in average science scores is especially surprising because there was no difference in the overall average scores earned in either group based on payment of exam fees. The number of exams given in Advanced Placement science increased in line with the increase of overall exams given, however the decrease in scores indicates that the students who enrolled and took these exams were not adequately prepared to succeed on them. Additionally, the number of students who qualified with scores of 3, 4, or 5 on the Advanced Placement science exams decreased significantly for both schools that paid exam fees and those that did not. Although this is not the desired result of increasing enrollment, Dougherty et. al. (2006) found that exposure to Advanced Placement courses and exams is sufficient to provide students with a better chance of success in college. However, the strongest performance in college is still by students who earn qualifying scores.

There are several possible reasons for this decline in Advanced Placement science exam scores. First, students in an Advanced Placement science should have had the requisite pre-AP course in the same science, but may not have. In the interest of increasing Advanced Placement enrollment, many schools have replaced the first year honors level science course with the Advanced Placement science course in the same

discipline therefore requiring students to master two years of science content in a single year (Mathews, 2007c).

Second, based on the growth in enrollment and the number of science exams taken, the conclusion can be drawn that the students enrolled in Advanced Placement science may not have been adequately prepared to take on the rigor of these courses. The fact that the decrease in average scores is seen specifically in schools that did not pay exam fees, though the relationship between scores and the payment of exam fees is very weak, may indicate that many of the schools that paid exam fees were also involved in the type of support and scaffolding necessary to give their students an edge in the Advanced Placement science exams while the schools that did not pay fees also did not have this scaffolding in place. Successful schools may have been more likely to offer teacher development or student-preparation sessions that have been shown to enhance students' success in Advanced Placement programs (Jackson, 2008; Kyberg, et. al., 2007).

Finally, considering the fact that the decrease in average and qualifying exam scores are only seen in Advanced Placement science exams highlights the need to improve the science preparation of students, not only in Advanced Placement courses but in the earlier years of their science education as well (Mollison, 2006). Providing highly qualified science teachers beginning at the middle school level has been one of the focuses of No Child Left Behind (2001), but training teachers to provide more rigor to science curriculum than is specified in the state Standards of Learning mandates is an important aspect of the process that cannot be overlooked. Even the teachers that are

considered qualified based on the coursework they have taken need to be trained to understand the rigor of Advanced Placement courses as well as the curriculum rigor necessary to prepare students to enter Advanced Placement. Too many schools consider the Virginia Standards of Learning a benchmark for the curriculum, when they are truly just the minimum standard to be reached by all students (Achieve, 2004). Teachers must be trained to incorporate rigorous content and skills development into the science curriculum beginning in middle school if students are to be adequately prepared to undertake the rigors of Advanced Placement sciences at the high school level.

Texas schools involved in the Advanced Placement Incentive Program have successfully implemented programs of teacher training that begins in middle school and has improved Advanced Placement scores in science, math and English (Jackson, 2008). Similar programs have been instituted in several Virginia schools through the National Math Science Initiative (NMSI) grants beginning in 2008, the results of which will be interesting to follow.

Although associations found in the regression analyses between the measured outcomes and the socioeconomic status of the schools was small, socioeconomic status correlated negatively to each of the outcomes. This indicates that as the percent of students eligible for free and reduced-price lunch programs increases, enrollment, the number of exams taken, average scores and percent qualifying scores earned decreases. A possible explanation for these findings is that schools with large populations of students from low socioeconomic backgrounds have traditionally allocated their resources for remediation required to allow students to meet state standards leaving few

resources available for Advanced Placement courses (Klopfenstein & Thomas, 2005). Additionally, there is often little demand for these rigorous courses in low-income areas where parents may be unaware of the programs or fail to understand the benefit of rigorous coursework for their children (Geiser & Santelices, 2004). Yet with the small contribution to the regression models made by the socioeconomic status of schools, it appears that in Virginia, growth in Advanced Placement programs is occurring in schools with students from all economic levels. This effort is aided by grants from the state or federal government to support those students from low socioeconomic backgrounds who wish to take Advanced Placement exams (Access to High Standards Act, 2001) by paying exam fees. Additionally, the College Board offers a \$22 reduction of exam fees for students that qualify based on socioeconomic factors which then decreases the amount that states have to contribute to support the efforts of students that qualify (College Board, 2002).

Although students from low socioeconomic backgrounds are participating in Advanced Placement programs in greater numbers each year examined in the study, the average scores earned by this group is significantly lower the larger their cohort in a school. One possible reason for lower average scores is the lack of preparation for the rigor of Advanced Placement courses which puts these students at a disadvantage. When students fill an Advanced Placement class without the requisite knowledge and skills to be successful, the course becomes one of remediation rather than concentration on the college level material students need to know to be successful on the exams (Taliaferro & DeCuir-Gunby, 2008). Another possible explanation is the difficulty of

recruiting qualified teachers to teach Advanced Placement courses in inner city or very rural school divisions where many of these high poverty schools are located (Geiser & Santelices, 2004; Klopfenstein & Thomas, 2005).

Alternatively, the lower average scores may be a result of the inclusion of schools that had recently instituted an Advanced Placement program so their teachers, being new to Advanced Placement curricula, had not yet met all the challenges of teaching Advanced Placement courses. Advanced Placement teachers responded in a survey that it takes five to seven years to become accomplished at teaching Advanced Placement courses (Finn & Winkler, 2009), placing schools with newly formed Advanced Placement programs at a disadvantage.

The fact that the size of the traditionally underserved minority population failed to factor meaningfully in any of the models was a somewhat surprising result given that many studies (Darity, Castellino, Tyson, Cobb & McMillen, 2001; Klopfenstein, 2004; Solorzano & Ornelas, 2004) had found that enrollment of Black and Hispanic students in Advanced Placement courses has remained significantly below the relative size of these cohorts in the high school population. One reason for this discrepancy may be the availability of Advanced Placement courses in Virginia, where 300 public high schools reported students enrolled in Advanced Placement courses. Solorzano and Ornelas (2004) found that a significant reason for the low enrollment of African American and Hispanic students in California schools was their lack of access to Advanced Placement courses. With so many Virginia schools offering Advanced Placement courses,

underserved minorities seemed to have no lack of access to the courses and took advantage of that access causing the growth rate of Advanced Placement programs in schools with moderate to high percent of underserved minorities to be close to that of all schools in Virginia schools.

Conclusions

Overall, this study found that payment of Advanced Placement exam fees had no impact on Advanced Placement course enrollment, the number of Advanced Placement exams taken by students, or on the scores that students earned either as a mean or as a percent of qualifying scores. The impact on Advanced Placement science enrollment mirrored that of the overall enrollment while average science scores and the percent of qualifying scores in science decreased.

The study also determined that Advanced Placement enrollment and the number of exams taken have increased significantly, yet had very little impact on the average scores earned or the percent of qualified scores earned on the Advanced Placement exams. This interesting conclusion may indicate that schools that have invested in programs of teacher development and curriculum alignment with the goal of improving student preparation for Advanced Placement coursework and are seeing positive results. The importance of this investment has been documented in several studies (Finn, C. E., Jr., & Winkler, A. M., 2009, Kyberg, R. M. et. al, 2008, Paek, P. L., et. al., 2005) and given the lack of impact attributed to Advanced Placement exam fee payment in the modeling, it is possible that other factors such as these development programs may have been a key variable responsible for the results that was observed.

One such program, that was developed in Texas and which has recently branched out to schools in other states including Virginia beginning in the fall of 2008, is Laying the Foundation[®]. A spin-off of the successful Texas company Advanced Placement Strategies, which was responsible for the teacher training in the Texas APIP program (Jackson, 2008), Laying the Foundation[®] produces curriculum and teacher training courses aimed at middle and early high school students designed to give them the preparation necessary to succeed in Advanced Placement courses later in high school (Laying the Foundation, 2009). The program has produced positive results throughout Texas which now leads the nation in the number of Advanced Placement tests taken and the number of students enrolled in Advanced Placement courses (College Board, 2008a).

Given that paying the Advanced Placement exam fees for students had no measureable impact on enrollment or the number of tests taken, and no measurable impact on the scores students earned or the percent of students earning qualifying scores on those exams, school divisions would be well-served to examine investing those funds in preparation programs such as this which could increase the population of students willing to take Advanced Placement courses and able to find success in them, especially in science. Although removing the fee payment policy once it has been implemented may negatively impact enrollment for the first year or two since students may opt out of exams if they have to pay for them, this issue would be short-lived since those students that had fees paid by the school division will soon graduate and the memory of that policy would be quickly lost.

The other negative impact of removing the fee payment policy is one of equity since low-income students will be at a disadvantage in being able to take Advanced Placement exams. However, the existence of federal and state grant programs to assist low-income students in paying exam fees (Access to High Standards Act, 2001) should provide the needed aid to those students.

Recommendations for further research

From this research, several areas have been identified for further study. It is apparent from the results of this study that some schools are very successful at preparing students for Advanced Placement and helping them find success on the Advanced Placement exams. A survey of high school teachers, directors of counseling, and administrators designed to determine what other factors might have contributed to that their success would be of interest to school divisions. This survey should include information on teacher background, years of experience and education, preparation programs or other staff development provided for staff. It might also include additional information on the prerequisites for Advanced Placement course enrollment, as well as teachers' perceptions of student readiness for Advanced Placement in each school. A survey produced by Farkas Duffett Research Group for The Thomas B. Fordham Institute's national study of Advanced Placement growing pains (Finn & Winkler, 2009) contains useful elements that would be a good place to start. Matching the results of that type of survey with schools whose students have found success in Advanced Placement might shed light on the possible forces at work that make them so successful, and ways of implementing those forces at other schools.

Second, it would be of interest to engage in a qualitative study of some of the most successful Advanced Placement teachers in Virginia to determine what elements they consider the most important in producing a successful Advanced Placement program. From that study, it would also be interesting to determine if those factors change based on the size of the school or socioeconomic status of the school's location, two factors in which differences were seen, though the impact was small.

Finally, it would be of interest to conduct a qualitative study of the sometimes unwritten policies and procedures employed in counseling departments at schools with successful Advanced Placement programs. From that study it would be possible to determine if there are specific ways in which students are counseled that lead to their having better preparation for Advanced Placement coursework or assuring that certain gate-keeping measures maintain school standards in Advanced Placement classrooms or on Advanced Placement exams.

REFERENCES

- Access to High Standards Act, PL 107-110 U.S.C. 1702 Section G (2001). Retrieved from <http://www.ed.gov/policy/elsec/leg/esea02/pg14.html>
- Achieve, Inc. (2004). *Ready or not: Creating a high school diploma that counts*. Washington, D.C.: The American Diploma Project. Retrieved from <http://www.achieve.org/node/552>
- Adelman, C. (1999). *Answers in the tool box: Academic intensity, attendance patterns, and bachelor's degree attainment* -. Washington, DC: U.S. Department of Education.
- Adelman, C. (2006). *The toolbox revisited: Paths to degree completion from high school through college*. Washington, D.C.: U.S. Department of Education. Retrieved from www.ed.gov/rschstat/research/pubs/toolboxrevisit/index.html
- Agresti, A., & Finlay, B. (1997). *Statistical methods for the social sciences* (3rd ed.). Upper Saddle River, NJ: Prentice Hall, Inc.
- Blickenstaff, J. C. (2005). Women and science careers: Leaky pipeline or gender filter? *Gender and Education*, 17(4), 369-386.
- Buck, G., Kostin, I., & Morgan, R. (2002). *Examining the relationship of content to gender-based performance in Advanced Placement exams* No. 2002-12). New York: College Board.

Bureau of Labor Statistics. (2008). *College enrollment and work activity of 2007 high school graduates* (News No. USDL 08-0559). Washington, D.C.: United States Department of Labor. Retrieved from <http://www.bls.gov/cps/>

Bystydzienski, J. M., & Bird, S. R. (Eds.). (2006). *Removing barriers: Women in academic science, technology, engineering and mathematics*. Bloomington and Indianapolis: Indiana University Press.

Cech, S. (2007). Number of schools offering AP falls after first audit of courses. *Education Week*, 27(12)

College Board. (2003). *A brief history of the Advanced Placement program*. College Board.

College Board. (2007). *AP data: 2007 program summary report*. College Board. Retrieved from http://apcentral.collegeboard.com/apc/public/repository/2007_Program_Summary_Report.pdf

College Board. (2008a). *4th annual AP report to the nation*. New York, NY: College Board. Retrieved from <http://professionals.collegeboard.com/profdownload/ap-report-to-the-nation-2008.pdf>

College Board. (2008b). *AP course audit information*. Retrieved 10/1, 2008, from http://apcentral.collegeboard.com/apc/public/courses/teachers_corner/46361.html

Darity, W. J., Castellino, D., Tyson, K., Cobb, C., & McMillen, B. (2001). *Increasing opportunity to learn via access to rigorous courses and programs: One strategy for closing the achievement gap for at-risk and ethnic minority students*. Raleigh, NC:

North Carolina State Department of Public Instruction, Division of Accountability.

Retrieved from

http://eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/19/81/da.pdf

Dillon, S. (2007, February 7). Advanced Placement tests are leaving some behind. *The New York Times*, pp. Section B, Pg. 9.

Dougherty, C., Mellor, L., & Jian, S. (2006). *Orange juice or orange drink: Ensuring that advance courses live up to their label* No. NCEA Policy Brief # 1). Austin, TX: National Center for Educational Accountability.

Dougherty, C., Mellor, L., Jian, S., & National Center for Educational Accountability. (2006). *The relationship between Advanced Placement and college graduation* No. 1- February 2006). Austin, TX: NCEA.

Finn, C. E., Jr., & Winkler, A. M. (2009). Growing pains in the Advanced Placement program: Do tough trade-offs lie ahead?

Geiser, S., & Santelices, V. (2004). *The role of Advanced Placement and honors courses in college admissions* No. CSHE.4.04). University of California, Berkley: Center for Studies in Higher Education.

<http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1036&context=cshe>

Gonzalez, E. J., O'Connor, K. M., & Miles, J. A. (2001). *How well do Advanced Placement students perform on the TIMSS advanced mathematics and physics tests?* Boston, MA: International Study Center.

- Gootman, E., Gebeloff, R., & Hu, W. (2008, August 20,). Mixed results on paying city students to pass tests. *The New York Times*, pp. Section B-1.
- Hancock, G. R., & Mueller, R. O. (Eds.). (2010). *The reveiwer's guide to quantitative methods in social sciences*. Routledge Taylor & Francis Group, New York.
- Hazari, Z., Tai, R. H., & & Sadler, P. M. (2007). Gender differences in introductory university physics performance: The influence of high school physics preparation and affective factors. *Science Education*, 91, 847-876.
- Hertberg-Davis, H., & Callahan, C. M. (2008). A narrow escape: Gifted students' perceptions of Advanced Placement and International Baccalaureate programs. *Gifted Children Quarterly*, 52(3), 199-216.
- Hoff, D. J. (2004). High scores on Mass. tests will lead to help with tuition. *Education Week*, 24(10), 26. Retrieved from <http://web.ebscohost.com.proxy.library.vcu.edu/ehost/detail?vid=9&hid=5&sid=38ac1ad4-2342-44de-9527-f33fcb823f64%40sessionmgr9&bdata=JkF1dGhUeXBIPWlwLHVybCxb29raWUsdWlkJnNpdGU9ZWWhvc3QtbGl2ZSZzY29wZT1zaXRI#db=a9h&AN=15200306>
- International Baccalaureate Organization. (2008). *International baccalaureate programs*. Retrieved October 20, 2008, from <http://www.ibo.org/diploma/become/>
- Jackson, C. K. (2008). *A little now for a lot later: A look at a Texas Advanced Placement incentive program*. Unpublished manuscript. Retrieved 9/30/2008, from http://works.bepress.com.proxy.library.vcu.edu/cgi/viewcontent.cgi?article=1000&context=c_kirabo_jackson

- Jeong, D. W. (2009). Student participation and performance on Advanced Placement exams: Do state-sponsored incentives make a difference? *Educational Evaluation and Policy Analysis*, 31(4), 346-366.
- Juilleret, F., Dubrowsky, N., Ridenour, N. V., McIntosh, W. J., & Caprio, M. W. (1997). Advanced Placement science courses: High school - college articulation issues. *The Journal of College Science Teaching*, 27(1), 48-52.
- Kirst, M. W. (1998). *Improving and aligning K-16 standards, admissions and freshman placement policies* No. Technical Report 2-06). Stanford, CA: National Center for Postsecondary Improvement.
- Klopfenstein, K. (2004). The Advanced Placement expansion of the 1990s: how did traditionally underserved students fare? *Education Policy Analysis Archives*, 12(68), 1-14. Retrieved from <http://epaa.asu.edu.proxy.library.vcu.edu/epaa/v12n68/v12n68.pdf>
- Klopfenstein, K., & Thomas, M., K. (2005). *The link between advanced placement experience and early college success*. Dallas TX: Texas Schools Project. Retrieved from <http://www.utdallas.edu/research/tsp/pdfpapers/newpaper>
- Kohn, A. (1993). *Punished by rewards*. New York, NY: Houghton Mifflin Company.
- Kyberg, R. M., Hertberg-Davis, H., & Callahan, C. M. (2007). Advanced Placement and International Baccalaureate programs: Optimal learning environments for talented minorities? *Journal of Advanced Academics*, 18(2), 172-215.
- Laying the Foundation®. *About Laying the Foundation*. Retrieved June 10, 2008 from <http://www.layingthefoundation.org/about/index.asp>.

- Lichten, W. (2000). Whither advanced placement? *Education Policy Analysis Archives*, 8(29)
- Manzo, K. K. (2004). Educators debate value of having all student take AP coursework. *Education Week*, 24(10), 1-22.
- Medina, J. (2007, October 15, 2007). Making cash a prize for high scores on advanced placement tests. *New York Times*, pp. Section B, page 1.
- Mathews, J. (2007a, December 13). Alexandria, Arlington schools lead nation in AP, IB enrollment. *The Washington Post*, pp. VA03.
- Mathews, J. (2007b, August 31). Top of the class: The complete list of the 1,300 top U.S. schools. *Newsweek Web Exclusive*, Retrieved from <http://www.newsweek.com/id/39380/output/print>
- Mathews, J. (2007c, July 17). Who needs honors courses? Try everyone. *The Washington Post*. Retrieved from <http://www.washingtonpost.com/wp-dyn/content/article/2007/07/16/AR2007071601288.html>
- McCauley, D. (2007). *The impact of Advanced Placement and dual enrollment programs on college graduation*. Unpublished Public Administration Applied Research Program, Texas State University-San Marcos, Retrieved from <http://ecommons.txstate.edu/cgi/viewcontent.cgi?article=1208&context=arp>
- Mead, S., & Rotherham, A. J. (2006). Challenged index: Why Newsweek's list of America's 100 best high schools doesn't make the grade. *Education Sector*, February, November 19, 2008.

- Mollison, A. (2006). *Surviving a midlife crisis: Advanced Placement turns fifty*. Education Next, Winter 2006. Retrived from http://educationnext.org/files/ednext20061_34.pdf
- Morgan, R., & Klaric, J. (2007). *AP students in college: An analysis of five-year academic careers*. College Board Research Report No. 2007-4. New York: College Board.
- Morgan, R., & Maneckshana, B. (2000). *AP students in college: An investigation of their course-taking patterns and college majors*. Princeton, NJ: Educational Testing Service.
- Morgan, R., & Ramist, L. (1998). *Advanced Placement students in college: An investigation of course grades at 21 colleges*. No. SR-98-13. Princeton, NJ: Educational Testing Service.
- National Association of College Admissions Counselors. (2005). *2004-2005 state of college admission survey* Advanced Placement Strategies, Inc.
- National Center for Education Statistics. (2008). *The condition of education 2000-2008*. Retrieved 10/20, 2008, from <http://nces.ed.gov/programs/coe/index.asp>
- National Science Foundation, Division of Science Resources Statistics. (2007). *Asia's rising science and technology strength: Comparative indicators for Asia, the European Union, and the United States* No. NSF 07-319. Arlington, VA
- No Child Left Behind Act, PL107-110U.S.C. (2001). Retrieved from <http://www.ed.gov/policy/elsec/leg/esea02/index.html>

- Ordovensky Staniec, J. F. (2004). The effects of race, sex, and expected returns on the choice of college major. *Easter Economic Journal*, 30(4), 549-563.
- Paek, P.L., Ponte, E., Sigel, I., Braun, H., & Powers, D. (2005). *Portrait of Advanced Placement teachers' practices*. College Board Research Report No. 2005-7. New York: College Board.
- Pennington, H. (2002). Better and faster: Accelerating advancement in school and work. *Aspen Institute Congressional Seminar*, Aspen, CO.
- Pittman, T. S., Jolee, E., & Boggiano, A. K. (1982). Intrinsic and extrinsic motivational orientations: Reward-induced changes in preference for complexity. *Journal of Personality and Social Psychology*, 42, 789-97.
- Sadler, P. M., & Tai, R. H. (2007). Advanced Placement exam scores as a predictor of performance in introductory college biology, chemistry and physics courses. *Science Educator the National Science Education Leadership Association Journal*, 16(2), 1-19.
- Santoli, M. P. (2002). Is there an Advanced Placement advantage? *American Secondary Education*, 30(3), 1-10.
- Solorzano, D. G., & Orneles, A. (2004). A critical race analysis of Latina/o and African American advanced placement enrollment in public high schools. *High School Journal*, 87(3), 15-26.
- Stockburger, D. W. (1998) *Multivariate statistics: Concepts, models, and applications*.
www.psychstat.missouristate.edu/multibook/mlt00.htm

- Taliaferro, J. D., & DeCuir-Gunby, J. T. (2008). African American educators' perspectives on the advanced placement opportunity gap. *The Urban Review*, 40(2), 164-185.
- Viestri, C. R. (1971). Effect of monetary rewards on insight learning task. *Psychonomic Science*, 23, 181-183.
- Virginia Commonwealth University, Honors College Admissions Bulletin (2009-2010). Retrieved from <http://www.pubapps.vcu.edu/bulletins/undergraduate/?uid=10120&iid=31028>

APPENDICES

Appendix 1: Quia electronic survey to Virginia School Divisions

This survey can be accessed electronically at <http://www.quia.com/sv/230716.html>
Advanced Placement Financial Incentive Survey

These 5 quick questions are asked to determine which Virginia school divisions offer financial incentives to students for taking Advanced Placement exams.

1. Do the high schools in your division offer financial incentives to students for taking Advanced Placement exams?
Yes
No

2. If you answered "yes" to question 1 above please specify the type of financial incentive offered in your division:
Pay student fee for AP exams
Pay cash award for taking exam
Payment of the financial incentive is tied to the exam score
Financial incentives are offered to AP teachers
Other (please explain below)

3. If you answered "yes" to question 1, for how many years has the division offered the financial incentives for AP exams?
1 year
2 years
3 years
4 years
5 years
6 or more years

4. School Division Name

Accomack County	Fairfax City
Albemarle County	Fairfax County
Alexandria City	Falls Church City
Alleghany County	Fauquier County
Amelia County	Floyd County
Amherst County	Fluvanna County
Appomattox County	Franklin City
Arlington County	Franklin County
Augusta County	Frederick County
Bath County	Fredericksburg City
Bedford City	Galax City
Bedford County	Giles County
Bland County	Gloucester County
Botetourt County	Goochland County
Bristol City	Grayson County
Brunswick County	Greene County
Buchanan County	Greensville County
Buckingham County	Halifax County
Buena Vista City	Hampton City
Campbell County	Hanover County
Caroline County	Harrisonburg City
Charles City	Henrico County
Charlotte County	Henry County
Charlottesville City	Highland County
Chesapeake City	Hopewell City
Chesterfield County	Isle of Wight County
Clarke County	James City County
Colonial Beach	King George County
Colonial Heights City	King William County
Covington City	King and Queen County
Craig County	Lancaster County
Culpeper County	Lee County
Cumberland County	Lexington City
Danville City	Loudoun County
Dickenson County	Louisa County
Dinwiddie County	Lunenburg County
Emporia	Lynchburg City
Essex County	Madison County

Manassas City	Richmond County
Manassas Park City	Roanoke City
Martinsville City	Roanoke County
Mathews County	Rockbridge County
Mecklenburg County	Rockingham County
Middlesex County	Russell County
Montgomery County	Salem City
Nelson County	Scott County
New Kent County	Shenandoah County
Newport News City	Smyth County
Norfolk City	Southampton County
Northampton County	Spotsylvania County
Northumberland County	Stafford County
Norton City	Staunton City
Nottoway County	Suffolk City
Orange County	Surry County
Page County	Sussex County
Patrick County	Tazewell County
Petersburg City	Virginia Beach City
Pittsylvania County	Warren County
Poquoson City	Washington County
Portsmouth City	Waynesboro City
Powhatan County	West Point
Prince Edward County	Westmoreland County
Prince George County	Williamsburg-James
Prince William County	City County
Pulaski County	Winchester City
Radford City	Wise County
Rappahannock County	Wythe County
Richmond City	York County

5. Please add any comments you wish and provide the name and email address of a contact person in your division.

Appendix 2: Quia electronic survey to Virginia public high school guidance directors

The survey can be accessed electronically at <http://www.quia.com/sv/264506.html>

Advanced Placement Program Survey

The purpose of this survey is to determine Advanced Placement policies in Virginia High Schools. It takes between 5 and 10 minutes to complete. Thank you!

1. School Name:

2. School Division Name (pop up answers)

Accomack County	Cumberland County
Albemarle County	Danville City
Alexandria City	Dickenson County
Alleghany County	Dinwiddie County
Amelia County	Emporia
Amherst County	Essex County
Appomattox County	Fairfax City
Arlington County	Fairfax County
Augusta County	Falls Church City
Bath County	Fauquier County
Bedford City	Floyd County
Bedford County	Fluvanna County
Bland County	Franklin City
Botetourt County	Franklin County
Bristol City	Frederick County
Brunswick County	Fredericksburg City
Buchanan County	Galax City
Buckingham County	Giles County
Buena Vista City	Gloucester County
Campbell County	Goochland County
Caroline County	Grayson County
Charles City	Greene County
Charlotte County	Greensville County
Charlottesville City	Halifax County
Chesapeake City	Hampton City
Chesterfield County	Hanover County
Clarke County	Harrisonburg City
Colonial Beach	Henrico County
Colonial Heights City	Henry County
Covington City	Highland County
Craig County	Hopewell City
Culpeper County	Isle of Wight County

James City County
King George County
King William County
King and Queen County
Lancaster County
Lee County
Lexington City
Loudoun County
Louisa County
Lunenburg County
Lynchburg City
Madison County
Manassas City
Manassas Park City
Martinsville City
Mathews County
Mecklenburg County
Middlesex County
Montgomery County
Nelson County
New Kent County
Newport News City
Norfolk City
Northampton County
Northumberland County
Norton City
Nottoway County
Orange County
Page County
Patrick County
Petersburg City
Pittsylvania County
Poquoson City
Portsmouth City
Powhatan County
Prince Edward County

Prince George County
Prince William County
Pulaski County
Radford City
Rappahannock County
Richmond City
Richmond County
Roanoke City
Roanoke County
Rockbridge County
Rockingham County
Russell County
Salem City
Scott County
Shenandoah County
Smyth County
Southampton County
Spotsylvania County
Stafford County
Staunton City
Suffolk City
Surry County
Sussex County
Tazewell County
Virginia Beach City
Warren County
Washington County
Waynesboro City
West Point
Westmoreland County
Williamsburg-James City
County
Winchester City
Wise County
Wythe County
York County

3. Are any of the following programs or courses offered at your school? Select all that apply
- Advanced Placement
 - International Baccalaureate
 - Other (please specify below)
 - No

4. Please specify if you selected “Other” for question #3 above.

5. Does your division or school pay student registration fees for Advanced Placement exams?

Yes

No

6. If yes, in which school year did the division or school begin paying for Advanced Placement exams?

2008-2009

2001-2002

2007-2008

2000-2001

2006-2007

1999-2000

2005-2006

1998-1999

2004-2005

1997-1998

2003-2004

1996-1997

2002-2003

1995-1996

1994-1995

7. Is payment of the registration fee dependent upon the student earning a passing score on the Advanced Placement exam?

Yes

No

8. Are Advanced Placement students required to take the Advanced Placement exams in the courses they are taking?

Yes

No

9. What other type of financial incentives are offered by your school or division (select only one)?

No other incentives offered

Pay cash award to students for taking exam

Pay cash award to students based on exam score

Pay cash awards to teachers for student exam performance

10. In which school year did your school or division begin to offer the incentive selected above?

2008-2009

2000-2001

2007-2008

1999-2000

2006-2007

1998-1999

2005-2006

1997-1998

2004-2005

1996-1997

2003-2004

1995-1996

2002-2003

1994-1995

2001-2002

11. Do you offer another type of financial incentive in addition to those mentioned above (select only one)?

- No other incentives offered
- Pay cash award to students for taking exam
- Pay cash award to students based on exam score
- Pay cash awards to teachers for student exam performance
- Other (please specify below)

12. Please specify if you selected "Other" in Question #11

13. In which school year did your school or division begin to offer the incentive selected above?

- | | |
|-----------|-----------|
| 2008-2009 | 1999-2000 |
| 2007-2008 | 1998-1999 |
| 2006-2007 | 1997-1998 |
| 2005-2006 | 1996-1997 |
| 2004-2005 | 1995-1996 |
| 2003-2004 | 1994-1993 |
| 2002-2003 | |
| 2001-2002 | |
| 2000-2001 | |

14. What prerequisites are required of students to register for Advanced Placement courses? (check all that apply)

- No prerequisites
- Minimum grade requirement in prerequisite course
- Honors level in prerequisite course
- Teacher recommendation
- Other (please specify below)

15. Please specify if you selected "Other" in Question #14.

16. Does your school recruit students for Advanced Placement courses, and if so how (select all that apply)?

- No, we don't recruit
- Yes, guidance counselors encourage qualified students
- Yes, guidance counselors encourage all students
- Yes, AP teachers visit classes to recruit AP students
- Yes, special recruitment events are held to recruit students

17. What grade-point value is awarded Advanced Placement courses at your school?

All courses carry the same grade-point value

Higher value than regular courses, but the same as honors courses

Higher value than honors courses

Other (please specify below)

18. Please specify if you selected "Other" in Question #17.

19. Are students at your school, who take the Advanced Placement exam, EXEMPT from taking the final exam in that course?

Yes

No

20. If yes, in what school year was the exam exemption policy instituted?

2008-2009

2007-2008

2006-2007

2005-2006

2004-2005

2003-2004

2002-2003

2001-2002

2000-2001

1999-2000

1998-1999

1997-1998

1996-1997

1995-1996

1994-1995

21. If your school is part of any state or federal grant program that includes incentives for Advanced Placement courses, please specify the program, the year it was instituted and the number of years the grant continues at your school.

VITA

Mary Louise Grupe Cirillo, born on December 9, 1952 in Sea Cliff, New York is a citizen of the United States. She graduated from North Shore High School, Glen Head, New York in 1971, received her Bachelor of Science and Master of Science in Biology from St. John's University, Jamaica, New York in 1975 and 1978 respectively. After spending twelve years in the analytical instrument industry, she earned her secondary science teaching certificate from the University of Bridgeport in 1993. She taught in the public schools in Stamford, Connecticut for three years, from 1992 to 1995 and in the Henrico County Public School division for ten years from 1998 to 2008 where she taught both Biology and Advanced Placement Chemistry and chaired the science department. She is currently employed at Benedictine High School as an Advanced Placement Biology teacher, serves as a University Supervisor for secondary science student teachers from VCU, and is an independent education consultant for Virginia Advanced Studies Strategies and Laying the Foundation®. She is also employed as an Advanced Placement Biology Reader for the College Board.