

A Quantitative Analysis of the Association between  
Advanced Placement Access and Equity at High Schools in a Mid-Atlantic State

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## **Dedication**

The author wishes to dedicate this work to his bride of 28 years, Marsha Ann Demaree.

Without the encouragement and support of a beautiful, intelligent, fun, loving, and patient wife, he would not have been able to start or to complete this work.

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The author wishes to acknowledge the encouragement and support provided by so many people along the way. Their advice and kind words provided the guidance and encouragement that I needed when it was needed.

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I also want to thank my four children for their patience in this process. In part because of the rigorous college-level instruction they received at River Hill High School, and later at West Point, Yale, Johns Hopkins, and University of Kentucky, all four have the opportunity to outperform me in all respects. That now includes earning a doctorate; I hope they will reach that milestone at a younger age than I did.

## **Abstract of Dissertation**

### **A Quantitative Analysis of the Association between Advanced Placement Access and Equity at High Schools in a Mid-Atlantic State**

Advanced Placement curricula have become significant components of instruction for high school students in the United States, consuming resources and shaping education in ways that affect high school students both within and outside the AP classroom. Educational research has documented significant gaps in educational equity for some demographic groups and substantial advantages for others. Peer reviewed literature exploring the relationship between the level of educational challenge offered within a school and educational equity within the same school is quite limited. In the absence of the appropriate research, planners and policy makers cannot properly evaluate whether educational strategies emphasizing rigorous instruction, such as is found in AP curricula, would help to address the racial gap in equity, contribute to that gap, or have no effect on educational equity.

The purpose of this quantitative study was to investigate the relationship between the size of a school's program to provide college-level instruction and the racial equity of that program. Quantitative methods were used to answer this question in a single Mid-Atlantic state, using the relative size of each high school's Advanced Placement program, per graduating senior, as an indicator of the size of the school's program to provide college-level instruction to its students. Racial equity was measured by comparing the relative numbers of AP exams per Black or Hispanic graduating senior with the corresponding numbers for all other seniors in the school. Additional qualitative data analysis investigated trends in student choice of AP exams.

Quantitative statistical tests found no statistically significant relationship between the size of a high school's AP program and the rate of Black or Hispanic participation in that program, or between changes in the size of a high school's AP program and changes in the rate of Black or Hispanic participation in that program. This neutral result implies that educational leaders can deal with AP planning and with educational gaps among subgroups of students as separate issues rather than as interrelated topics. Qualitative explorations identified several trends, including an apparent general decrease in the proportion of AP exams taken in English and Mathematics as the size of a school's AP program increases and an apparent changes in the proportions of certain exams, including an increase in the proportion of Science exams taken in Environmental Science, an increase in the proportion of Mathematics exams taken in Statistics, and a decrease in the proportion of Science exams taken in Biology for schools with larger AP programs.

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## **CHAPTER 1: Introduction**

No matter how much evidence you collect, you're always guessing about cause-and-effect, and assuming things . . . Keep testing your guesses against the evidence. Keep trying out new guesses to see if they fit better. Keep looking for new evidence, even if it disproves your old hypotheses. With each step you get just a little closer to that elusive thing called 'the truth.' With each step you see how much farther away the truth is than you ever imagined it to be. (Card, 2006, p. 318)

### **Overview**

Advanced Placement (AP) and International Baccalaureate (IB) curricula have become significant components of the instruction for high school students in the United States, consuming resources and shaping education in ways that affect high school students both within and outside the AP and IB classrooms. In addition to their well-documented status as rigorous curricula that prepare students for college-level work (e.g., Christiansen, 2009; Dutkowsky, Evensky, & Edmonds, 2009; Fowler & Luna, 2009; O'Keefe, 2009; Preston, 2009; Thompson & Rust, 2007), many educators perceive AP and IB as potential tools for school-wide reform, tools that may offer an opportunity to bridge economic, racial, and ethnic educational gaps and thus better prepare at-risk students for college and for careers (e.g., Hale, 2007; Ohrt, Lambie, and Ieva, 2009; Taliaferro & DeCuir-Gunby, 2008).

### **Statement of the Problem**

Significant evidence supports the position that African American and Hispanic students do not on average obtain an education of the same quality as that achieved by

their White and Asian peers (e.g., Conger, Long, & Iatarola, 2009; Donnor, & Shockley, 2010; National Center for Education Statistics, 2011). Educational research has documented significant gaps in educational equity for some demographic groups and substantial advantages for others. To the degree that public education discriminates based on race or ethnicity, or fails to meet the needs of individual students, our generation is falling short in its most important responsibility – preparing the next generation for life in the twenty-first century. Peer reviewed literature exploring the relationship between the level of educational challenge offered within a school and educational equity within the same school is quite limited. In the absence of the appropriate research, planners and policy makers cannot properly evaluate whether educational strategies emphasizing rigorous instruction, such as is found in AP and IB curricula, would help to address the racial gap in equity, contribute to that gap, or have no effect on educational equity.

Given the shortage of peer-reviewed research on this topic, available data do not support a definitive conclusion regarding even the general direction of any relationship between educational quality and equity within individual schools. The terms *quality* and *equity* require definition in the context of education. Sayed and Ahmed provide an excellent summary of the literature on educational quality and equity, addressing the human rights, human capital, and social justice perspectives on educational quality, where quality is defined to include dimensions of effectiveness, efficiency, equality, relevance, sustainability, responsiveness, and reflexivity (2011). Although including equality as part of the definition of quality may have political utility in addressing the problems of post-Apartheid South Africa, where Sayed and Ahmed conducted their research, this definition blurs the distinction between quality and equity, rendering the

task of identifying any association between the two concepts more difficult. My research investigated education using the narrower and more traditional definitions of quality and equity implied by John Dewey's philosophical mandate that: "School facilities must be secured of such amplitude and efficiency as will in fact and not simply in name discount the effects of economic inequalities, and secure to all . . . equality of equipment for their future careers" (Dewey, 1916, p. 44).

In considering accelerated coursework, offerings that represent one aspect of educational quality, one might reason that college-level instruction in high schools could expand through either or both of two natural strategies with opposite implications for the educational equity gap. School leaders could expand their advanced education programs by providing additional advanced offerings to students who are already receiving some advanced instruction, motivated by a perception that those students have demonstrated both the ability and the willingness to work hard enough to benefit from rigorous academic offerings. Educational leaders might also expand their advanced education programs by reaching out to underserved students, whether motivated by equity considerations or by a pragmatic belief that the law of diminishing marginal returns (Harris, 2007, pp. 31-32) implies that a greater gain will result from allocating resources to improving the education of underserved students. Determining which description of the mechanism for expanding college-level offerings describes schools today could provide an indication of whether expanding advanced educational opportunities such as AP instruction has the potential to improve equity, requires compensatory action to avoid further exacerbating educational inequity within individual schools, or can be addressed independently from questions of educational equity.

## Purpose and Research Questions

This research investigated the relationship between the size of a school's program to provide college-level instruction and the racial equity of that program. I explored this question in a single Mid-Atlantic state, using the relative size of each high school's Advanced Placement (AP) program as an indicator of the size of the school's program to provide college-level instruction to its students. I operationalized the relative size of each school's AP program using a quantity that I called the school's *AP Challenge Index*, defined as the ratio of the number of AP exams administered at that school to the total number of seniors in the school, to obtain a measure of the number of AP exams administered per student. The familiar *Challenge Index* used by Jay Mathews in ranking America's best high schools for Newsweek and the Washington Post (Mathews, 2012, para. 1) provided the inspiration for this measure, except that my AP Challenge Index included only Advanced Placement exams. The more familiar general Challenge Index introduced by Jay Mathews also included International Baccalaureate (IB) and the Cambridge Advanced International Certificate of Education (AICE) tests. I excluded IB and AICE tests from my index because of the substantial differences among these three types of exams. I measured racial equity for Black or African American students using the ratio of the AP Challenge Index for Black or African American students to the school's AP Challenge Index for all students except Black or African American students, a ratio that I called the *Black or African American Equity Index*. Similarly, I measured racial equity for Hispanic or Latino students using the ratio of the AP Challenge Index for Hispanic or Latino students to the school's AP Challenge Index for all students except Hispanic or Latino students, a ratio that I called the *Hispanic or Latino Equity Index*.

The major research questions included:

1. Is there an association between the average level of participation in AP programs at a high school and the level of racial equity in AP participation for Black or African American students at that school? I addressed this question by evaluating the relationship between the AP Challenge Indices for schools in this Mid-Atlantic state and the Black or African American Equity Indices for the same schools.
2. Is there an association between the average level of participation in AP programs at a high school and the level of racial equity in AP participation for Hispanic or Latino students at that school? I addressed this question by evaluating the relationship between the AP Challenge Indices for schools in this Mid-Atlantic state and the Hispanic or Latino Equity Indices for the same schools.
3. Is there an association between changes in the average level of participation in AP programs at a high school and changes in the level of racial equity in AP participation for Black or African American students at that school? I addressed this question by evaluating the relationship between year-to-year changes in the AP Challenge Indices for schools in this Mid-Atlantic state and year-to-year changes in the Black or African American Equity Indices for the same schools.
4. Is there an association between changes in the average level of participation in AP programs at a high school and changes in the level of racial equity in AP participation for Hispanic or Latino students at that school? I addressed this

question by evaluating the relationship between year-to-year changes in the AP Challenge Indices for schools in this Mid-Atlantic state and year-to-year changes in the Hispanic or Latino Equity Indices for the same schools.

5. How do the proportions of AP Exams allocated to particular subjects or subject areas change as a school's AP Challenge Index increases? I addressed this question through graphical displays of data and a discussion of those displays.

### **Statement of Potential Significance**

School administrators face numerous pressures, including demands for educational options that will improve the quality of education, raise the school's or district's rankings, and increase educational fairness or equity. Schools rankings based on college-level instruction represent a significant consideration for educational leaders. Dutkowsky et al. noted that, "Unfortunately, another criterion that some high schools use is to improve their standing in the Newsweek ratings of 'America's Best High Schools' . . . based upon tests taken as opposed to success . . . districts chose AP or IB for this reason alone" (2009, p. 276), pointing out that schools may make decisions to boost school rankings even when other choices might provide better educational outcomes for students. Educational leaders deciding whether to expand a school's AP or IB program to meet the needs of gifted, talented, and accelerated students and the demands of parents concerned with a school's perceived status may also consider equity issues. These include whether such an expansion affects other measures of educational performance including indicators of the gap in educational equity, and whether such an effect tends to increase or decrease the equity gap. Despite significant and continuing growth in AP and

IB programs, well-documented gaps remain in AP access and equity, particularly for low-income and Black or African American students ("8<sup>th</sup> Annual AP Report to the Nation," 2012, p. 16-22). Evidence that expanding the AP or IB program also improves educational equity would tend to imply that schools could increase the emphasis on these programs in order to close the educational gap. Evidence of a positive statistical association between the size of an AP program and equity would demonstrate the value of further research to determine whether that association arises from a cause and effect relationship. Evidence of a negative relationship between the size of a school's AP program and the equity of that program would point to the need for a different emphasis or at least mitigating efforts to accompany any expansion of the AP or IB program, in order to avoid increasing the existing educational gap. Although I focused only on identifying a correlation, not causation, the existence of a correlation would imply a need for future inquiry into whether any such relationship results from cause and effect. Even a neutral result, indicating no association between the size or expansion of an AP or IB program and racial or ethnic educational gaps, would suggest that educational leaders could deal with AP or IB planning and with educational gaps among subgroups of students as separate issues rather than as a single unified question.

### **Epistemology and Theoretical Model**

The fundamental question of interest in this research, whether the relative level of AP access for traditionally underserved students varies with the size of a school's AP program, can be directly addressed with classical statistical research and thus most closely matches a quantitative approach. An objectivist epistemology fit this research, leading to an empiricist theoretical perspective. Karl Popper described the scientific

method as a method of elimination in which scientists, “do everything they can in order to criticize and to test the theory in question . . . the theory is criticized from very many different viewpoints in order to bring out those points which may be vulnerable” (1940, p. 404). Popper then defined empiricism as the perspective that, “only experience enables us to decide upon the truth or falsity of a scientific theory,” concluding “some form of empiricism . . . is the only interpretation of the scientific method which can be taken seriously in our day” (pp. 413-414). Thomas Kuhn presented a similar perspective: “Theories are . . . to be evaluated in terms of such considerations as their effectiveness in matching predictions with the results of experiment and observation. Both the number of matches and the closeness of fit then count in favor of any theory under scrutiny” (1983, p. 564). For the purpose of this research, I accepted the empiricist perspective as outlined by Popper and by Kuhn.

This empiricist theoretical model emphasized accurate identification of any association between the independent and dependent quantitative variables. I conducted this research to identify the objective relationship, if any, between the size of a school’s college equivalency program or changes in that program’s size and racial equity or changes in racial equity for that school.

### **Conceptual Framework**

I used the conceptual framework of human capital theory, combined with classical theories of justice in this research. Human Capital Theory centers on the idea that, “individuals and society derive economic benefits from investments in people” (Sweetland, 1996, p. 341). Sweetland summarized the work in Human Capital by researchers Schultz, Becker, and Denison, concluding “Each of the benchmark studies

suggests that a specific type of human capital investment - education - provides economic benefits" (p. 351). Classical theories have described justice in ways that include education as a major factor in a just society (Plato, trans. 1951) and equal or proportionate access and opportunity as one facet of justice (Aristotle, trans. 1931, pp. 1006-1007). These perspectives on justice helped in selecting and clarifying the central research questions for this study. Classical theories do not answer whether justice requires equal educational outcomes or merely an equal opportunity for education that leads to an education commensurate with interest and ability, but they do identify equal opportunity as a minimum baseline. Further, the same research tools can measure progress toward either concept of justice, so the proposed research does not require the selection of one concept of justice over another. Human Capital theory provided a practical reason to make at least the standard of equal educational opportunity a priority, where the practical economic benefit of a well-educated population added to the legal requirement (e.g., *Brown v. Board of Education of Topeka*, 347 U.S. 483, 1954) and the moral imperative of furthering justice.

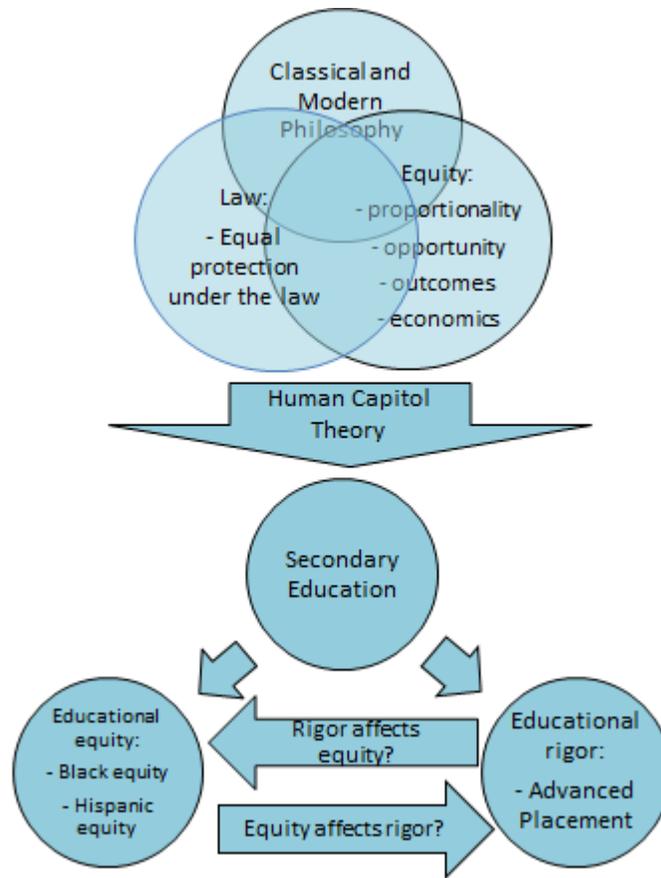


Figure 1: Relationship between conceptual framework and research questions.

### Summary of Methodology

I used a quantitative analysis methodology to investigate the relationships between a measure of the rigor of a public high school's educational program or rate of change in rigor and a measure of the equity of that program or rate of change of equity. I represented rigor with the AP Challenge Indices for individual public high schools in a Mid-Atlantic state, and equity with the Black or African American Equity Index and the Hispanic or Latino Equity Index. I obtained data from the school systems and individual schools in that Mid-Atlantic state.

I used simple linear regression and Spearman's rank order correlation for statistical analysis of the retrospective data obtained, evaluating whether a linear relationship existed between the independent and dependent variables and whether the slope of any such relationship was different from zero. Further, I displayed the pattern of changes in the proportions of AP Exams allocated to particular subjects or subject areas at various levels of a school's AP Challenge Index in appropriate graphical displays.

### **Delimitations and Limitations**

To limit the scope of study to a manageable level and avoid the complexity of addressing the significant potential differences between public and private schools and between magnet or charter schools and neighborhood schools, I restricted my analysis to traditional, non-magnet, public schools. Further, to avoid confounding the effects of differences in educational systems among states with the effects of demographic differences between those states, I restricted my analysis to schools in a single state. The sampling frame for this study excluded private schools, charter schools, and magnet schools because research has suggested that students of different races may enroll at these schools for differing reasons (Conger, Long, & Iatarola, 2009, p. 568), so that the admissions policies of these schools might otherwise have significantly influenced relationships among the variables of interest. More selective or differently organized schools might provide an opportunity for additional research in a separate study, as would the relationships between the variables of interest in other states. Maryland, New York, and Virginia had the highest rates of AP participation in the country in 2011 ("8<sup>th</sup> Annual AP Report to the Nation," 2012, p. 13). Given the approximate doubling in the number of AP exams taken nationwide from 2001 to 2011 and the continuing upward trend in that

number ("8<sup>th</sup> Annual AP Report to the Nation," 2012, p. 13), today's high-performing states serve as an appropriate representation of AP characteristics nationwide over the next decade. Geographically I limited schools in this study to those in a specific high-performing Mid-Atlantic state. Further, I based this study on data from two academic years, the school years ending in 2011 and 2012, and a major change in either public education or social attitudes subsequent to these dates might call into question whether the results of this study would remain applicable under a significantly modified educational system or an evolving social structure.

### **Definition of Key Terms**

- **AP Challenge Index** – For each high school in the study, I defined that school's AP Challenge Index to serve as the independent variable in this study, denoting the ratio of the number of AP exams administered at that school in 2011 and 2012 to the total number of seniors in the school in the same years, in order to obtain a measure of the number of AP exams administered per student. I based this measure on the familiar Challenge Index used by Jay Mathews in ranking America's best high schools for Newsweek and the Washington Post (Mathews, 2012, para. 1), except that my AP Challenge Index included only Advanced Placement exams. The more familiar general Challenge Index also included International Baccalaureate (IB) and the Cambridge Advanced International Certificate of Education (AICE) tests.
- **Black or African American AP Challenge Index** - For each high school in the study, I defined that school's Black or African American AP Challenge

Index, denoting the ratio of the number of AP exams administered to Black or African American students at that school in 2011 and 2012 to the total number of Black or African American seniors in the school.

- **Hispanic or Latino AP Challenge Index** - For each high school in the study, I defined that school's Hispanic or Latino AP Challenge Index, denoting the ratio of the number of AP exams administered to Hispanic or Latino students at that school in 2011 and 2012 to the total number of Hispanic or Latino seniors in the school.
- **Charter School** – The U. S. Department of Education describes charter schools as public schools that:

operate with freedom from many of the local and state regulations that apply to traditional public schools. Charter schools allow parents, community leaders, educational entrepreneurs, and others the flexibility to innovate and provide students with increased educational options within the public school system. Charter schools are sponsored by local, state, or other organizations that monitor their quality while holding them accountable for academic results and responsible fiscal practices. (“School choices for parents,” 2009, para. 7)

For the purposes of this study, the category of charter schools included any public school that identified itself as a charter school.

- **Black or African American Equity index** – The Black or African American equity index is a metric I defined to serve as a dependent variable for this study. This index denotes the ratio of the Black or African American AP

Challenge Index to the school's Challenge Index for all students other than Black or African American students. An Equity Index value of one indicates parity, less than one indicates Black or African American statistical underrepresentation in AP exams, and greater than one indicates Black or African American statistical overrepresentation in AP exams.

- **Hispanic or Latino Equity index** – The Hispanic or Latino equity index is a metric I defined to serve as a dependent variable for this study. This index denotes the ratio of the Hispanic or Latino AP Challenge Index to the school's Challenge Index for all students other than Hispanic or Latino students. An Equity Index value of one indicates parity, less than one indicates Hispanic or Latino statistical underrepresentation in AP exams, and greater than one indicates Hispanic or Latino statistical overrepresentation in AP exams.
- **International Baccalaureate (IB) Schools** - International Baccalaureate schools are those schools listed at the International Baccalaureate Organization website, [www.ibo.org](http://www.ibo.org), as offering an approved International Baccalaureate Diploma Program. The population of interest for this study excludes IB schools because of the significant differences between AP and IB curricula.
- **Magnet School** - The U. S. Department of Education describes magnet schools as public schools that are:
  - designed to attract students from diverse social, economic, ethnic, and racial backgrounds. They focus on a specific subject, such as science or the arts; follow specific themes, such as business/technology or

communications/humanities/law; or operate according to certain models, such as career academies or a school-within-a-school. Some magnet schools require students to take an exam or demonstrate knowledge or skill in the specialty to qualify to go to the school, while others are open to students who express an interest in that area.

(“School choices for parents,” 2009, para. 9)

For the purposes of this study, the category of magnet schools included any public school that identified itself as a magnet school or that had admissions requirements significantly beyond proof of residency within specified geographic boundaries, including schools with admission by test or by lottery. The category of magnet schools in this research did not automatically include schools with a Junior Reserve Officer Training Program open to district students outside the normal school boundaries unless the school mandated uniforms for all students.

- **Traditional Neighborhood School** – For the purpose of this study, I defined a traditional neighborhood school as one in which attendance was primarily determined by residence within specified school attendance boundaries. The category of traditional neighborhood schools specifically excluded charter schools, magnet schools, and IB schools.

### **Summary**

Advanced Placement curricula have become significant components of high school instruction in the United States, affecting education for AP and non-AP students. Many researchers see AP courses as a rigorous option to prepare students for college-

level work, one that may bridge economic, racial, and ethnic educational gaps (e.g., Christiansen, 2009; Dutkowsky et al., 2009; Fowler & Luna, 2009; Hale, 2007; Ohrt et al., 2009; O’Keefe, 2009; Preston, 2009; Taliaferro and DeCuir-Gunby, 2008; Thompson & Rust, 2007). Research has documented significant gaps in AP participation, with African American and Hispanic students showing lower participation in AP programs and in general obtaining an education that falls short of the level achieved by White and Asian students (e.g., Conger, Long, and Iatarola, 2009; Donnor, & Shockley, 2010; National Center for Education Statistics, 2011). Existing research has not clearly documented the relationship, if any, between the overall level of advanced instruction in individual schools and the racial equity of that instruction within those individual high schools.

I designed this research to explore the relationship between the size of a school’s program to provide college-level instruction, or changes in that program’s size, and racial equity, or changes in racial equity, for that school. I operationalized these concepts by narrowing the category of college-level instruction to Advanced Placement only. In this study, I also explored how the proportions of AP Exams allocated to particular subjects and subject areas changed in schools with larger AP programs, in order to add to the impact of the results.

Chapter 2 of this proposal presents a review of current literature regarding justice, the interrelationship between justice and education, existing racial gaps in education, the origins and history of the AP program, the value of the AP program, and educational outcomes for Black or African American and Hispanic or Latino students in AP

programs. Chapter 3 describes the methodology for this study, research questions, statistical hypotheses, and the planned data collection procedures. Chapter 4 presents the study results, and Chapter 5 discusses the conclusions and recommendations for further research.

## Chapter 2: Literature Review

Advanced Placement (AP) coursework has become a significant component of public high school education in the United States, with Maryland, New York, and Virginia leading the country in AP participation ("8<sup>th</sup> Annual AP Report to the Nation," 2012, p. 13). Out of approximately three million high school graduates per year in the United States (Chapman, Laird, Ifill, & KewalRamani, 2011, pp. 46-47), over nine hundred thousand took at least one AP exam ("8<sup>th</sup> Annual AP Report to the Nation," 2012, p. 33). Approximately sixty percent of students who take AP exams pass at least one AP exam with a score of 3 or better ("8<sup>th</sup> Annual AP Report to the Nation," 2012, p. 33), where the College Board scores AP exams on a scale from 1 to 5, with a minimum passing score of 3 and a highest achievable score of 5. Maryland students led the nation in AP performance in 2011, with 27.9% of high school graduates earning a passing score on at least one AP exam, well above the national average of 18.1% ("8<sup>th</sup> Annual AP Report to the Nation," 2012, p. 13). In 2011, New York ranked second in AP participation, and Virginia ranked third ("8<sup>th</sup> Annual AP Report to the Nation," 2012, p. 13).

AP programs have received significant weight when evaluating high school performance. Business Week identified America's best high schools based on criteria that include AP exams ("America's Best High Schools," 2009, para. 2), as did Newsweek ("America's Best High Schools," 2012, para. 1). These rankings in popular magazines have confirmed the public perception of Advanced Placement as an important component of high school education today. Consistent with this perception, peer-reviewed research has documented a strong positive association between AP participation and positive

outcomes for students. Outcomes associated with increased AP participation include improvements in school-wide achievement; in first year college performance; in success within science, technology, engineering, and mathematics majors; and in college graduation rates (e.g., Christiansen, 2009; Dutkowsky et al., 2009; Fowler & Luna, 2009; O’Keefe, 2009; Preston, 2009; Thompson & Rust, 2007). Given this link between Advanced Placement and a broad range of educational outcomes, and given the centrality of justice in questions of educational equity, I began the main body of this chapter with a review of classical theories of justice. I then summarized the history of the Advanced Placement program, research on the value of participation in Advanced Placement, and research on racial disparities in Advanced Placement participation. In performing ERIC and JSTOR database searches for research on the value of advanced placement instruction and on disparities in AP access and performance, I used the key words *Advanced Placement* and *International Baccalaureate* to locate relevant studies from 1950 through the present. Other search terms, such as *African American (or Black) education gap*, *Hispanic (or Latino or Latina) education gap*, and *NAEP* provided additional relevant background information.

### **Classical Theories on Justice and Education**

Philosophers and scholars have addressed the relationships among justice, equality, and education for over 2,400 years. The poetically concise quotation at Delos, “Most noble is that which is justest” (Aristotle, trans. 1931, p. 945), highlighted the importance of being just but failed to clarify what its author meant by *just*. Aristotle’s analysis in *Nicomachean Ethics* presented justice as a broad range of virtuous behaviors

or as a balance between extremes, rather than as a single concept. Aristotle further argued in favor of a two-way link between law and justice:

Since the lawless man was seen to be unjust and the law-abiding man just, evidently all lawful acts are in a sense just acts; for the acts laid down by the legislative art are lawful, and each of these, we say, is just. (Aristotle, trans. 1931, p. 1003)

Aristotle's position that power or an act of legislation determined justice, and that independent moral values did not define justice coincided with the view presented by Thucydides that might makes right. "You know as well as we do that, when these matters are discussed by practical people, the standard of justice depends on the equality of power to compel and that in fact the strong do what they have the power to do and the weak accept what they have to accept" (Thucydides, trans. 1954, p. 402). Livy illustrated the prevalence of that sentiment with his story of a Gaul army led by Brennus defeating a Roman army, taking control of all but the Capitoline Hill in the city of Rome, and demanding tribute. According to Livy, when paying the agreed thousand pounds of gold in ransom, the Roman humiliation was "aggravated by the despicable meanness of the Gauls, who produced unjust weights, and when the tribune protested, the insolent Gaul threw his sword into the scale, with an exclamation intolerable to Roman ears, 'Woe to the vanquished!'" (Livy, trans. 1905, p. 344).

Livy's commentary (trans. 1905) implied that the Gauls had violated an objective standard of justice, a standard beyond simple brute force. Plato presented a logical justification for such an absolute standard in his *Republic*, refuting the statement that "justice is nothing other than the interest of the stronger" while arguing that justice

included "virtue and wisdom" along with "the excellence of the soul" and implicitly defining justice through examples of injustice (Plato, trans. 1974, p. 983). Aristotle, in his extensive discussion of justice in *Nicomachean Ethics*, reasoned that "there is more than one kind of justice," a conclusion similar to that reached in Plato's *Republic*, but one that again failed to provide a clear and concise definition for justice (Aristotle, trans. 1931, p. 1005).

Aristotle narrowed the idea of justice to specific categories of just actions, recognizing that equity constituted one element of justice. Aristotle posited "The laws . . . aim at the common advantage either of all or of the best or of those who hold power" (trans. 1931, p. 1003), in his exploration of different facets of justice. An attractively mathematical portion of this analysis stated:

What is just in distribution must be according to merit in some sense . . . democrats identify it with the status of freeman, supporters of oligarchy with wealth . . . and supporters of aristocracy with excellence. The just, then, is a species of the proportionate . . . the unjust is what violates the proportion.

(Aristotle, trans. 1931, pp. 1006-1007)

In this discussion, Aristotle introduced but never fully resolved a central question on the concept of justice – whether justice required an equality of outcomes for all people, or an appropriate and proportional level of inequality among individuals of unequal merit.

Plato's writings extensively explored the interactions between education and justice. He linked justice to the civic importance of education in his *Republic*, writing that one should take care to protect ordinary citizens from the more powerful guardians of the state. Otherwise, those guardians might become "savage masters instead of kindly allies

. . . And wouldn't a really good education endow them with the greatest caution in this regard" (Plato, trans. 1974, p. 1051). Plato's other writings extended this stance to all citizens. He reasoned in *Timaeus* that "one should make every possible effort to flee from badness, whether with the help of one's upbringing, or the pursuits or studies one undertakes" (trans. 1997, p. 1286), and in *Laches* "What I say we ought to do . . . is to join in searching for the best possible teacher, first for ourselves - we really need one - and then for the young men, sparing neither money nor anything else" (trans. 1973, pp. 687-688). Plato also wrote, in *Laws*, "ask in general what great benefit the state derives from the training by which it educates its citizens" and reasoned that education "will make them good men, and being good they will achieve success in other ways" (trans. 1951, p. 1335). If one accepted Plato's logic regarding the societal value of education, one could reasonably conclude that providing a quality education to all citizens served the interest both of his idealized republic and of a modern state.

Aristotle, in *Topics*, presented a compatible view of the value of developing reasoning skills, although without Plato's direct link to justice: "the ability to raise searching difficulties on both sides of a subject will make us detect more easily the truth and error about the several points that arise" (Aristotle, trans. 1957, p. 144). Similarly, Kant reasoned over two thousand years later:

In academical instruction . . . the student ought to examine the assertions made on both sides of speculative questions step by step, and to test them. . . . and thus he begins early to feel his own power of securing himself against the influence of such sophistical arguments, which must finally lose, for him, all their illusory power. (Kant, 1781/1952, p. 223)

In contrast to the nearly universal reverence for education in Plato's and Aristotle's works, some early Christian philosophers argued that learning had value only when placed in a spiritual context. Later writers saw education as a potential threat to social stability. Saint Augustine wrote "what did it profit me that all the books I could procure in the so-called 'liberal arts' . . . For I had my back toward the light" (Augustine, 397/1999, p. 71). Similarly, Thomas Aquinas observed "Now Scripture, inspired of God, is no part of philosophical science, which has been built up by human reason. Therefore it is useful that besides philosophical science, there should be other knowledge, i.e. inspired of God" (1274/1941, P. 3). Both Augustine and Aquinas thus presented spiritual understanding as of least equal importance to the knowledge from a formal education. Thomas Hobbes went even further in expressing concern about education, arguing for strict censorship of any curriculum that might interfere with social stability (all spelling original):

And as to Rebellion in particular against Monarchy; one of the most frequent causes of it, is the Reading of the books of Policy, and Histories of the antient Greeks, and Romans. . . . From the reading, I say, of such books, men have undertaken to kill their Kings, because the Greek and Latine writers, in their books, and discourses of Policy, make it lawfull, and laudable, for any man so to do; provided before he do it, he call him Tyrant. . . . In summe, I cannot imagine, how anything can be more prejudiciall to a Monarchy, than the allowing of such books to be publikely read, without present applying such correctives of discreet Masters, as are fit to take away their Venime. (Hobbes, 1651/1950, p. 281)

Like Hobbes, John Stuart Mill saw the potential for education to lead to social instability, although he interpreted that possibility as a positive: “Any education which aims at making human beings other than machines . . . makes them claim to have control over their own actions. . . . Even Jesuit education . . . was sufficient to call forth the appetite for freedom” (1861, p. 344).

### **Post-Renaissance Writings on Justice and Education**

Several great enlightenment thinkers have questioned the value of universal education, whether expressing concern over the variable abilities of teachers and of learners, rationalizing that certain races required different education, or arguing that women had less capacity to learn. Rene Descartes advocated limiting the scope of education based on the individual’s mental powers. “He is no more learned who has doubts on many matters than the man who has never thought of them. . . . Hence it were better not to study at all” (1650/1954, p.2 ). Similarly, John Locke addressed the damage done by a flawed education, “There is scarce any one that does not observe something . . . really extravagant, in the opinions, reasonings, and actions of other men . . . usually imputed to education and prejudice, and for the most part truly” (1997, p. 354). Jean Jacques Rousseau also presented a negative view of education, which he condemned for amplifying innate differences. Rousseau argued that an idealized state of nature produced only negligible inequality and criticized education, “which may have improved the human understanding while depraving the species, and made man wicked while making him sociable; so as to bring him and the world . . . to the point at which we now behold them” (1754/1993, p. 348). In *War and Peace*, Tolstoy’s Prince Andrew questioned the value of educating people above their station. “You talk of schools. . . . you want to raise

him . . . and awaken in him spiritual needs. . . . you want to make him what I am, without giving him my means” (1869/2007, p. 385). Adam Smith similarly warned against public education, with his caution based on the absence of a connection between education and any productive outcome, questioning the quality of public education and praising policies that excluded women from that education:

In modern times, the diligence of public teachers is more or less corrupted by the circumstances which render them more or less independent of their success and reputation in their particular professions. . . . Were there no public institutions for education, no system, no science would be taught for which there was not some demand, or which the circumstances of the times did not render it either necessary, or convenient, or at least fashionable, to learn. . . . There are no public institutions for the education of women, and there is accordingly nothing useless, absurd, or fantastical in the common course of their education. (1776, p. 340)

Although not endorsing educational inequality, the United States Supreme Court opinion in *Brown v. Board of Education of Topeka* observed that in the United States immediately after the Civil War “education of Negroes was almost nonexistent, and practically all of the race were illiterate. In fact, any education of Negroes was forbidden by law in some states” (*Brown v. Board of Education*, 347 U.S. 483, 1954). Frederick Douglass, in his 1894 commencement address at the Colored High School of Baltimore, said:

The Negro is, and of right ought to be . . . entitled to justice, liberty and equality before the law, to education and to an equal chance with all other men in the race of life and in the pursuit of happiness. . . . A little learning, indeed, may be a

dangerous thing but the want of learning is a calamity to any people, and to no people more than to the Colored People of this country. Ignorance for us means poverty, and poverty means degradation, and degradation brings contempt and persecution. . . . The existence of this High School in the city of Baltimore is a triumphant rebuke to any cry of despair. . . . The Negro in ignorance and in rags, meets no resistance. He is rather liked. He is thought to be in his place. It is only when he acquires education, property and influence, only when he attempts to rise and be a man among men that he invites repression. (Bragg, 1914, pp. 44-45)

Frederick Douglass spoke in this address almost uncritically in favor of education as the key to rising in our society, an appropriate position to take in a graduation speech. In contrast, Booker T. Washington argued more selectively for what he saw as the right kind of education, a practical education compatible with available employment, as he wrote of the late 1800s:

Negro men and women were educated in literature, in mathematics and in the sciences. . . . There were young men educated in foreign tongues, but few in carpentry or in mechanical or architectural drawing. Many were trained in Latin, but few as engineers and blacksmiths. Too many were taken from the farm and educated, but educated in everything but farming. For this reason they had no interest in farming and did not return to it. And yet eighty-five percent of the Negro population of the Southern states lives and for a considerable time will continue to live in the country districts. (Washington, 1903, p. 7)

In these passages, Douglass and Washington both emphasized appropriate educational opportunity as a key factor in rising to an equal position in American society, an opportunity previously denied to Negroes.

The topic of women's education and intellectual ability has remained controversial, long after Adam Smith's comments, as demonstrated by Harvard University's president, Larry Summers, in 2005. Summers argued that innate differences in ability represented a significant factor in the underrepresentation of women in tenured positions at the most prestigious universities:

It is after all not the case that the role of women in science is the only example of a group that is significantly underrepresented in an important activity and whose underrepresentation contributes to a shortage of role models for others who are considering being in that group. . . . There are three broad hypotheses about the sources of the very substantial disparities . . . the first is what I call the high-powered job hypothesis. The second is what I would call different availability of aptitude at the high end, and the third is . . . different socialization and patterns of discrimination in a search. And in my own view, their importance probably ranks in exactly the order that I just described. . . . on many, many different human attributes -- height, weight, propensity for criminality, overall IQ, mathematical ability, scientific ability -- there is relatively clear evidence that whatever the difference in means -- which can be debated -- there is a difference in the standard deviation, and variability of a male and a female population. ("Harvard President Summers' remarks," 2005, para. 5-15)

Although several of the above Renaissance and later writers have presented concerns regarding the pitfalls associated with education, the positions held by many current writers and especially by educational theorists for the most part matched the positive view of education found in Plato and Aristotle.

Rawls and Nozick extensively analyzed justice in the second half of the twentieth century, with an emphasis on economic opportunities and outcomes. John Rawls argued for two principles of justice: “Each person is to have an equal right to the most extensive scheme of equal basic liberties compatible with a similar scheme of liberties for others” and “social and economic inequalities are to be arranged so that they are both (a) reasonably expected to be to everyone’s advantage, and (b) attached to positions and offices open to all” (1971, p. 53). Rawls’s first principle of justice would logically have included an equal right to education. Robert Nozick extensively criticized numerous elements in Rawls’s theory of justice, arguing that Rawls failed to justify his starting assumptions and advocating instead a position that:

- (1) People are entitled to their natural assets.
- (2) If people are entitled to something, they are entitled to whatever flows from it (via specified types of processes).

- (3) People's holdings flow from their natural assets.

Therefore,

- (4) People are entitled to their holdings.
- (5) If people are entitled to something then they ought to have it (and this overrides any presumption of equality there may be about holdings). (1973, p. 121)

Nozick argued that individuals have a right to the free exchange of their goods and services and thus to any distribution of assets that arises from free market exchanges, implicitly assuming that even a large number of voluntary exchanges of goods and services cannot introduce injustice, and attributing the position held by Rawls to envy (Nozick, pp. 121-124). Nozick's reasoning supported the natural level of property inequality among individuals of unequal merit. Rawls, in contrast, advocated for equality of property outcomes for all as an ideal, with deviations permitted only when such deviations raise the welfare of the least well off. Thus, even as recently as the 1970s, prominent philosophers continued the debate highlighted by Aristotle over the criteria and basis of a just distribution (trans. 1931, pp. 1006-1007), without having reached a compelling answer to these questions.

Equity and equality theories to a substantial extent parallel theories of justice. As one example, Dworkin's reflections on equality compare the two perspectives "equality of welfare . . . transfers resources among them (people) until no further transfer would leave them more equal in welfare . . . equality of resources . . . transfers so that no further transfer would leave their shares of the total resources more equal" (1981, p. 186). The subsequent discussion dismissed those who "hold meritocratic theories of distributional equality . . . often called equality of opportunity" (p. 188) without providing a logical justification for preferring equality of outcomes to equality of opportunity. Although academically interesting, resolving these central questions of equality and associated equity distinctions addressed in such articles lies well beyond the scope of a dissertation or even a career. Further, the research planned in this dissertation proposal does not require such a resolution because the proposed research provides insight into the equality

and justice of high school education regardless of the preferred perspective on the appropriate definition of “equality”.

John Dewey provided a particularly clear and logical argument on equality and education, one that has shaped modern educational theory. Dewey defined the general purpose of education: “Education, in its broadest sense, is the means of this social continuity of life,” because, without formal education, “it is not possible to transmit all the resources and achievements of a complex society” (1916, p. 3). Dewey continued with an indictment of modern educational practice that has remained as applicable throughout subsequent generations as in his lifetime:

Why is it, in spite of the fact that teaching by pouring in, learning by a passive absorption, are universally condemned, that they are still so entrenched in practice? That education is not an affair of "telling" and being told, but an active and constructive process, is a principle almost as generally violated in practice as conceded in theory. (p. 16)

Dewey expressed this concern because he saw ineffective efforts at teaching as one of the obstacles to a culture gaining both the maximum possible participation from all individuals and the maximum possible return from the resources devoted to education.

Dewey articulated an ideal for education that embraced Aristotle’s notion of justice as proportionality “School facilities must . . . in fact and not simply in name discount the effects of economic inequalities, and secure to all the wards of the nation equality of equipment for their future careers” (1916, p. 44). He later summarized the education debate over the significance of differences in innate ability:

Before the time of Rousseau . . . All the differences between peoples and between classes and persons among the same people were said to be due to differences of training, of exercise, and practice . . . This essential identity of mind means the essential equality of all and the possibility of bringing them all to the same level. As a protest against this view, the doctrine of accord with nature meant a much less formal and abstract view of mind and its powers. It substituted specific instincts and impulses and physiological capacities, differing from individual to individual (just as they differ, as Rousseau pointed out, even in dogs of the same litter), for abstract faculties of discernment, memory, and generalization. . . . It means, in effect, that great as is the significance of nurture, of modification, and transformation through direct educational effort, nature, or unlearned capacities, affords the foundation and ultimate resources for such nurture. (1916, p. 53)

Dewey's position on proportionality and equality struck a balance between the concepts of nature and nurture as the source of differences among adults, reminiscent of the link between proportionality and justice articulated by Aristotle (trans. 1931, pp. 1006-1007). Dewey similarly argued "A third undesirable result is the substitution of a conventional average standard of expectation and requirement for a standard which concerns the specific powers of the individual under instruction" (1916, p. 26). Dewey further emphasized his conclusion that education must be individualized based on both interest and ability "An educational aim must be founded upon the intrinsic activities and needs (including original instincts and acquired habits) of the given individual to be educated" (p. 49).

State Constitutions and the Constitution of the United States have also addressed education directly or indirectly. The Constitution of Maryland required “throughout the State a thorough and efficient System of Free Public Schools” (“Maryland Constitution,” Article VIII, Section 1). The Maryland Court of Appeals delivered an opinion in *Hornbeck v. Somerset County Board of Education* that under the “thorough and efficient” constitutional language “education need not be ‘equal’ in the sense of mathematical uniformity, so long as efforts are made, as here, to minimize . . . disadvantages on any given child. The current system, albeit imperfect, satisfies this test” (1983, p. 776). The Constitution of the Commonwealth of Virginia mandated more specifically that “The General Assembly shall provide for a system of free public elementary and secondary schools for all children of school age throughout the Commonwealth, and shall seek to ensure that an educational program of high quality is established and continually maintained” (“Constitution of Virginia,” Article VIII, Section 1). Virginia’s Supreme Court found in *Scott v. Commonwealth* that “education is a fundamental right under the Constitution. . . . however, we hold that nowhere does the Constitution require equal, or substantially equal, funding or programs among and within the Commonwealth’s school divisions” (1994, p. 143). The courts have thus interpreted these state constitutions to allow substantial local control over education. In contrast, several United States Supreme Court rulings over the past six decades addressed the relationship between justice and education more forcefully. Under a range of theories, stretching back to the classical Greek perspective that the law is inherently just but also consistent with Dewey’s comparatively modern positions, these state and federal constitutional mandates and judicial opinions represent an expression of justice. The 1896 *Plessy v. Ferguson* opinion

finding that separate but equal accommodations for White and Colored persons on trains in Louisiana did not violate the thirteenth and fourteenth amendments to the Constitution of the United States was overturned, at least in the context of education, by the 1954 Supreme Court opinion that “segregation is a denial of the equal protection of the laws,” an opinion explicitly recognizing that “education is perhaps the most important function of state and local governments” and that “segregation of children in public schools solely on the basis of race” does “deprive the children of the minority group of equal educational opportunities” (*Brown v. Board of Education of Topeka*, 347 U.S. 483). This ruling found that such segregation was unlawful because it was inherently unequal, which under standards articulated by Plato and Aristotle also rendered segregation and other educational structures resulting in unequal educational opportunities unjust. In 1971, the Supreme Court rendered an opinion in favor of the “remedial technique of requiring bus transportation as a tool of school desegregation,” again for the purpose of promoting the educational equality required by justice and by the law (*Swann v. Charlotte-Mecklenburg Bd. of Educ.*, 402 U.S. 1).

In summary, the survival of a society requires education, which makes schooling one of the most important functions of government. Consideration of justice in the context of government thus must include educational equality, whether equality of opportunity or equality of outcomes. If one accepts Aristotle’s maxim that “all lawful acts are in a sense just acts” (trans. 1931, p. 1003), then justice requires some form of educational equality in the United States, because the Supreme Court has said that the Constitution requires equal educational opportunity as one facet of equal protection. Even if one only accepts Aristotle’s more nuanced position that “the just, then, is a species of

the proportionate . . . the unjust is what violates the proportion” (trans. 1931, p. 1006-1007), then justice at least requires the form of equity advocated by John Dewey, favoring “a standard which concerns the specific powers of the individual under instruction” to “discount the effects of economic inequalities, and secure to all the wards of the nation equality of equipment for their future careers” (Dewey, 1916, p. 26).

### **Racial Gaps in Education**

Measures such as the Department of Education’s National Assessment of Educational Progress (NAEP), which have regularly evaluated nationwide educational performance in grades 4, 8, and 12, have provided some indication of the gap between the above standards of justice and the current performance of public education in the United States. The NAEP has since 1990 published regular assessments of the achievement gap between White and Hispanic students in math and reading (Hemphill, & Vanneman, 2011, p. 1) and since 1978 for the achievement gap between White and Black students in math and reading (Vanneman, Hamilton, Baldwin Anderson, & Rahman, 2009, p. 3). Although these reports have shown statistically significant reductions in educational gaps in some areas, the NAEP has continued to show group differences in math and reading performance in the United States, with White students outperforming Black and Hispanic students. These reports used sample sizes of well over 100,000 students in NAEP math and reading assessments, with representative samples from each state, and the Long Term Trend NAEP data included samples of over 7,000 students. The College Board, which runs the Advanced Placement program, has generated annual reports that have shown a significant educational gap, with substantially lower AP participation for Black or African-American students than for White students, and a much smaller though still

measurable gap for Hispanic or Latino students ("8<sup>th</sup> Annual AP Report to the Nation," 2012, p. 16).

Peer reviewed research has documented similar findings. As one example, Bali and Alvarez (2004) explored the development of the education gap for Black and Hispanic students in a well-designed quantitative study analyzing over a thousand students in a southern California school district that included a substantial non-White student body, including 52% Hispanic and 29% Black students in the district as a whole. Bali and Alvarez found that the Hispanic-White educational gap began after the first grade, especially in math, and the Black-White educational gap began at or before the first grade (p. 404). These researchers concluded that the achievement gaps for Hispanic and Black students grew with age, and that the gap for Black students grew more than that for Hispanic students, although the school district under study had an unusually low percentage of White students, 13%, so these results may not generalize to school districts throughout the country with substantially different demographics. Donner and Shockley observed that in the United States, 70% of African American males entering ninth grade will not graduate within four years (2010, p. 43). Other research has confirmed racial disparities in the context of AP participation (Hale 2007; Kyburg, Hertberg-Davis, & Callahan, 2007; Solorzano & Ornelas, 2004; Taliaferro & DeCuir-Gunby, 2008; Venkateswaran, 2004).

### **History of the AP Program**

The Advanced Placement program developed from research published in the early 1950s and funded by the Ford Foundation, in particular from the School and College Study of Admission with Advanced Standing (Vance, 1961, p. 492). In these studies,

teams of experts from high schools and colleges “spent that academic year . . . designing a course at the secondary level that would be the equivalent of one year of college work” (p. 493-494). The College Board took charge of this program in 1955, and their college-level program became known as the Advanced Placement Program (p. 495). Referring to mathematics in particular, Vance observed “Thus, the Advanced Placement Syllabus has received almost universal acceptance and its present course description appears to be agreeable to all” (p. 494).

The director of the School and College Study of Admission with Advanced Standing provided a first person account of the decisions involved in the creation and early evolution of the AP Program (Cornog, 1957). Cornog wrote that in the early 1950s, educational leaders representing twelve high schools and twelve colleges agreed upon basic assumptions for the acceleration of able students, including that the best place for a school-age child was in school and that the best teachers for those children were in schools (p. 50). These assumptions led to the development of approximately twelve courses for a pilot study conducted during school years 1953-1954 and 1954-1955, during which high school students studied college level material and then took a written exam, with the same exam administered to college students studying the same material. Cornog articulated a moral case for Advanced Placement: "The school must be persuaded that it has a very serious obligation . . . to stretch the minds of these students . . . commensurate with the abilities of the ablest students" (p. 50). The College Entrance Examination Board (CEEB), now known as the College Board, assumed control of this educational acceleration program and administered the first set of twelve AP exams in

May of 1956 (p. 52). The CEEB administered these exams to over one thousand students from 110 schools, and, as in the pilot study, the CEEB administered the same examination to college students enrolled in comparable introductory college courses for the various subjects. Fifty-five years later, Trevor Packer, the College Board's Senior Vice President for Advanced Placement, described the AP program in remarkably similar terms, stating that professors at "institutions like Duke, Stanford, University of California–Berkeley, University of Texas at Austin, and Yale . . . piloted AP Exam questions . . . to confirm comparability of content, skills and rigor" (Packer, 2012, para. 4). Packer's statement confirmed that, although new AP courses and grading standards have evolved over the years, the core philosophy of aligning AP courses with the corresponding college courses remained relatively unchanged.

### **Value of the AP Program**

Given the observed racial disparities in education, peer-reviewed research addressing the value of AP coursework and exams has taken on added importance in the context of educational equity. Extensive research has documented a strong positive association between AP participation by students and desirable outcomes in high school and in college for AP students. Outcomes associated with increased AP participation included improvements in school-wide achievement; in first year college performance; in success within science, technology, engineering, and mathematics majors; and in college graduation rates (e.g., Christiansen, 2009; Dutkowsky et al., 2009; Fowler & Luna, 2009; O'Keefe, 2009; Preston, 2009; Thompson & Rust, 2007). Several studies have, however, questioned the benefit of AP participation: based on comparisons with high-achieving

non-AP students (Williams, 2010, p. 82), based on a comparison of AP students who did not receive credit for the associated course against non-AP students (Sadler & Tai, 2007a), and in a primarily theoretical critique (Casement, 2003).

Administrative decisions at most American colleges and universities to give credit or placement for satisfactory scores on AP exams (Dutkowsky et al., 2009, p. 267) indicate that college administrators have accepted both the academic rigor of courses that prepare students for these exams and the validity of the exam results. Extensive peer-reviewed research has generally confirmed the benefits of AP programs. Fowler and Luna argued in their literature review article that credit-based transition programs that included AP courses increased high school graduation rates, eased the transition from high school to college, and improved the academic preparation of participating students (2009, p. 72). Further, they noted that AP credits saved money by providing a college-level education and college credits at a substantially reduced cost in the high school setting, potentially permitting early graduation with fewer semesters of tuition at a university (p. 69). A well-designed statistical study conducted by Dutkowsky, Evensky, and Edmunds (2009) documented the widespread acceptance of Advanced Placement among American colleges. These authors reviewed college and university web sites from a nationwide stratified random sample of 240 colleges and universities, including sixty offering master's degrees, sixty with doctorates, and one hundred twenty that only offered a Baccalaureate degree. In this study, thirty-one schools (13%) did not post an AP policy on their websites, only the California Institute of Technology explicitly refused to grant AP credit, and the remaining 208 schools (87%) accepted AP exams for credit (Dutkowsky et al., 2009, p. 267). Among those schools listing the required AP exam

scores for credit, a substantial majority awarded credit for scores of 3 or higher on courses such as Calculus AB and English Literature, although roughly one third of colleges and universities required at least a 4, and a few colleges and universities required a 5 to receive AP credit (Dutkowsky et al., 2009, pp. 267-268). This study might have provided more precise answers if the authors had sought additional information from the thirteen percent of colleges and universities with no AP policy information on their websites, making an extra effort to obtain the relevant information from those additional schools. Even without this extra investigation, the study provided clear evidence that AP exams have general acceptance among colleges and universities in the United States.

### **Improved Performance for Non-AP Students**

In an expansion of the search for AP effects, Christiansen investigated whether the benefits of a large AP program applied to the entire high school and not just to AP students (2009, p. 76). Christiansen found, based on a regression between the proportion of AP students in public high schools in Florida and the school's average score on a standardized statewide test, that schools with larger AP programs also scored higher on the statewide test. These results held even after accounting for other variables such as free and reduced price lunch rates, and the authors concluded that ( $p < .01$ ) "school-wide student achievement on standardized tests increased through an increase in the number of students participating in the AP program" (p. 7). The positive results of Christiansen's study could have resulted from other causes, such as from students who performed well on the standardized test having selected AP courses, and some schools having a larger proportion of students who tested well, rather than from an increase in achievement that spreads beyond AP students to boost the performance of all students. However, Shaw,

Marini, and Mattern found a negative association ( $p < .001$ ) between the proportion of offered AP exams taken in high school and freshman year GPA in college among students (2013, p. 243). The authors interpreted this as evidence that “students at high schools that offered more AP courses, even if they do not take the AP courses, tend to perform better in college than students at high schools offering fewer AP courses—clearly signaling the role of high school rigor in college preparedness” (p. 246). Additional research might clarify the appropriateness of this interpretation.

### **Student Assessment of the AP Experience**

AP students who have reached college rated their AP courses highly. Thompson and Rust (2007) used a small sample including twenty-nine AP students and twelve high-achieving non-AP students selected from a state university in the South. Their participants included volunteers who participated in their study for extra credit and psychology majors who were required to participate in the volunteer pool as subjects for their study (p. 418), so the sample may not be representative of all college students. These authors found, as anticipated, that study participants rated their high school AP courses higher than their non-AP courses on a Likert scale from 1 to 5, with  $t(26) = 2.07$  ( $p = .05$ ), and that AP students liked their AP courses better than their non-AP courses (p. 419). The authors also expected that AP students would rate their AP courses higher than non-AP students would rate their non-AP courses, but the data showed ( $p = .84$ ) no significant differences in this measure (p. 419). Thompson and Rust did not discuss the additional consideration that AP students who received AP credit for introductory level courses might have selected different college classes than their non-AP peers, affecting their likelihood of participating in this study. Hertberg-Davis and Callahan reached

similar conclusions using a larger sample with 200 students (2008). In this study, AP students again described AP coursework as more challenging than other work, with dedicated, hardworking, and knowledgeable teachers who helped them to get the best education available in their high schools (2008, p. 207-209). Roughly ten percent of AP students in this study had left the AP program, in most cases because they found the AP curriculum rigid or otherwise unsuited to their unique needs (p. 209-210). These dissatisfied students should serve as a reminder that, even if AP courses have benefitted many students and schools, AP does not provide a universal solution to the challenge of educating high-performing high school students.

Research on Ohio postsecondary enrollment opportunities found that students in Ohio, given a choice between dual enrollment and AP courses, preferred the AP program, a preference that led to lower than expected utilization of dual enrollment (Smith et al., 2007). This qualitative study used surveys and focus group interviews to investigate why AP students decided against dual enrollment. The authors found that both the academic rigor of AP courses ( $t=4.02, p < .001$ ) and satisfaction with high school AP offerings ( $t=4.75, p < .001$ ) ranked as high priorities for AP students who chose that program over dual enrollment at a college (p. 94). This study also found that students respected their AP teachers and that current AP students had received positive testimonials about the value of AP coursework from former AP students (p. 99).

Similarly, a survey of 88 adults who had participated in various forms of gifted education, selected from a longitudinal study of the top two to five students in their graduating classes and from National Merit Scholars in a Midwestern state, demonstrated widespread support for AP programs. The authors reported that 88 percent of study

participants would support placement in advanced classes for their children, and only 2 percent would oppose such placement for their children (Perrone, Wright, Ksiazak, Crane, & Vannatter, 2010, p. 134). Given this survey's high (73 percent) response rate, the overwhelming support for advanced education programs among survey respondents suggested that participants generally valued their AP experiences. This study, however, only surveyed the most academically elite adults, so the results may not accurately reflect the perceived value of AP and IB curricula for advanced students below this top tier. Further, 94% of participants classified themselves as Caucasian (p. 129), so the results may not generalize to other demographic groups, represented by only a small number of participants in this study. In another study, researchers Reid and Moore found in their extensive interviews with 13 first-generation college students from a single urban high school that all eight of the students who had participated in AP classes considered those classes beneficial, and that three of the five students who had not taken AP courses would recommend AP courses to help prepare other students (2008, pp. 246-248). In an analogous study, 26 Canadian IB program graduates responded similarly when ranking aspects of their IB experience on a Likert scale, overwhelmingly approving of the depth and breadth of coverage and of their resulting preparation for postsecondary study (Taylor & Porath, 2006, pp. 154-155). Although these last two studies used small samples, the work by Reid and Moore and by Taylor and Porath indicates that the advantages of AP classes may extend beyond the narrow demographic of Caucasian students in the United States.

## College Success for AP Students

Shaw et al. found in a previously mentioned study that college admissions officers consider AP performance, both the number of AP exams taken and the average score for those exams, in college admissions and that the emphasis on these factors has increased (2013, p. 247). This well-designed quantitative study used hierarchical linear modeling with a sample of over 250,000 AP students who entered college in 2008 to predict freshman year GPA based on high school data. Their results showed ( $p < .001$ ) that mean AP exam score provided statistically significant predictions of freshman year GPA in college, second only to high school GPA (p. 249).

In a dissertation that presented a well-designed statistical comparison using a two-sample t-test for quantified survey responses, Preston (2009) found that students with an AP background experienced more success  $t(67) = 8.08, p < 0.001$ , in their first year of college than peers who had no AP exposure (pp. 74, 122). O'Keefe conducted a similar study, finding a positive association  $F(3, 3509) = 3.844, p = .009$  between four-year graduation rates and AP participation (2009, p. 31). Meek and Morton observed that participating in AP Economics improved both performance in higher-level economics courses and educational equity (2009, p. 82).

Flowers, in a study based on human capital theory, investigated associations between AP participation and multiple outcomes (2008). These outcomes included college entrance examination scores, undergraduate grade point average, highest degree obtained, and later incomes. Based on an analysis of data from the National Educational Longitudinal Study, Flowers found statistically significant associations between AP participation and improved outcomes in all four metrics ( $p < .05$  for each of these

associations), with larger effects for Asians, Pacific Islanders, and White participants than for African American and Hispanic AP students (pp. 128-129). As with any observational study, the conclusions of Flowers's work do not imply cause and effect.

AP students also earned higher grades in college than their non-AP peers received. Sadler and Tai conducted a study comparing AP exam scores to college grades earned in introductory college biology, chemistry, and physics courses (2007b). The authors acknowledged that their study faced multiple challenges, including that AP students are in many cases self-selected from among the most highly motivated high school students, and that students who do well on the AP exam and feel confident in their subject matter knowledge are likely to accept credit for the course and not retake the same course. The authors used a well-designed survey in collecting data, and they explained in detail their analysis of the survey results and their treatment of missing responses for individual questions. Their results showed strong associations between college science course grades and five different variables from the student's high school experience: AP science exam scores, highest math grade, most advanced math course, SAT math score, grade received in the regular or honors version of the associated science course, and highest science course type (pp. 11-12). These associations, however, translated to just under half of a letter grade difference between students who received a 3, which the College Board considered the minimum passing score, and those who received the maximum possible score of 5 (pp. 13-14). The authors pointed out multiple potential explanations for the observed letter grade improvement associated with a high AP score being less than would be expected under the College Board's interpretation of its grading scale. Differences between the focus on a single test with the AP exam and the

broader grading of a college science course that included lab work and other graded assignments might explain this result (pp. 14-15). Alternatively, overgenerous AP exam scoring in which a 3 may not justify receiving credit could factor into the observed outcome (pp. 14-15), a point on which several colleges may agree, as indicated by some colleges and universities requiring an AP exam score of 4 for credit (Dutkowsky et al., 2009, p. 268). Further, the authors recognized that results might differ if the study could include students who felt confident enough to accept credit for the course (2007b, p. 16). The study concluded that AP had significant value in science, but that for the students in this study other background variables explained performance in college as well as AP exam scores (2007b, p. 17). Hansen et al. expressed a similar concern over whether AP exam scores of 3 justified receiving credit for English Composition, taking the position that this decision depended on the university, the university's course offerings, and the student's ability (2006, p. 484).

### **Adverse Research on AP Value**

AP programs also received mixed or negative reviews in some research. Casement provided extensive criticism of the AP program based on theoretical and anecdotal considerations (2003). Casement echoed Sadler and Tai's point (2007b) that a passing score should require at least a 4 on the AP exam (p. 14). This author observed that quality may have declined as students and teachers became associated with AP courses after less screening than when the AP program originated, citing examples of colleges that required scores of 4 or even 5 to receive credit based on AP exam results (p. 14). Casement provided no empirical research to support his criticisms, instead objecting to the availability of AP coursework to large numbers of high school students who "while

they are college bound, will not be mistaken for the top echelon of high school seniors,” and continued “it is not reasonable to expect these students to read college texts, comprehend college-level concepts, and move at a pace necessary to complete a college level course successfully” (p. 18). In contrast to Casement’s criticisms, Hale found that, even for students at the bottom of a below-average high school, rigorous AP English instruction produced positive outcomes (2007). Further, one might expect that if students unprepared for the rigors of college level work entered AP and International Baccalaureate (IB) programs in high school, they would experience substantial increases in stress. Instead, studies of stress levels for AP and IB students found that those students experienced only slightly higher stress levels than their non-advanced peers in the same school, with these differences statistically significant but not large;  $t = -2.77$ , ( $p < .01$ ), and a Cohen’s  $d$  effect size of 0.32 (Sudlo, Shaunessy, & Hardesty, 2008, p. 280). Additional research using qualitative data from 141 students in a rural southeastern school concluded that AP and IB students coped with stress in a manner similar to their non-advanced peers (Shaunessy & Sudlo, 2010, p. 134). Casement further questioned the credentials of AP teachers and the propriety of students receiving both high school and college credit for the same AP course (2003, p. 22). Although Casement provided an extensive critique of AP programs, he provided no empirical evidence in support of most of his criticisms, and numerous other studies reached more positive conclusions regarding the value of AP course work (e.g., Christiansen, 2009; Dutkowsky, Evensky, & Edmonds, 2009; Fowler & Luna, 2009; O’Keefe, 2009; Preston, 2009; Sadler & Tai, 2007b; Thompson & Rust, 2007).

In a theoretical article, Schneider expressed concerns about the long-term prospects for AP programs based on the tendency of highly elite schools to differentiate their curricula from those of other schools (2009). Schneider discussed the potential for elite high schools to move away from AP programs, questioning whether AP programs will last as a tool for increasing educational equity, although he did not question the value of an AP education (p. 826). My quick review of the official websites associated with elite private schools from the 2010 Forbes selection of “America's 20 Best Prep Schools” showed that nine of the top ten prep schools as ranked by Forbes (Laneri, 2010) still offered AP courses. It should be noted that the Philips Exeter Academy, ranked sixth by Forbes, website reported declining participation in Advanced Placement at Exeter but also advertised the large number of AP courses and exams offered (Hassan, 2013, p. 63); and the Spence School, ranked ninth among the Forbes 20 best prep schools, did not offer any AP courses but described two of its calculus courses as equivalent to AP Calculus AB and AP Calculus BC (“The Spence School,” n.d., para. 7-8). Any move away from AP offerings in these elite high schools appeared to be either limited in scope or slow in pace. The previously mentioned Dutkowsky et al. study found widespread acceptance of AP exams in American colleges and universities (2009). An update to this study might show whether the hypothesized trend away from AP among elite private high schools has spread to college and university policies.

A high school English teacher also questioned the value of AP English and of automatically choosing AP courses to make the school statistics look good rather than choosing the course that best matches the needs and interests of that school’s students (Daddone, 2008, pp. 76-77). Daddone emphasized the importance of protecting his

journalism program from AP competition, and he used a convenience sample with no evidence that his sample was representative of high school students who faced a choice between AP English and another advanced English elective (pp. 78-79). Despite the potential for bias in his sample selection, Daddone's point that AP courses did not always represent the best among rigorous options for a particular student had validity. This article served as a reminder that, although AP courses offered a rigorous curriculum, other options may also provide a high-quality education, one better suited to meeting the needs of some students. Finally, one qualitative study of Latina and Latino experiences in high school found that AP and IB instruction shaped the expectations of teachers because of the labeling of students, with high expectations for students in these programs and low expectations for the remaining Hispanic students (Cavazos & Cavazos, 2010, pp. 100-102). This study illustrated the potential risk that a student's decision not to participate in AP courses might affect teacher expectations for that student, and that the expansion of a school's AP program might increase the gap in expectations between AP and non-AP students.

### **Factors Associated with AP Enrollment**

Several studies have evaluated factors that may be associated with AP enrollment. Li, Alfeld, Kennedy, and Putallaz (2009) studied the association between middle school participation by students in a Duke University summer program based on a talent search and later advanced course taking by the same students in high school. Although the authors otherwise appeared to have designed their survey well, they excluded participants who continued their summer program participation into high school to avoid confusion between the benefits of the middle school program and the benefits from high school

summer program participation (pp. 410-411). Excluding those who continued their participation into high school may have selectively excluded students who perceived the summer program as most beneficial, potentially causing the study to understate the value of Duke's summer program in preparing students for AP work. Further, the low response rates of 23 percent to 31 percent may have induced a response bias that could have affected their results (p. 422). Despite these limitations, Li et al. used ANOVA and ANCOVA to find that participants in the Duke mathematics summer program took more AP math courses during high school than those selected who did not participate, with  $\text{Chi-squared} = 5.67$  ( $p = .02$ ), but they found no significant association for the summer programs in science (pp. 425-426).

Barber and Torney-Purta (2008) evaluated teacher nominations for advanced programs using cluster samples of approximately 26 students from each of 752 public, private, and parochial schools. These researchers studied high-achieving students, defined as those scoring in the top decile for their grade on the math or English sections of the Educational Longitudinal Study of 2002, a standardized test. In answer to a question on whether they had ever recommended these high achieving students for AP or honors classes, teachers were given choices of *yes*, *no*, or *not applicable*, and the researchers removed responses indicating *not applicable* from analysis, under the assumption that the schools offered no honors or AP classes (p. 421). The removal of students marked as *not applicable* may also have removed students who selected programs that did not require a teacher nomination for participation in these advanced programs, resulting in the loss of useful data. After this screening, over 1,000 high-achieving students remained for study of reading achievement and math. The authors also surveyed students to determine their

social perceptions, motivation, and background, with missing data values imputed using a standard method (pp. 421-423). Logistic regression results indicated that high achieving Black or African American students and males received fewer nominations for advanced programs in English, although similar Hispanic students experienced no disadvantage and Asian students and females received more nominations than average (pp. 426-428). Math outcomes displayed similar racial and gender gaps, with additional indications that students who perceived their friends as valuing academics and students with high self-efficacy received more nominations for advanced programs. Interestingly, male students with intrinsic motivation to do well in math received more nominations for advanced programs, but female students showed no association between intrinsic motivation and nominations (pp. 429-432). This study suggested that failure to nominate high-achieving students for advanced programs might result from bias, especially “when considering the high-achieving, but disengaged, male student” (p. 438). Further studies could evaluate different methods of identifying high-achieving students for advanced academic work or compare the AP and honors enrollment of high-achieving students in schools that require a teacher recommendation for such classes with that of high-achieving students in schools that do not require such nominations.

Wood conducted qualitative dissertation research, studying whether the school principal’s attitudes also affected AP access and equity and measuring principals’ views on various issues related to advanced coursework (2010). This research used a convenience sample of schools in the Chicago area, in which 88 representative high school principals received surveys and 57 responded to the questionnaire (p. 100), recording their responses on a five point Likert scale. Wood’s research indicated that

schools with principals who believed in open access to AP courses versus strict admissions requirements had greater AP enrollment, including improved enrollment  $F(1, 57) = 3.96$  ( $p < .05$ ) for traditionally underserved students (pp. 121-125). In another study, Jeong explored the relationship between AP exam fee exemptions or performance incentives and AP participation, finding that although performance incentives did not lead to increased AP participation, exam fee exemptions increased the likelihood ( $p < .1$ ) of disadvantaged students taking AP exams (2009, p. 362). Jeong's work indicated that financial considerations, or a lack of awareness of available exam fee waivers, might still have served as a barrier to AP participation for some students.

### **Racial Issues in Advanced Placement**

Given the preponderance of favorable studies regarding the effects of AP participation and the above evidence regarding racial and gender differences in entry to AP programs, demographic disparities in AP access and equity should raise concerns about justice. Extensive peer reviewed research has shown significant underrepresentation for African-American students both in AP course enrollment and in AP exam taking (e.g., Hale 2007; Venkateswaran, 2004). College Board reported African-Americans representing 14.7 percent of the student population but only 9 percent of AP exam takers in 2011 ("8<sup>th</sup> Annual AP Report to the Nation," 2012, p. 16). In contrast, the College Board stated that Hispanic or Latino students came much closer to overall parity with 15.9 percent of the overall student population and 15.5 percent of AP exam takers in the same year, although significant disparities existed in particular subject areas (p. 16). Hispanic or Latino student overrepresentation in Italian Language, Spanish

Language, and Spanish Literature contrasted with their underrepresentation in Calculus and Physics ("4<sup>th</sup> Annual AP Report to the Nation," 2008, p. 15-47).

The College Board's 2008 annual report provided a well-organized summary of AP activity ("4<sup>th</sup> Annual AP Report to the Nation," 2008), and their reported data matched objective, peer-reviewed research. Venkateswaran described, from the Educational Testing Service's perspective, efforts to identify and eliminate racial and gender biases in questions for the AP United States History Examination, an effort that extended to the analysis of individual question disparities in performance among racial and gender groups participating in the U. S. History exam (2010, pp. 503-507). This study quantified racial and gender performance gaps for the United States History exam and identified specific areas of weakness, with the racial difference on multiple-choice questions reportedly more than ten times as large as on the essay portion of the exam (pp. 510-511). Venkateswaran further discussed the possibility that cultural gaps in knowledge might have caused the racial disparity in test scores, pointing out that Asian students outscored White students to support a conclusion that academic preparation and not differences in cultural backgrounds caused the performance gap (p. 508).

### **Racial or ethnic minority student participation in AP**

Hale discussed the benefits of AP instruction for low-performing African American students in a qualitative, anecdotal paper (2007). Hale described his experience with a group of African-American high school students from the lower academic quartile of a public magnet high school in Florida. These students participated in a low-level English 12 class for the first nine weeks of their senior year, but after the regular teacher's reassignment, the author agreed to take over their class under the condition that he could

teach an AP English curriculum. Hale described his initial teaching approach as “to get them to feel good about what they did know and to ignore for the time what they did not know,” with an added emphasis on getting students to this first period class on time, calling them at home as necessary to remind them (p. 123). More rigorous academics followed this adjustment period, with all course work done in class and no homework. Hale did not comment on whether he perceived the absence of homework and other outside assignments as a major drawback that limited student learning or merely an instructional constraint that he successfully addressed. According to Hale, despite the students’ minimal preparation for advanced work, discipline problems disappeared once his students received challenging instruction, and the vast majority of these at-risk students continued on to college. No student in the class achieved a passing score on the AP exam, but four reached a score of 2, which the author appropriately described as “amazing” given the students’ initial skill level (p. 125). Qualitative follow up studies to Hale’s work could include evaluating a future class of previously low-performing Black or African American students receiving AP level instruction for the entire academic year to see if the additional weeks of advanced instruction would help a greater proportion of students to achieve scores above the minimum of 1. Alternatively, researchers could conduct a similar evaluation for a class that also received homework assignments, with sufficient support that the students would complete that work, both to increase the available instructional time and to build an increased capability for the independent work expected in college. Including these low-performing Black or African American students in an AP class with high-performing AP students might seem impractical without further preparation or support, but potentially satisfactory supports exist. A follow on study

might investigate whether previously low-performing students could succeed alongside traditional AP students in an AP class with appropriate content and a receptive teacher if given sufficient support, perhaps with interventions that included either daily lunchtime help or a second regular class period dedicated to supplementing in-class instruction and providing time and guidance for completing assigned homework. One successful example of such extensive support occurred at Garfield High School in Los Angeles, where:

Escalante . . . requires his Advanced Placement Calculus students to attend enrichment classes . . . on Wednesday evenings, Saturday mornings, and during the summer – in addition to the time they spend in class at Garfield. Other Advanced Placement classes at Garfield are now based on this extended time approach. (Cavazos, 1990, p. 67)

Additional research could test the feasibility of replicating the Garfield High results through comparable levels of extra support to students, to determine the degree to which this example demonstrated extraordinary results due to a unique teacher’s leadership as opposed to extraordinary results due to an effective teaching model. Alternatively, motivated students who superficially appear unready for AP work might succeed in a classroom beside more traditional AP students through a *flipped classroom* approach, in which students with reduced preparation could watch prerecorded supporting lectures out of class to prepare those students for participation with their classmates during in class activities and discussions (Tucker, 2012, para. 3-4).

Kyburg et al. observed (2007), based on an in-depth qualitative study, that teachers who recognized the potential of traditionally underserved students to succeed

with appropriate external scaffolding and internal motivation could guide students to success in a rigorous academic curriculum. This result and Hale's achievement in increasing the rigor of instruction for previously underperforming students (2007) demonstrate the potential for students other than those from the top echelon of high school to benefit from AP instruction. In a study with some similarities to Hale's work, Ohrt et al. (2009) described a pilot program in identifying African American and Hispanic students with the potential to succeed in AP courses, matching them with suitable classes, and providing ongoing counseling support and mentoring. The authors described the effort as a success in which "12.5% of students enrolled in this program scored a 3 or better on an AP examination, which is similar to the overall national average of 15.2%" (p. 62). The College Board reported that 15.2% of all students graduating from high school in 2007 received a score of 3 or better on at least one AP exam ("4<sup>th</sup> Annual AP Report to the Nation," 2008, p. 47). It is not clear whether one can appropriately compare the 12.5% of students taking an AP exam in this study who earned a score of at least a 3 on an exam to the 61% of those high school students nationwide who took an AP exam during high school who earned a score of at least a 3, or the percentage of students in this study who would not otherwise have taken an AP exam but earned at least a 3 and the percentage of students nationwide who earned at least a 3 on an AP exam, or if some other comparison would more appropriately illustrate this effort's success. The disparity between the percentage of students who passed at least one exam in the study and the overall percentage of AP exam takers who passed at least one exam may require further consideration and study to determine the practical significance of the results. The large difference might also indicate that purposeful placement of Black or

African American and Hispanic or Latino students in advanced courses, even with counseling and mentorship support, may require more than one year of student participation in AP courses or at least one year of advanced pre-AP instruction prior to a formal AP course to produce results comparable with those in the overall student population. Additional research might investigate which additional supports most effectively boost such a program's success.

In other research, a purposive sample of eleven female African American educators in ten urban North Carolina schools found a gap in African American enrollment in advanced courses including AP courses (Taliaferro & DeCuir-Gunby, 2008, pp. 173-178). These educators expressed concerns about access to AP courses, parental involvement in education, teacher support, and a sense of school belonging for African American students (pp. 181-182). The entire sample consisted of advisors for the American Excellence Association (AEA), described as “a flagship program of a national civil rights and social justice organization,” and AEA schools are described as being chosen based on “the presence of barriers to minority student achievement” (p. 170). Given the purposive sampling, the views expressed by women who chose to serve as AEA advisors may not represent the views of female African American educators in these selected schools, of all educators in the selected schools, or of educators in typical urban schools. Generalizing from opinions expressed by a small, non-representative sample requires caution, although these educators expressed concerns regarding AP access, parental involvement, teacher support, and school belonging that paralleled the findings from other research.

Solorzano and Ornelas reported that schools with high African-American and Hispanic populations had low student enrollment in AP courses, and that African-American and Hispanic students had low AP enrollment rates even when they attended schools with larger AP programs (2004, pp. 22-23). The authors reached these conclusions based on critical race theory and an analysis of California's fifty top high schools selected from those schools with more than five hundred students, where the criterion for top schools used only the ratio of number of students to number of distinct AP course offerings (p. 17). The authors concluded that because student populations at these top fifty schools included a lower percentage of Latino, Latina, and African American students than the state as a whole, non-White students had less access to AP courses than did White students (p. 22). Although the extensive research discussed above supported the benefit of offering AP courses in a school, the authors did not justify their implication that a school's offering of a large number of different AP courses provided significantly greater AP access for non-White students than a school of the same size offering fewer AP courses. This assertion required evidence, particularly if schools offering fewer AP choices still include the most popular AP courses from each subject area, or those most popular among disadvantaged students. In addition to basing the selection of schools for a discussion of AP enrollment on an index that required justification, the authors failed to communicate their reasoning clearly when addressing the question "How do these data get played out in specific schools within LAUSD?" The authors' introduction to their answer generated confusion: "We chose four schools . . . among the top 10 AP high schools in the district. . . . Van Nuys High School is ranked . . . 28<sup>th</sup> (out of 52 schools) in the entire LAUSD" (Solorzano & Ornelas, 2004, pp. 19-20).

Despite the lack of clarity over whether the selected schools ranked in the top ten or in the case of Van Nuys High School slightly below average, the subsequent discussion supported the authors' point that at three of the four selected schools, Hispanic and African American students enrolled in AP courses at a rate below the average rate for the school (pp. 20-23). The authors reported that at the top rated school in LAUSD, Black or African American representation in AP courses matched their low (4%) representation in the school population, but Hispanic/Latino and White student participation lagged behind the overall average for the school (p. 22). Solorzano and Ornelas did not directly address possible explanations for these observations other than those implied by their stated assumption using critical race theory that race and racism play a central role in explaining the results of education research. The four choices selected to represent LAUSD included three non-traditional schools, with one charter school, one school with a substantial proportion of students bused in from other areas, and one magnet school (pp. 20-22). With these nontraditional structures, a significant proportion of students at each school might have chosen attendance at those schools for reasons that could explain the racial differences in AP enrollment based on self-selection.

Conger, Long, and Iatarola addressed exactly the above concern on racial differences in reasons for choosing a particular high school, pointing out that African American and Hispanic students may select specific schools "because they are neighborhood schools, while white and Asian students selectively enroll" (2009, p. 568). The appropriate leadership and policy responses to address this racial gap in AP enrollment within selected schools would differ substantially depending on whether institutional racism at the high school directly caused the AP enrollment gap or individual

differences in high school selection led to that gap. If self-selection differences among students choosing a high school caused these racial disparities, then corrective action should address education at the elementary and middle school levels to increase both the readiness of Black or African American and Hispanic or Latino students for advanced academic work and student interest in seeking academic challenges, while a problem with staff or leadership perceptions at the high school level would have implied the need for a different solution. Solorzano and Ornelas made several recommendations for addressing the racial gap in AP enrollment (2004, p. 24), but at least two of their suggestions posed a risk of reducing AP access or enrollment for all students, including underserved students. They recommended eliminating the extra point allocated to AP courses, presumably meaning the additional weighting given to AP courses when calculating GPA at many schools; and they suggested using an AP Student Admissions Index that would rank students based on the proportion of available AP classes taken (p. 24). Under their proposed AP Student Admissions Index, a student who took the only AP course offered at one school would have ranked higher than a student who took nineteen of twenty AP courses at another school, which might not have supported the appropriate admissions decision for all colleges. Other researchers have found that the weighted GPA bonus for AP courses served as an incentive to choose AP courses despite the extra work associated with these advanced courses (Dentith, 2008; Kyburg et al., 2007). Further, the recommendation to eliminate the extra weight for AP courses contrasts with the findings of Sadler and Tai, who in a well-designed quantitative study of 7,613 students from 55 randomly selected colleges concluded that subsequent academic performance in college justified bonus points for AP courses (2007c, p. 26). The Student Admission Index

proposed by Solorzano and Ornelas (2004, p. 24) would also provide an incentive for schools to discontinue AP courses with lower than average enrollment numbers, potentially choosing their AP offerings to boost their student rankings under the new system rather than to meet the educational needs of students. Given the documented racial differences in interest levels among different AP courses ("4<sup>th</sup> Annual AP Report to the Nation," 2008, p. 15-47), such a policy could lead to discontinuing the AP courses in which minority students show disproportionate interest.

In contrast to the qualitative results obtained by Solorzano and Ornelas, quantitative studies that controlled for non-racial factors such as school size, urban/rural location, and income or property values have concluded that taking these non-racial factors into account dramatically reduced or eliminated racial disparities in AP enrollment (Klopfenstein, 2004; Conger, Long, & Iatarola, 2009). Klopfenstein studied students in Texas, and Conger et al. (2009) used data from Florida, but both controlled for confounding variables and reached the conclusion that other socioeconomic or educational factors dominated in influencing a student's AP choices and success, and that race had no statistically significant effect after correcting for those non-racial factors. Klopfenstein's statistical methodology may not have met the criteria for the statistical tests used, given that that the zero inflated negative binomial regression selected (2004, p. 4) assumed a binomial setting, which did not apply to the actual situation, but the differences between the actual distribution of AP course offerings and the binomial setting may not be large enough to change the results. Klopfenstein wrote "While the recent expansion of the AP program is promising, low income and rural students continue to be systematically excluded" (p. 3), but he concluded that "students at predominantly

Black and Hispanic schools enjoyed access comparable to that at predominantly White schools” (p. 8).

Conger et al. (2009) reached a similar conclusion in their well-designed quantitative study. After controlling for the fixed effects of confounding variables such as eighth grade test scores and differences among individual schools, the authors stated “blacks and Hispanics are advantaged by the schools they attend . . . within a given high school, blacks and Hispanics are more likely to take advanced courses in most subjects than their observably similar white classmates” (p. 567). Conger et al. investigated statewide changes in AP participation over time, noting that the percentage of Black students taking at least one AP exam increased from 5.3 to 6.4 percent, and the numbers for White students increased from 13.4 to 16.2 percent (p. 570). Both observed increases represented approximately a twenty percent increase in the proportion of students participating in the AP program over the three-year period under investigation. These researchers also considered the possibilities that access disparities resulted from Black or African American and Hispanic or Latino students entering high school less prepared, attending high schools that did not offer AP courses, or attending high schools with characteristics that lowered the likelihood of non-White students taking advanced courses (p. 556). The authors concluded that socioeconomic and existing school educational differences before high school fully explain the observed gap in AP participation and that any racial disparity in AP access resulted from observable preexisting conditions rather than from bias within the high school (p. 564). Based on this research, one might reasonably conclude that solutions directed toward improving the quality of education for younger Black or African American and Hispanic or Latino students might be more

effective than high school interventions in improving AP equity and access. In contrast, Klopfenstein's research (2004) suggested that policymakers could most effectively address gaps in AP access by focusing on programs to provide low-income and rural students with access to AP courses (pp. 11-12).

The potential expansion of AP access to a larger body of high school students or to students with a wider ability range does not threaten the integrity of AP exam scores because the College Board references AP scores to the performance of college students:

Periodic college comparability studies are undertaken in which the performance of college students on a selection of AP Exam questions is compared with that of AP students to ensure that grades earned by college students are aligned with scores AP students earn on the exam. (College Board, 2010a, p. 3)

Thus, an expansion in the number or ability range of high school students taking AP tests should not affect the performance levels needed for passing scores on the AP Exams.

The authors of a study in which eighth grade Hispanic students who spoke Spanish fluently studied AP Spanish Language while in middle school reported a significant association between participation in the program and later participation in advanced coursework in high school (Kettler, Shiu, & Johnsen, 2006, pp. 43-44). All but one of the 55 participating students who remained in the school district took advanced courses in high school, and more than two thirds took at least three pre-AP or college preparatory courses (p. 44). Although the authors acknowledged the limitations on drawing cause and effect inferences from their work due to the self-selection of participants in this program, this result demonstrates the potential value of further studies designed to determine whether early exposure to AP work actually causes higher

participation in advanced high school study. A related study highlighted the language experiences of native Spanish-speaking students as an asset that allowed them to take advanced coursework at a younger age than monolingual students and discussed the experiences of these economically disadvantaged eighth grade students when studying AP Spanish Language in Texas (Shiu, Kettler, & Johnsen, 2009). In this study, the authors selected 16 Hispanic males and 42 Hispanic females to study AP Spanish, with the selection based on teacher recommendations and previous academic performance. These middle school AP students demonstrated significantly better academic outcomes than did their peers (p. 76). The authors recognized the potential selection bias as a serious limitation of this study (p. 78). In the absence of random assignment to the AP course, the authors cannot distinguish whether the selection process picked highly motivated students or the rigorous AP instruction improved educational outcomes for participating students.

The above studies strongly suggested that Black or African American and Hispanic or Latino students benefited from AP access and enrollment. Further, research documented the slight underrepresentation of Hispanic students in AP classes and the significant underrepresentation of Black or African American students in those classes, with those access and enrollment disparities significantly reduced or eliminated when quantitative analyses accounted for observable pre-high school characteristics. The work by Conger et al. (2009) in particular drew attention to the issue of changes in AP participation over time. Although their study of students in Florida looked at statewide numbers for AP enrollment, questions about the patterns or trends of changes in AP

enrollment for underrepresented students within a single school as overall AP enrollment changes remained unanswered.

One study addressed the changes in AP participation over time for Hispanic or Latino and for Black or African American students, finding that these students started the period under study with lower participation in AP programs and that Hispanic and African American participation grew more slowly than White or Asian participation (Brown & Campbell, 2009, p. 237). This study involved a quantitative analysis of AP data from the state of California during the years from 1998 to 2003, using a general linear model. Although the data were consistent with the numerical conclusions and with the general trend described, these data could reasonably support a more positive conclusion in terms of AP equity. African American *Average Tests Taken* in science showed an increase from just above zero in 1998 to about four in 2003 on an unspecified scale, and the score for White students on the same scale increased from just below 10 to about 19 (2009, p. 234). The authors characterized this change as an increased gap of five additional points for African American students, with a similarly increased gap in results for Hispanic students (2009, p. 233). From a different perspective, one could view the same change as a decrease in the proportional gap: White students dropped from over ten times the AP participation of African American students to less than five times the AP participation of African American students. A third perspective on the same data would look at how many years White students required to raise their scores on this undefined *Average Tests Taken* metric from zero to about four, comparing the four years required for African American students to make this progress with the time that White students needed for the same advancement. For the purposes of this study, I have chosen to follow

Aristotle's description of justice as involving proportionality, so that the reported decrease in the ratio of AP exams between White and African American students can be seen as representing evidence of progress. The authors also reported that the general linear model had a *Quadratic slope* term, one that the authors justified with the observation that this term improved the quality of the model fit (2009, pp. 231-232). The authors did not attempt to clarify the real world significance, if any, of this quadratic term. Brown and Campbell also reported similar math AP test results for White and Hispanic students, but African American student participation in math actually decreased overall from 1998 to 2003, a clearly adverse outcome (2009, p. 234). The authors finally hinted at a relationship between AP program size and the rate of change in Average Tests Taken for White and Asian students: "Schools with stronger student achievement increased student test taking at a faster rate" (Brown & Campbell, 2009, p. 234), but they failed to explore either this relationship or the relationship between student achievement and racial equity within schools. Although these conclusions based on data from California paralleled those of Solorzano and Ornelas (2004) in their California study, the results may not generalize to the country as a whole.

### **Urban student participation in AP**

Research in urban schools suggested that AP programs could succeed even in urban areas dealing with challenges. Werkema and Case credited high academic standards and a goal of preparing students to take AP Calculus, when their school had previously offered no math above Algebra 1, as major factors in turning around an inner-city high school and in restoring their accredited status ahead of their goal date (2005, p. 517). Other research suggested from a quantitative study that PSAT scores could help (*p*

< .001) in identifying urban students with the potential to perform well in AP courses (Vaughn, 2010, p. 402), and that urban students benefited from consistent support for their advanced academic work (Kyburg et al., 2007, p. 198). Kyburg et al. in particular pointed out that the “prepackaged curricula for advanced coursework” and the lack of other challenging options for able students made the AP and IB programs particularly appealing to urban school systems (2007, p. 177). The sample for the focus group in this qualitative study consisted of a convenience sample selected from three urban high schools in the Mid-Atlantic States in which focus group participation “was predominantly based on scheduling availability” (p. 188). The authors observed that they provided instructions to a contact person at each school, but “it is not possible to assess definitively the degree to which these instructions were followed . . . participation was voluntary and the number of students who may have refused participation is not known” (p. 188). The researchers scheduled observations of each selected classroom twice in the course of a year, for one class period per observation. Given the multiple opportunities to introduce intentional or inadvertent bias in choosing a convenience sample of participants, all from the same geographic region, and then choosing a small number of announced class sessions from which to collect data in scheduled observations, the data used in this study may not represent AP instruction in urban schools. Despite these weaknesses, Kyburg et al. obtained findings for urban schools that paralleled those for students from other backgrounds. These findings included the importance of giving students time to respond to academic questions, the difference that experience and interest in the children made in a teacher’s effectiveness, and the challenge of overcoming social barriers in which being smart could have negative social consequences. Although based on demographically

quite different populations, the conclusions reached by Kyburg et al. overlapped substantially with those of Dentith surveying middle-class and upper middle-class high school girls (2008, pp. 160-163). The girls studied by Dentith worried about being pretty and popular (p. 160), and the urban students studied by Kyburg et al. worried that “it’s not cool to be smart” (2007, p. 198), but students from both groups commented on the balance between social pressures and academic pursuits.

Finding methods of identifying Black or African American and Hispanic or Latino urban students with the potential to succeed in an AP environment may be important, given the proportion of students in these groups who did not take the initiative to select these challenging courses and evidence that many students who did not select AP courses on their own could have benefitted from those courses (Kyburg et al., 2007; Hale, 2007). Vaughn investigated the value of using PSAT test results to identify urban students with the potential to succeed in an AP curriculum (2010). The author concluded, based on a quantitative study applying logistic regression, that the PSAT had only modest effectiveness in identifying students with AP potential (p. 403). He added that, as high school grade averages rose due to apparent grade inflation, the PSAT had the advantage of protecting against an erroneous conclusion, based on an inflated grade point average alone, regarding student readiness for advanced work (p. 403). One significant issue in this study is that Vaughn only looked at whether students eventually took at least one AP course, not whether the students took or passed the associated AP exam or how many AP courses the students took. Exploring these questions could provide an informative follow up to this study and support efforts to expand AP participation, while ensuring that participating students benefit from that participation.

## **Ability Grouping and Tracking**

Several of the above studies directly or indirectly addressed issues of preparedness for advanced study in high school. Bali and Alvarez found racial gaps in education, beginning at or before the first grade and growing in subsequent grades (2004, p. 404). Casement argued that, based on intellectual potential and preparation, "it is not reasonable to expect" the growing number of AP students "to read college texts, comprehend college-level concepts, and move at a pace necessary to complete a college level course successfully" (2003, p. 18). Klopfenstein observed that in Texas "students attending schools with large Hispanic or black populations generally experience AP opportunities comparable to or better than those offered at predominantly white schools" (2004, p. 4), and that socioeconomic and educational factors before high school dominated in influencing a student's AP access (p. 7). Researchers found that middle school participation in a summer enrichment program boosted advanced course taking in high school (Li et al, 2009, p. 425), as did participation in an AP Language program in middle school (Shiu et al., 2009). These findings and conclusions have emphasized the importance of elementary and middle school academic preparation in supporting high school AP success. Ability grouping and tracking may have important implications for this academic preparation.

The courts have ruled extensively on the issues of ability grouping and tracking, including prohibiting actions taken for the purpose of maintaining segregation. In *Smuck v. Hobson*, the United States Court of Appeals for the District of Columbia affirmed that a court order to end academic tracking did not specifically prohibit ability grouping

within schools (1969). In *McNeal v. Tate*, the United States Court of Appeals, Fifth Circuit, found the school system obligated to choose an educationally sound but race neutral method of classroom assignment, other than ability grouping (1975). In contrast, in *Shannon v. Morales*, the circuit court supported a decision that segregation resulting from ability grouping did not prove discriminatory intent, with the absence of proven intent to discriminate a deciding factor (1975). In *United States v. Gadsden County School District*, this court, after referencing the *McNeal v. Tate* and *Shannon v. Morales* decisions, ruled that the ability grouping in Gadsden County elementary schools had been introduced at the time of a court desegregation order and that a statistical pattern supported the inference that grouping served the purpose of continued segregation (1978, para. 27). The circuit court ordered the Gadsden County School system to "choose any racially neutral method of classroom assignment . . . it considers educationally sound" for court review and approval (para. 28). Finally, in *Castaneda v. Pickard*, the same court emphasized this reasoning, without ruling directly on the merits of the ability grouping plan in question:

We have consistently stated that ability grouping is not per se unconstitutional. In considering the propriety of ability grouping in a system having a history of unlawful segregation, however, we have cautioned that if testing or other ability grouping practices have a markedly disparate impact on students of different races and a significant racially segregative effect, such practices cannot be employed until a school system has achieved unitary status and maintained a unitary school system for a sufficient period of time that the handicaps which past segregative

practices may have inflicted on minority students and which may adversely affect their performance have been erased. (1981, para. 9)

Court decisions to remove school districts from court supervision similar to that in the rulings described above, or to permit specialized educational programs while under such supervision, can be important in understanding the considerations that must be weighed in introducing or expanding educational programs with potentially disproportionate racial or ethnic effects, a category that may include Advanced Placement. In *Andrews v. City of Monroe*, a ruling with particular relevance to the proposed research, the Eighth Circuit found in favor of a Louisiana school district decision to establish an Advanced Placement English program in a school district prohibited by court order from using ability grouping (1984). The court based this ruling on the perspective that an AP program did not constitute ability grouping if the program was an elective and open to all senior students who had passed junior English (para. 8). The Eighth Circuit also addressed Advanced Placement in *Little Rock School District v. Arkansas*, finding that despite instances of noncompliance with court desegregation orders in some areas, including Advanced Placement, the school system had achieved unitary status (1989). The Fifth Circuit found in *Quarles v. Oxford Municipal Separate School District* that "Oxford's achievement grouping system 'is neither intended nor does it have the effect of having significant racial impact upon the makeup of the classrooms in the various schools of the system'" (1989, para. 23). This ruling permitted achievement grouping in the public schools, subject to conditions on intent addressed in *Castaneda v. Pickard* (1981). In *Montgomery v. Starkville*, the Fifth Circuit found in favor of a school system's use of achievement grouping, basing this ruling in part on the Mississippi school

system's performance over the previous sixteen years and in part on the distinction between *achievement grouping* based on individual student performance and *ability grouping* based on student potential as measured by indicators such as IQ tests (1988). In *People Who Care v. Rockford Board of Education*, the circuit court found that a school system could be released from court supervision, even without the achievement of racial parity in educational outcomes, in the absence of evidence that prior discrimination led to any portion of the remaining educational gap (2001). In *Hoots v. Pennsylvania*, the United States District Court found that permitting some students to take Algebra 1 in seventh or eighth grade, rather than in ninth grade, did not constitute tracking and should not interfere with declaring unitary status or with removing a school system from court supervision (2003).

The United States Court of Appeals, Eleventh Circuit, has ruled similarly to the Fifth and Eighth circuits on related issues. In *Holton v. City of Thomasville School District*, the Eleventh Circuit permitted ability grouping based on perceived ability, in the absence of evidence documenting intentional discrimination (2007). In *Bester v. Tuscaloosa City Board of Education*, the court ruled that requiring minimum reading standards for grade advancement did not constitute prohibited ability grouping (1984). In *Debra P. v. Turlington*, the court found that a school district could require students to pass a test as a graduation requirement (1984), and in *Johnson v. Sikes* the court dismissed an objection to the imposition of an exit exam for high school graduation (1984). However, in *Georgia State Conference Branches of NAACP v. State of Georgia*, the court found that black schoolchildren subjected to discriminatory ability grouping into regular classrooms for the educable mentally retarded were entitled to appropriate

relief (1985, para. 98). In summary, unless the school system remained under court supervision due to past discrimination or program implementation induced a disparate racial or ethnic effect, the courts have generally permitted the various forms of tracking, ability grouping, and achievement grouping, including accelerated course work, honors or gifted programs, and Advanced Placement instruction.

Kalogrides and Loeb (2013) in a study of three large urban school districts found that at all grade levels, from elementary to high school, individual classrooms within schools tended to show statistically significant racial and socioeconomic variations from school-wide demographic distributions. These authors attributed the observed differences, in part, to middle class parent intervention, resulting in increased racial and socioeconomic segregation within classrooms beyond the level expected from academic tracking alone (p. 306). Kalogrides and Loeb reported further that low-achieving students had a 2% higher proportion of novice teachers than students in the middle half of each school, and that high-achieving students had a 2% to 7% lower likelihood than average students of learning in a classroom with a novice teacher, levels that the authors attributed to a combination of causes, including the preference many experienced teachers have for higher-level classes and administrator efforts to reward experienced teachers by accommodating this preference (pp. 311-313). This research documented a side effect of ability-group tracking: the racial, ethnic, and socioeconomic sorting of students by classroom, and potentially an associated difference in the experience levels of the teachers responsible for educating these students and in the resulting quality of instruction.

Jeannie Oakes wrote extensively on the subject of tracking, providing several major critiques of educational tracking. She described two levels of tracking: curriculum tracking into educational paths such as college-prep, vocational, or general; and ability grouping within individual subject areas, such as math, English, science, and social studies, with significant overlap between these two levels of tracking (1987, p. 131). Oakes argued that tracking in multiple subject areas can lead to de facto tracking in all subject areas due to demands of the master schedule, so that students assigned together for their academic subjects will also tend to stay together for untracked subjects such as the arts and physical education, a convincing argument that to some extent matched my experience as both a parent and a teacher (pp. 131-132). Oakes cited evidence on the advantages of educational tracking for students in the top tracks but questioned the favorable interpretation of that evidence, particularly in the context of other evidence showing similar advantages for comparable students in heterogeneous groups. Oakes argued that "tracking systems consistently hinder those students not placed in the top groups" (p. 134). While the author cited research in support of these statements, approaching tracking subject-by-subject with a detailed discussion of the research for several subject areas and various grade levels could have provided a more convincing case for her position. The author, in another article, cited research to support heterogeneous grouping for high school mathematics education (Oakes, 2008, p. 703), but the referenced research focused on low-performing schools in California and might not generalize to all high schools (Boaler & Staples, 2008, p. 625). Neither article clarified how the subject matter for advanced courses such as AP Calculus or AP Statistics could be taught in a heterogeneous classroom while teaching Geometry or

Algebra 2 effectively to other students in the same classroom. Oakes ascribed at least part of the success of mathematics instruction in a school that had eliminated tracking to an effort to provide "all students with an 'accelerated' mathematics curriculum and access to the rich and challenging International Baccalaureate program" adding that "it is significant that" the school under study "is well-resourced. Detracking will be most successful in the context of a well-qualified teaching staff and additional support for students who are struggling academically" (Oakes, 2008, p. 709). In other research, Oakes and Wells praised efforts to eliminate remedial or other low-level courses, put all students on a college preparatory track, offer open access or heterogeneous honors classes, and encourage "minority students to enroll in Advanced Placement classes" as well as schools that offer extra support to students making an effort to improve their academic performance (1998, p. 39). Oakes and Wells observed that major objections to the elimination of separate educational tracks came from the parents of students categorized as gifted, who objected that "their children were no longer being singled out and treated differently" (1998, p. 41). Oakes also referenced research by Rubin that documented failures in high school instruction conducted in classrooms without achievement grouping, concluding that "tracking structures stand on a foundation of tracking logic that embodies deep-seated cultural beliefs about the strengths and deficits of various groups of students . . . . the constrained practices associated with lower track classes did not change with detracking," and at a second school experimenting with detracking "students whose needs were seen as too far below the norm were segregated from the rest of the student body during the academic portion of the school day" (Oakes, 2008, p. 710). While the extensive research Oakes conducted clearly documented that

education without tracking could succeed, the examples selected seem to prove that heterogeneous grouping combined with high quality teaching and high expectations for all students produced superior outcomes, but not necessarily that heterogeneous grouping would produce superior results to tracking with all other factors equal.

Burris et al. compared the achievement of students provided with accelerated math instruction in middle school followed by instruction with high expectations in heterogeneous ninth grade classes to that of students in classes with achievement grouping (Burris, et al, 2008). Burris observed "Even in studies finding that high-track classes result in higher achievement, it is not clear why this is so. Researchers have not been able to disentangle the effects of . . . peer effects, better instruction, and more qualified teachers" (p. 576). While the research described in this article certainly proved that heterogeneous grouping could succeed in high school, research on heterogeneous instruction presented similar challenges in disentangling the effects of other changes introduced with the removal of achievement group tracking. This research demonstrated the potential for successful expansion of advanced instructional programs, even without achievement grouping, concluding that "the percentage of students who scored the highest scores on IB exams (5, 6 and 7) increased even as the enrollment in IB classes expanded from an exclusive gifted program to a program for the majority of students" (p. 601). In research complementary to that of Burris, Mickelson and Everett studied *neotracking*, described as a combination of "rigid comprehensive tracking" into college, college tech, or career path Courses Of Study (COS) with "flexible within-subject area curricular differentiation" in North Carolina high schools (2008, p. 236). The authors found that the courses of study selected showed substantial dependence on income

quintile, Chi-square = 2247, df = 12 ( $p < .001$ ) (p. 549); and on race, Chi-square = 1025, df = 15 ( $p < .001$ ) (p. 550). The authors also found that "a high percentage of students enrolled in the College/University Prep COS do not even demonstrate minimal proficiency as measured by EOC tests" (p. 561). In summary, according to this research, neotracking in North Carolina failed students placed on the lower tracks, and this failure had unequal effects on students of different races and economic levels; neotracking did not meet the educational needs of the students under the measures selected by the researchers.

Slavin described several approaches to ability grouping: assigning elementary students to a self-contained class on the basis of ability or achievement; regrouping students by achievement level for selected subjects, typically reading and math; "nongraded plans" in which student assignments follow from performance rather than age, with no reference to the traditional numbered grade levels; special classes for high or low achievers following a different curriculum; and within-class ability grouping, especially for reading and math (1987, pp. 294-296). Slavin's best evidence synthesis of existing research used clear and appropriate criteria to select fourteen studies for meta-analysis, finding some support for ability grouping but only in subjects for which student heterogeneity matters, such as math and reading (p. 328). However, the exclusion of studies with separate grouping for high or low achievers limits the applicability of his conclusions; the results may not apply to grouping involving these special classes.

Another review study described similar categories of ability grouping and concluded that between-class grouping and flexible within-class grouping, with appropriate curriculum differentiation, could enhance education for students at all ability

levels (Tieso, 2003, pp. 34-35). Given the sequential nature of mathematics in particular, further study on the interactions between ability grouping in mathematics and readiness for AP courses that depend on reaching a particular level of mathematical proficiency, especially AP Calculus and AP Physics, and on other subject areas requiring substantial sequential instruction may have significant implications for expanding AP enrollment in those subject areas.

### **Inferences for Further Study**

Existing studies on AP programs and on disparities in AP access and equity have not fully addressed the development of AP programs within schools over time. The studies I reviewed also failed to address the relationship between the size or growth of an AP program and the relative participation of Black or African American and Hispanic or Latino students in that AP program. One could plausibly argue that the most advantaged students would be the first to benefit from an increased selection of AP courses or from added emphasis on these advanced courses, or that given the existing gaps in AP participation the greatest opportunity for rapid growth would come from the underrepresented student groups. A quantitative study comparing actual rates of AP enrollment or AP exam taking among students from different demographic groups within individual schools, as those schools experience growth in the number of AP exams taken by students, could provide this important information. Such an investigation could help in understanding the degree to which the size or the rate of expansion of a school or county AP program is associated with improved equity.

## **Theoretical and Conceptual Framework for this Study**

The existing research has explored AP access and equity from a broad range of theoretical and conceptual frameworks, including rationalist, positivist, and constructivist. These studies have applied perspectives including critical race theory and feminist theory, and have used quantitative, qualitative, and mixed-methods approaches. This research will investigate whether the level of AP access for traditionally underserved students varies with the size of a school's AP program, a question that most closely matches a positivist, quantitative approach. This research will follow an empiricist conceptual framework. Karl Popper describes the scientific method as a method of elimination in which scientists "do everything they can in order to criticize and to test the theory in question . . . the theory is criticized from very many different viewpoints in order to bring out those points which may be vulnerable" (1940, p. 404). Popper then defines empiricism as the perspective that "only experience enables us to decide upon the truth or falsity of a scientific theory," concluding "some form of empiricism . . . is the only interpretation of the scientific method which can be taken seriously in our day" (pp. 413-414). Thomas Kuhn presents a similar perspective: "Theories are . . . to be evaluated in terms of such considerations as their effectiveness in matching predictions with the results of experiment and observation. Both the number of matches and the closeness of fit then count in favor of any theory under scrutiny" (1983, p. 564). For the purpose of this research study, I have accepted the empiricist perspective outlined by Popper and by Kuhn.

## Summary

Despite extensive theoretical discussions of justice, the concept remains imprecisely defined (e.g., Aristotle, trans. 1931; Thucydides, trans. 1954; Plato, trans. 1951; Plato, trans.1974). Many experts agree, however, that justice requires some level of equality, whether in opportunity or in outcomes, that justice requires respect for the law, and that equal educational opportunity is a significant component of justice (e.g., Dewey, 1916; Hobbes, 1950; Plato, trans. 1951; Washington, 1903). Further, the Supreme Court has ruled extensively on equal educational opportunity, reinforcing a relationship between education and justice for those who accept a link between justice and the rule of law (e.g., *Brown v. Board*, 347 U.S. 483; *Swann v. Charlotte-Mecklenburg Bd. of Educ.*, 402 U.S. 1; *United States v. Montgomery County*, 395 U.S. 225) and repeatedly finding that various elements of educational equity are a legal right and thus potentially an essential component of a just society.

Despite these findings on education and justice, research shows that significant educational gaps remain between Black or African American, Hispanic or Latino, and White or Asian educational outcomes in the United States, both overall and in Advanced Placement participation in particular (Hale 2007; Hemphill, & Vanneman, 2011; "8<sup>th</sup> Annual AP Report to the Nation," 2012, p. 16; Vanneman et al., 2009; Venkateswaran, 2004). Given the extensive research documenting the educational value of AP participation for all participating students and in particular for Black or African American and Hispanic or Latino students (e.g., Christiansen, 2010; Dutkowsky, Evensky, & Edmonds, 2009; Fowler & Luna, 2009; Kyburg et al., 2007; O'Keefe, 2009; Perrone et al., 2010; Preston, 2009; Thompson & Rust, 2007), the documented racial gap in AP

participation raises concerns in terms of justice as well as the human capital concerns over the lost productivity from failing to educate so many of our youth to their full potential. Further, this educational gap, both overall and in AP participation, suggests that we have failed to meet Dewey's generally approved educational aim of targeting “the intrinsic activities and needs (including original instincts and acquired habits) of the given individual to be educated” (Dewey, 1916, p. 49).

This review of existing research identified an absence of information on any link between the size of school AP programs and educational equity within those schools. To address that gap, this quantitative investigation explored the strength of the association between the size or the rate of expansion of a school’s AP program and the racial equity or change in racial equity of that program.

### **Chapter 3: Methodology**

This chapter presents a summary of the completed research approach in six parts. First, I present an overview of the problem and methodological approach. Second, I state the research questions and formal statistical hypotheses operationally, including the specific definitions of the parameters of interest and a direct association to specific and measurable observed variables. Third, I describe in detail the population of interest and the methods used for sample selection, along with the processes for data collection and data analysis and a discussion of how well the sampling frame corresponded to the population of interest. Fourth, I describe study procedures. Fifth, I present a discussion of study limitations and potential biases. Finally, I describe the potential risks to human participants and formal procedures that were followed for GW Office of Human Research Internal Review Board (IRB) submission and approval.

#### **Problem and Methodological Approach**

The specific problem of interest was whether there was a relationship between the size of a school's Advanced Placement (AP) program or growth rate in the size of that program and the equity of the AP program within individual public high schools in the selected Mid-Atlantic state. I explored this problem quantitatively, analyzing data from the 2010-2011 and 2011-2012 academic years for public high schools in this Mid-Atlantic state. When possible, data from the 2010-2011 and 2011-2012 academic years were combined to use as the primary dataset for analyses of the relationship between the values of Challenge Index and of Equity Indices, and changes between the 2010-2011 and 2011-2012 academic years were used when analyzing the relationship between changes in the Challenge Index and changes in the level of racial equity.

## **Research Questions and Statistical Hypotheses**

This study explored the relationships between AP access and educational equity as measured by the relative participation rates of Black or African American, Hispanic or Latino, and all other students in each Mid-Atlantic state high school's AP programs. The major research questions included:

1. Is there an association between the average level of participation in AP programs at a high school and the level of racial equity in AP participation for Black or African American students at that school? I addressed this question by evaluating the relationship between the AP Challenge Indices for schools in a Mid-Atlantic state and the Black or African American Equity Indices for those schools.
2. Is there an association between the average level of participation in AP programs at a high school and the level of racial equity in AP participation for Hispanic or Latino students at that school? I addressed this question by evaluating the relationship between the AP Challenge Indices for schools in a Mid-Atlantic state and the Hispanic or Latino Equity Indices for those schools.
3. Is there an association between changes in the average level of participation in AP programs at a high school and changes in the level of racial equity in AP participation for Black or African American students at that school? I addressed this question by evaluating the relationship between year-to-year changes in the AP Challenge Indices for schools in a Mid-Atlantic state and year-to-year changes in the Black or African American Equity Indices for

those schools.

4. Is there an association between changes in the average level of participation in AP programs at a high school and changes in the level of racial equity in AP participation for Hispanic or Latino students at that school? I addressed this question by evaluating the relationship between year-to-year changes in the AP Challenge Indices for schools in a Mid-Atlantic state and year-to-year changes in the Hispanic or Latino Equity Indices for those schools.
5. How did the proportions of AP Exams allocated to particular subjects or subject areas change as a school's AP Challenge Index increases?

### **Measures**

The AP Challenge Index was defined for this study as the ratio of the number of AP exams administered at a school in the two years under consideration to the total number of graduating seniors in those two years, and this measure operationalized the average level of participation in AP programs. The familiar *Challenge Index* used by Jay Mathews in ranking America's best high schools for Newsweek and the Washington Post (Mathews, 2012, para. 1) provided the inspiration for this measure, except that my AP Challenge Index included only Advanced Placement exams. Conger et al. used a similar measure in their study of the relative participation of blacks and whites in advanced coursework (2009). An AP Challenge Index of zero would indicate no AP Exams administered at a given school in the year under consideration. An AP Challenge Index of one would result if all seniors at a particular school took one AP exam each in their senior year and no other students took AP exams that year. An AP Challenge Index of approximately ten would result if the average student at a particular school took ten of the

more than thirty different AP exams offered by the College Board.

For this study, I defined the Black or African American AP Challenge Index as the ratio of the number of AP exams administered at a school in a given year for Black and African American students to the total number of Black and African American graduating seniors in that year. Similarly, for this study, I defined the Hispanic or Latino AP Challenge Index as the ratio of the number of AP exams administered at a school in a given year for Hispanic or Latino students to the total number of Hispanic or Latino graduating seniors in that year.

For this study, I defined the Black or African American Equity Index as the ratio of the Black or African American AP Challenge Index at an individual high school to that school's AP Challenge Index for all students except Black or African American students. For this study, I defined the Hispanic or Latino Equity Index as the ratio of the Hispanic or Latino AP Challenge Index at an individual high school to that school's AP Challenge Index for all students except Hispanic or Latino students. A Black or African American Equity Index value of zero would result if a school had Black or African American seniors, and AP exams were administered to non-Black students, but no AP exams were administered to Black or African American students in that year, while a Black or African American Equity Index value of one would result if Black or African American students took AP exams at the same rate as other students in the school in that year.

### **Population of Interest and Methods for Sample Selections**

Individual high schools constituted the experimental units under study in this research. The population of interest in addressing these five research questions consisted of the traditional neighborhood schools among this Mid-Atlantic state's public high

schools.

The sampling frame comprised all traditional neighborhood public schools in the Mid-Atlantic state for which AP Exam participation and graduating class size and race data were available for academic years 2010-2011 and 2011-2012. The sample consisted of those school systems or individual schools that actually responded to my requests for data. For the purpose of this study, I defined traditional neighborhood schools as schools for which the student's place of residence rather than a lottery or competitive admission determined enrollment. For the purpose of this study, I defined charter schools and magnet schools as schools that self-identified as belonging to either category on the official school website or on the school district website. I treated a description of admissions testing or admissions lottery procedures as magnet school self-identification.

Because the selective or self-selected admissions of a magnet school and the alternate administrative structures of a charter school might affect the measures used for educational equity and might interact with other effects in an unpredictable manner, this study only included neighborhood schools. The AP and IB programs differ significantly in curriculum and in structure, so I treated IB schools as a separate population and excluded those schools from this analysis. The relationships at magnet schools, charter schools, and IB schools among the quantities in the research questions represent potential topics for future studies, but these schools were defined to be outside the population of interest for the current research. The College Board, school system central offices, and school AP Coordinators controlled the AP exam data of interest. I obtained graduating class size and racial composition data from the Mid-Atlantic state's Department of Education, from school system central offices, and from individual schools. Given the

expected sample size of approximately 142 schools, the power of the t-test was expected to be approximately .99 for an effect size of  $d=.50$  or greater, and .70 for an effect size of  $d=.30$ .

### **Procedures**

Data collection included obtaining AP data from the state Department of Education, from school systems, or from school AP Coordinators. I omitted schools for which the required data could not be obtained and documented such omissions. With the exception of the College Board AP exam numbers, the requested data were public information. I omitted schools with fewer than ten White, Black and African American, or Hispanic and Latino graduating seniors from the analysis for associated measures of equity, due to the mathematical sensitivity of the associated Challenge Index calculations to variations in the size of a small population. Because state policy prohibited releasing aggregate data on groups of ten or fewer students, I set the threshold for analysis in each hypothesis to omit schools with fewer than ten students in the categories under study for that test.

I compared the overall number of AP exams in each subject and the corresponding numbers for Black or African American and for Hispanic or Latino students, and determined how the proportions of Black or African American and Hispanic or Latino students taking each AP exam changed as values of the AP Challenge Index changed. I then displayed these distributions of exams among schools within selected intervals for the AP Challenge Index in a manner that provided insight into how the distribution changed with the AP Challenge Index. This graphical display of data illustrated general subject areas and specific AP exam topics that might be suitable for

students in a particular school or district, based on the proportions of AP exams selected in comparable schools and school systems. Alternatively, school leaders might use a comparison between their proportions of students selecting each AP exam and the exams more commonly selected by Black or African American and Hispanic or Latino students as indicators of the subject areas in which an AP expansion might promote increased educational equity. Educational leaders could thus use this information in planning for the expansion of their AP programs or for efforts to increase equity, adding to the impact of the statistical conclusions in this study.

The assumptions underlying regression included a requirement that the independent and dependent variables permit measurement on an interval or ratio scale, that the data came from a random or otherwise representative sample, that the independent and dependent variables demonstrated a linear relationship, and that the independent and dependent variables followed a normal distribution. As defined, each variable under analysis matched either an interval scale or a ratio scale, as required. Because most measures of Challenge Index, of Equity Index, and of changes in those variables failed tests for normality, due to observed sample skewness values with magnitude greater than 2, excess kurtosis greater than 2, or failure of the Shapiro-Wilk test for normality, Spearman's rank-order correlation was used for all hypothesis tests. AP participation in neighborhood schools in a Mid-Atlantic state during 2010-2011 and 2011-2012 was treated as representative of expected future performance from neighborhood schools similar to those in that Mid-Atlantic state, in the absence of major future changes in state schools. Follow up studies of similar questions could evaluate the degree to which AP exam participation in these schools was

representative of AP exam participation rates for schools in other states.

### **Statistical Analyses**

The sample for this study consisted of 98 of the 142 neighborhood schools in the Mid-Atlantic state. For each school, the data allowed computation of values for the AP Challenge Index, the Black or African American Challenge Index, and the Hispanic or Latino Challenge Index. These values were used in calculating the Black or African American Equity Index (the ratio of the school's Black or African American Challenge Index to the school's overall AP Challenge Index for students other than Black or African American students) and the Hispanic or Latino Equity Index (the ratio of the school's Hispanic or Latino Challenge Index to the school's overall AP Challenge Index for students other than Hispanic or Latino students) as discussed above.

The first research question, whether there was an association between the average level of participation in AP programs at a high school and the level of racial equity in AP participation for Black or African American students at that school, was answered through a Spearman's rank-order correlation test due to a failure of the data to meet the normality requirements for regression. I found the correlation between the rank order of the independent variable (AP Challenge Index) and the rank order of the dependent variable (Black or African American Equity Index) for the data and tested whether there was an association between these two quantities, at a significance level of .05. The statistical hypotheses associated with this research question were:

$H_{01}$ :  $\rho_B=0$ . There is no association between the rank order of AP Challenge Index values for individual schools and the rank order of Black or African American equity index values for the same schools among the Mid-

Atlantic state's neighborhood schools.

$H_{a1}$ :  $\rho_B \neq 0$ . There is an association between the rank order of AP Challenge Index values for individual schools and the rank order of Black or African American equity index values for the same schools among the Mid-Atlantic state's neighborhood schools.

The second research question, whether there was an association between the average level of participation in AP programs at a high school and the level of racial equity in AP participation for Hispanic or Latino students at that school, was answered through a Spearman's rank-order correlation test, required due to a failure of the data to meet the normality requirements for regression. I found the correlation between the rank order of the independent variable (AP Challenge Index) and the rank order of the dependent variable (Hispanic or Latino Equity Index) for the data and tested whether there was an association between these two quantities, at a significance level of .05. The statistical hypotheses associated with this research question were:

$H_{02}$ :  $\rho_{H/L} = 0$ . There is no association between the rank order of AP Challenge Index values for individual schools and the rank order of Hispanic or Latino equity index values for the same schools among the Mid-Atlantic state's neighborhood schools.

$H_{a2}$ :  $\rho_{H/L} \neq 0$ . There is an association between the rank order of AP Challenge Index values for individual schools and the rank order of Hispanic or Latino equity index values for the same schools among the Mid-Atlantic state's neighborhood schools.

The third research question, whether there was an association between changes in

the average level of participation in AP programs at a high school and changes in the level of racial equity in AP participation for Black or African American students at that school, was answered through a Spearman's rank-order correlation test, required due to a failure of the data to meet the normality requirements for regression. I found the correlation between the rank order of the independent variable (change in AP Challenge Index from 2011 to 2012) and the rank order of the dependent variable (change in Black or African American Equity Index from 2011 to 2012) for the data and tested whether there was an association between these two quantities, at a significance level of .05. The statistical hypotheses associated with this research question were:

$H_{03}$ :  $\alpha_{\Delta b} = 0$ . There is no association between the rank order of changes in the AP Challenge Index values for individual schools and the rank order of changes in the Black or African American equity index values for the same schools among the Mid-Atlantic state's neighborhood schools.

$H_{a3}$ :  $\alpha_{\Delta b} \neq 0$ . There is an association between changes in the AP Challenge Index values for individual schools and changes in the Hispanic or Latino equity index values for the same schools among the Mid-Atlantic state's neighborhood schools.

The fourth research question, whether there was an association between changes in the average level of participation in AP programs at a high school and changes in the level of racial equity in AP participation for Hispanic or Latino students at that school, was answered through a Spearman's rank-order correlation test, conducted for consistency with the first three statistical tests. Since the data for this fourth research question met the normality requirements for regression, a t-test on the slope of the

regression line was also conducted. The results of the t-test and of Spearman's rho produced equivalent conclusions. I found the correlation between the rank order of the independent variable (change in AP Challenge Index from 2011 to 2012) and the rank order of the dependent variable (change in Hispanic or Latino Equity Index from 2011 to 2012) for the data and tested whether there was an association between these two quantities, at a significance level of .05. The statistical hypotheses associated with this research question were:

$H_{04}$ :  $\alpha_{\Delta h} = 0$ . There is no association between the rank order (or values) of changes in the AP Challenge Index values for individual schools and the rank order (or values) of changes in the Hispanic or Latino equity index values for the same schools among the Mid-Atlantic state's neighborhood schools.

$H_{a4}$ :  $\alpha_{\Delta h} \neq 0$ . There is an association between the rank order (or values) of changes in the AP Challenge Index values for individual schools and the rank order (or values) of changes in the Hispanic or Latino equity index values for the same schools among the Mid-Atlantic state's neighborhood schools.

There were no statistical hypotheses associated with the final research question. Rather, tabular and graphical displays of the resulting data were generated to answer this question. These displays provide information on the relative levels of participation in individual AP subjects and exams in schools with AP programs of various sizes, as measured by the AP Challenge Index, information that may be of value to school leaders when planning an expansion of their AP programs. In accordance with College Board

policies on publishing AP data for individual schools, I presented these data in a manner that aggregates school data to avoid disclosing data associated with individual schools or with a small number of schools.

### **Limitations and Biases**

Because this observational study used numbers from existing databases, many of the classic threats to internal validity had limited relevance to this research. Borg outlined Campbell and Stanley's eight threats to internal validity: history, maturation, testing, instrumentation, statistical regression, differential selection, experimental mortality, and selection-maturation interaction (1984, pp. 11-12). Borg also addressed Cook and Campbell's additional threats to internal validity: differential experimental mortality, diffusion or imitation of treatment, compensatory equalization of treatment, compensatory rivalry by those receiving less desirable treatments, and compensatory demoralization of those receiving less desirable treatments (1984, pp. 11-13). Because I did not impose a treatment on the population, there could not have been differential, diffusion, or compensatory effects of the independent variable beyond than those intended for modeling as functions of the dependent variable. The following paragraphs address a range of potential threats to validity, most of which were not major issues in this study. In general, the most significant potential threats to validity included history, selection bias, and differences between the selected sample and the population of interest to the reader.

#### **Internal validity**

History might have been a consideration in this study if the conditions of the school years under study were not representative of future conditions. Differences

between teaching conditions in the ongoing economic recession and future economic conditions, or differences between curricula in place under No Child Left Behind and curricula under future educational experiments such as the Common Core or the educational trends that follow Common Core represented examples of history threats to internal validity that might have affected the applicability of study results to future educational environments. Maturation, testing, statistical regression to the mean, and selection-maturation interaction should not have affected this observational study; any of these effects present in retrospective observational data should have been considered relevant to the study regardless of the effect's origin. The decision to study these retrospective data should not have affected the correlation between the selected independent and dependent variables.

In general, the instrumentation used in a study might have posed a threat to internal validity, depending on the degree to which the defined variables measure the concepts of interest to educational leaders. If the number of AP exams administered per graduating senior did not represent the size of a school's AP program, that flaw would have limited this study's internal validity. One example of such a situation would have been a newly opened school with large numbers of non-seniors available to take AP exams but only a partial senior class. There were no such schools for which the computed Challenge Index failed to suitably indicate the school's AP program size, and there were no such special circumstances that justified special treatment of data, other than schools for which only one year of data was obtained. For those schools for which only one year of data was available, or for which one year of data represented fewer than ten students from a demographic group under study, AP Challenge Index and Equity Index values

were calculated using the only suitable year of data rather than two years of data, and no calculation was made for changes in Challenge Index or for changes in the appropriate Equity Index. Researchers and educational leaders might have debated the appropriateness of the Black or African American and Hispanic or Latino Equity Indices as defined. They might have argued that absolute changes in the Black or African American AP Challenge Index and in the Hispanic or Latino AP Challenge Index constituted a better measure of equity than the proportional approach used in the Equity Indices, and those who disagree with this selection may question whether this research measured what it purported to measure. I concluded that the ratio representation of Black or African American and Hispanic or Latino student participation in AP exams provided a useful indicator of the meaningful participation of Black or African American and Hispanic or Latino students in AP education. This was a values question, but the selected variables were consistent with Aristotle's characterization of justice as "the just, then, is a species of the proportionate . . . the unjust is what violates the proportion" (trans. 1931, p. 1006-1007). Investigating the validity of these assumptions or exploring the same issues with different value assumptions could form starting points for subsequent research.

The choice of non-IB neighborhood schools for the regression analysis introduced a potential differential selection bias. If magnet schools, charter schools, and IB schools tend to cluster in particular regions of the state or in non-representative school districts, then the exclusion of these schools might have biased the research so that the results would have been less representative of schools outside the population of neighborhood schools in this Mid-Atlantic state. Mortality and attrition were potential considerations. Schools could potentially have shifted between AP and IB programs, or even closed

completely, and the preparations for these changes could have produced outliers or influential observations that were not consistent with data from schools not engaged in such a transition. While these special circumstances had the potential to occur, no such situations were actually observed within the data, so no school analyses required or received special treatment.

Experimenter bias provided the final potential threat to internal validity (Morgan, Gliner, & Harmon, 2000, para. 18), but that threat should have been minimal in an observational study. Further, I chose this research question because I consider the answer important, and I did not have an expected or preferred outcome to the study. As the parent of four students who participated extensively in AP programs, I have a personal interest in the effects of these programs on public education. Further, as an AP teacher, I have a personal interest in accurate knowledge of the role, if any, that my work as an AP teacher has had in promoting equal educational opportunity. If it had turned out that there was an association between having a large AP program or expanding a school's AP program and educational equity, I would have considered that knowledge useful in improving educational outcomes for my future students. Similarly, if it had turned out that the size of a school's AP program and the educational equity of that program were not associated, I would have considered that information useful, both for the knowledge that such decisions could in the future be made independently and for the knowledge that an expansion of a school's AP program could not be expected to improve equity.

Although correlation does not imply causation, schools attempting to improve educational equity for Black or African American or for Hispanic or Latino students could have referred to the study results for guidance when expanding their AP programs

and decided based on their professional experience whether the results were consistent with their expectations. Further research could have determined whether such conscious expansion efforts in fact led to improved educational equity. Conversely, if the data had shown a negative association between having a large AP program or expanding a school's AP program and AP equity, that result could also have contributed to improving educational outcomes. Still keeping in mind the fact that correlation does not imply causation, schools attempting to expand their AP programs might recognize a moral obligation to mitigate the potential racially disparate effects of expanding their AP programs, if such expansions had shown an association with an increased gap between Black or African American student performance or Hispanic or Latino student performance and the remainder of the school's students. Further research could then have determined whether purposeful mitigation efforts in fact led to a reduction in the gaps in educational equity or at least to a reduction in growth of that gap when expanding AP programs. Consciously imposing experimenter bias on the results in either direction would have made no sense, particularly given the risk that inaccurate results would lead to policies that harm students.

### **External validity**

According to Bracht and Glass, threats to external validity may arise from such factors as population validity, consisting of (A) differences between the accessible population and the target population of interest, and (B) "interaction of personological variables and treatment effects," meaning that assigning experimental subjects to different treatments would have reversed the outcome (1968, p. 438). Threats to external validity may also emerge from ecological validity issues, including (A) a presupposition

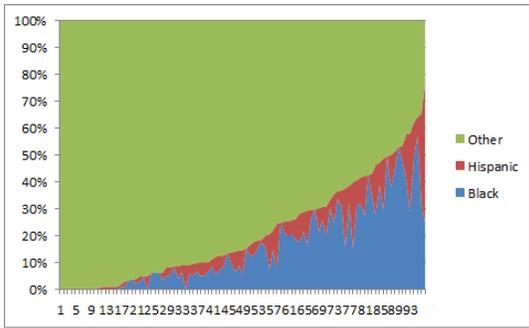
of complete knowledge of all aspects of the treatment and experimental setting (1968, p. 438), (B) multiple-treatment interference, (C) the Hawthorne Effect, (D) novelty or disruption effects, (E) experimenter effects, (F) pre-test sensitization, (G) post-test sensitization, (H) interaction between history and treatment effects, (I) accurate definition and measurement of the dependent variable, and (J) interactions between the time of the measurement and treatment effects (1968, p. 439).

The second threat to population validity, "interaction of personological variables and treatment effects," could not have arisen in this retrospective observational study because I did not impose any treatment. The first threat to population validity, differences between the population of neighborhood high schools in the Mid-Atlantic state for which data were obtained for this study and the target population, might have been a consideration. If I had obtained data for most or all selected schools, or even for a representative sample of schools, I could reasonably have assumed that the results would apply to neighborhood high schools in the Mid-Atlantic state under consideration in future years, at least for the near future. Attempts to generalize these results to high schools in other states, to schools other than neighborhood high schools, or to school systems unlike those represented in the Mid-Atlantic state, such as very large urban school districts, might still have raised issues with external validity. However, two large majority-minority school districts with high proportions of Black or African American students failed to provide data, despite numerous follow-up requests, and those missing school districts are significantly different in both demographics and socio-economic status from the school districts that provided data for this study. In the absence of these data, caution should be used in any attempt to generalize the results of this research to

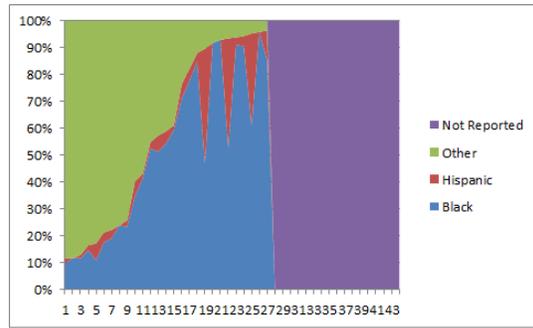
schools from districts significantly different from those represented in the study. The reader must decide on a case-by-case basis whether differences between the experimental population in this study and the population of interest to the reader represented a threat to the validity of these results, or further research might help to evaluate that validity. The graphs below illustrate the differences between the demographic distributions of schools used in this study and the demographic distributions of schools not used in this study, among those schools with known demographic distributions. The schools with demographics listed as “Not Reported” are from a comparatively large, urban, majority-minority school district and chose both not to provide data for my study and not to provide demographic data to the state department of education website used in this study. Figures 2 and 3, below, show minimal representation of majority-minority schools, suggesting that research conclusions from this study may not generalize to such schools.

The neighborhood schools for which no data were reported were disproportionately majority-minority, meaning more than 50% Black or African American and Hispanic or Latino, even excluding the schools for which demographic data were not reported. The schools for which demographic data were not reported can reasonably be assumed to be predominantly majority-minority based on the demographics of their school district. The schools for which data were obtained but the data could not be used in research questions 1 and 3 generally had a low percentage of Black or African American students, as would be expected because the exclusion criteria required fewer than ten Black or African American graduating seniors. Similarly, the schools for which data were obtained but the data could not be used in research questions 2 and 4 generally had a low percentage of Hispanic or Latino students, as would be

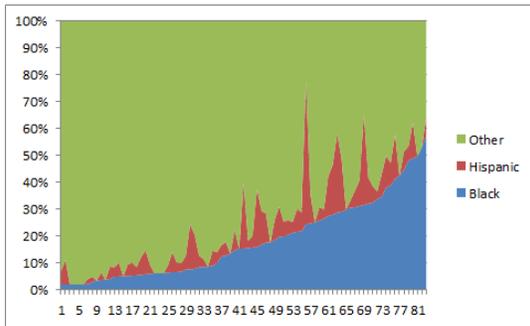
expected because the exclusion criteria required fewer than ten Hispanic or Latino graduating seniors.



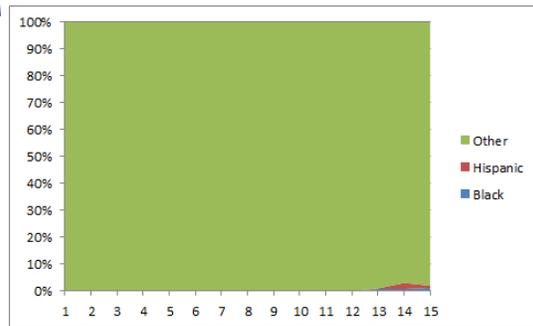
Demographics: Neighborhood schools for which AP data were obtained. n=98



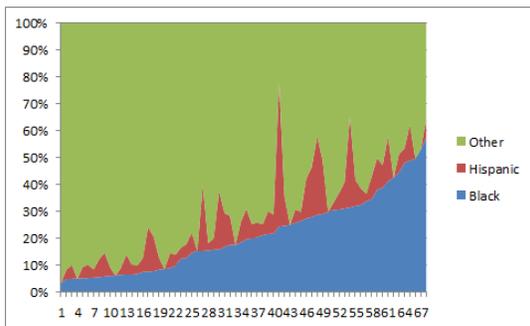
Demographics: Neighborhood schools for which AP data were not obtained. N=44



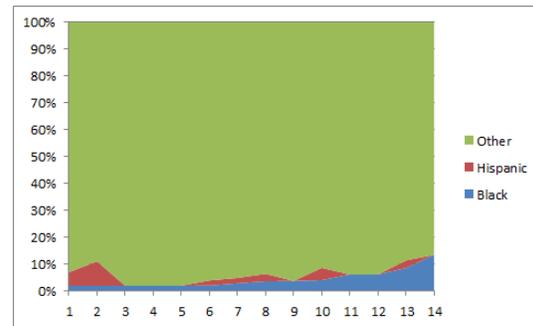
Demographics: Neighborhood schools with useable data for Research Question 1. n=83



Demographics: Neighborhood schools without useable data for Research Question 1. n=15

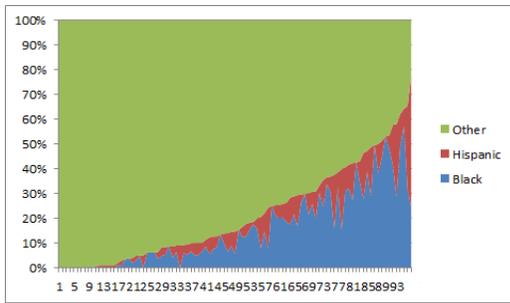


Demographics: Neighborhood schools with useable data for Research Questions 1 and 3. n=69

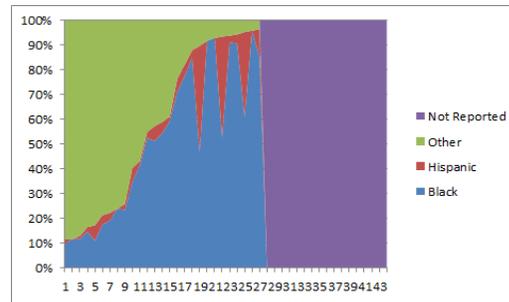


Demographics: Neighborhood schools with useable data for Research Question 1 but not Research Question 3. n=14

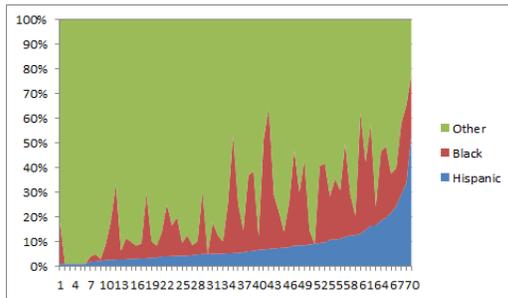
Figure 2: Demographic distributions - percent of Black, Hispanic, and other students in each school used for Research Questions 1 and 3.



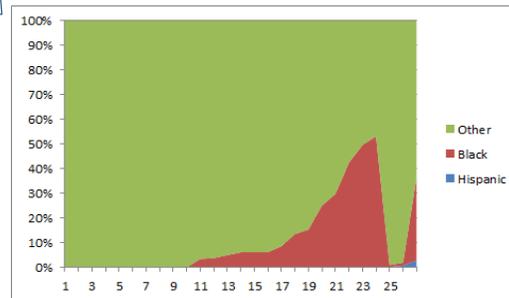
Demographics: Neighborhood schools for which AP data were obtained. n=98



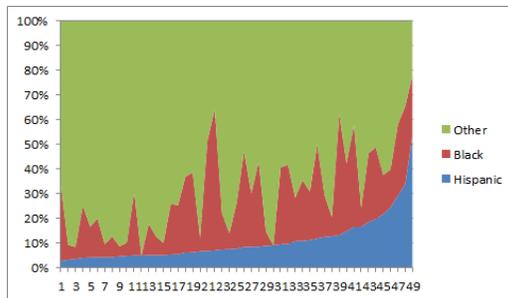
Demographics: Neighborhood schools for which AP data were not obtained. N=44



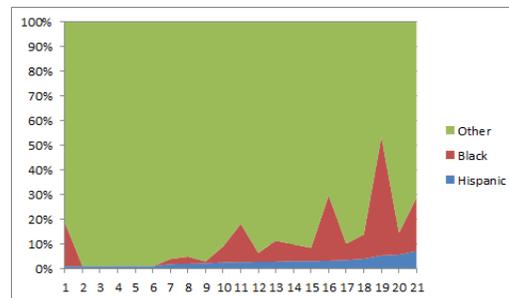
Demographics: Neighborhood schools with useable data for Research Question 2. n=70



Demographics: Neighborhood schools without useable data for Research Question 2. n=28



Demographics: Neighborhood schools with useable data for Research Questions 2 and 4. n=49



Demographics: Neighborhood schools with useable data for Research Question 2 but not Research Question 4. n=21

**Figure 3:** Demographic distributions - percent of Black, Hispanic, and other students in each school used for Research Questions 2 and 4.

I have addressed ecological threats to external validity individually, as outlined by Bracht and Glass (1968). This study came reasonably close to satisfying the presupposition of complete knowledge of all aspects of the treatment and experimental

setting. Because I conducted this retrospective study using clearly defined variables that were known to a high level of accuracy, validity threats of this type should have been minimal. There was room for minor fluctuations in some reported data, so that, for example, schools might have reported either the number of AP Exams taken or the number of AP exam scores received, where small differences between the two numbers might have occurred due to rare score cancellations. There was no reason to believe that errors of these types would have had a large effect on the data of interest for this research.

The other factors: multiple-treatment interference, the Hawthorne Effect, novelty and disruption effects, experimenter effects, pretest/post-test sensitization, and the interaction of history and treatment or of time and treatment should not have arisen, again because this was an observational study with negligible opportunity for such interactions to have occurred. A more relevant potential threat to external validity was the definition and measurement of the dependent and independent variables. Just as I defined the population for this study narrowly, and any potential application of results to other populations would have to have been evaluated carefully, I defined the variables narrowly and limited these variables to absolute and relative participation rates in Advanced Placement exams and to changes in those rates. This narrow definition reduces the uncertainty that might otherwise arise due to differences between the AP curriculum and IB or other college-level curricular alternatives, but the restriction to AP data also added to the uncertainty of any application of these results to these other advanced programs. Additional research may be appropriate before generalizing study results to other advanced curricula. Further, I have implicitly assumed that the results from the selected years for this study apply to education in future years, but a major change in

public education between the years of this study and the years of interest for applying study results could affect the applicability of the results to the target population.

Study limitations arose from the selection of data sources, including the exclusion of data from International Baccalaureate (IB) schools. Both the inclusion of such schools and their exclusion would have carried risks. Their exclusion from statistical analysis carried some risk because of the loss of data from schools that might have differed significantly in some unknown ways from the schools retained in the study. The results of the study might not apply to IB schools and might not apply to schools that are building toward an AP or IB program if those schools share critical traits with the excluded IB schools. The exclusion of data from charter, magnet, and IB schools also risked introducing biases in the results if these excluded schools predominated in regions with disproportionate populations representing particular demographic groups. In particular, excluding charter and magnet schools, both of which disproportionately occurred in areas with high Black or African American and Hispanic or Latino populations, might have had a significant effect on conclusions regarding racial equity. In addition, the definition of a magnet school may vary between states or even between schools. For the purposes of this study, the category of magnet schools comprised all schools that self-identified as magnet schools. Some schools with small magnet programs might have classified themselves as magnet schools, and other schools with larger magnet programs might not have self-assigned the same label. There was no uniform standard on whether a school with a small random admissions lottery qualified as a magnet school, whether schools with competitive admissions for small programs within the school counted as magnets, or what size program open to students from outside the usual residence boundaries justified

categorizing the school under the magnet classification. The study results from the selected schools, primarily in areas that have not created magnet and charter school structures, might not generalize to the school districts that have concentrated their AP efforts in magnet and charter schools.

Construct validity, the extent to which the metrics defined actually measure the phenomena of interest, had relevance to this study. The defined AP Challenge Indices and AP Equity Indices should have measured the relationship between the size of a school's college-level educational program and the racial equity of that school's college-level educational program in most schools. The number of AP exams administered per graduating senior represented the size of the college level program at a school. This choice omitted the significant number of schools offering IB and Cambridge exams, a choice that narrowed the population of interest but reduced the variability due to previously addressed differences among types of exams. The number of exams administered per graduating senior measured the participation rate in these programs more appropriately than a direct count of the number of students enrolled in AP classes would have, because having chosen to take the exam provided an added indication of serious participation in the course. Self-reported race, as entered by the student when taking the AP exam, provided the race input for calculations of Black or African American and Hispanic or Latino Educational Equity Indices. The student's self-reported race as recorded by the College Board might have differed from the student's race as reported by the school in total numbers of Black or African American and of Hispanic or Latino students in the graduating class, potentially resulting in inconsistencies in the data. Further, particularly in schools with small or rapidly changing Black or African

American and Hispanic or Latino populations, schools might have exhibited significant differences in the proportions of Black or African American and Hispanic or Latino students in the grades that took AP exams and the proportion of Black or African American and Hispanic or Latino students in the senior class. The selected measure of educational equity thus might not have measured exactly the parameter of interest and might have exhibited significant fluctuations relative to the true ratio level of equity.

The Black or African American Challenge Index and the Hispanic or Latino Challenge Index may have exhibited sensitivity to small changes in the number of AP exams taken in schools with very small numbers of students either in these racial groups or outside those groups. Due to this sensitivity, I omitted schools with very small numbers (fewer than ten) of White, Black and African American, or Hispanic and Latino graduating seniors from the analysis for associated measures of equity and documented all such omissions.

### **Risks to Participants**

Local school districts and the state Department of Education served as the primary source of data and AP results for this research. All results that might have permitted identification of individual schools were omitted from the graphical displays of data. A second risk was in the collection of data on the numbers of graduates and their race. These general numbers could not have been associated to any specific individuals, and the risk associated with such data was minimal. Because of the negligible risk, the IRB classified this study as exempt. Careful reviews of changes to the planned procedure ensured that changes did not impose additional risk to the schools under study or to

individuals within those schools, and regular reviews determined that no previously undetected risks emerged in the course of the study.

## **Chapter 4: Results**

The goal of this quantitative study was to identify any relationships between the size of high school Advanced Placement (AP) programs and the racial or ethnic equity of those programs. This study examined the relationship between the overall size of a school's AP program, as measured by the school's AP Challenge Index, defined as the ratio of the number of AP exams administered at that school to the total number of seniors in the school, and the equity of that AP program, as measured by the ratio of the AP Challenge Index for Black or African American students to the school's AP Challenge Index for all students except Black or African American students, a ratio that I called the Black or African American Equity Index.

Data were collected from both the state Department of Education (DOE) website and from individual schools and school districts within this Mid-Atlantic state. Where privacy policies permitted, these data included the total number of graduates for 2011 and 2012, the number of black graduates for each year under study, the number of Hispanic graduates for each year under study, and the number of AP exams administered in each year under study. In addition to the total number of AP exams administered at each high school, the state DOE website listed the number of AP exams administered in each of six categories of exams – Fine Arts, English, Foreign Language, Math, Science, and Social Studies.

### **Description of the Population**

The state DOE website did not include AP Exam data for eight of the 142 neighborhood schools in 2011 or for nine such schools in 2012. Similarly, the DOE website omitted the numbers of graduates from eight neighborhood schools in each of

2011 and 2012. Additionally, in many school districts, data values describing fewer than ten students were replaced with an asterisk.

Additional data were obtained directly from the school systems in this Mid-Atlantic state. Several school districts provided all the requested data, under the condition that I agree not to use numbers associated with fewer than ten students in my analysis and not to publish such numbers, or all requested data except for values under ten. Most school districts provided the number of exams administered for each AP Exam subject, although some omitted values under ten, and one of the larger school districts only provided numbers for the twenty most popular AP exams in that district, regardless of the numbers at each individual school.

The Mid-Atlantic state of interest has 206 public high schools. Of these 206 public high schools, 142 were classified as neighborhood schools based on information available from the high schools and from the school districts. Of those 142 schools, data were received for 98 high schools, approximately a 69% response rate. Black or African American demographic data for a total of fifteen schools were either not provided by those school systems in accordance with a state policy of not reporting aggregate data on fewer than ten students, or the data were provided but under the condition that I exclude such data from analysis and publication. In accordance with that agreement and for data consistency, data from all fifteen of those schools with fewer than ten Black or African American seniors were excluded from data analysis. This left a total of 83 schools in the database for tests dealing with the Black or African American Equity Index.

Of the 98 neighborhood high schools for which data were received, Hispanic or Latino demographic data for fourteen schools were not provided by those school systems

in accordance with a state policy of not reporting aggregate data on fewer than ten students. Hispanic or Latino demographic data were provided for an additional fourteen schools that showed fewer than ten Hispanic or Latino students, in most cases with the condition that I exclude such data from my analysis. In accordance with that agreement and for data consistency, all twenty-eight schools with fewer than ten Hispanic or Latino seniors were excluded from data analysis. This left a total of 70 schools in the database for tests dealing with the Hispanic or Latino Equity Index.

Data for the hypothesis tests were used as reported by the school districts, with the following exceptions:

The Black or African American Challenge Index and Equity Index were not calculated for schools reporting a total of fewer than ten Black or African American graduates. While values can be imputed for observations below a detection limit or below a reporting threshold, the Equity Index values calculated using small imputed values for the denominator (number of Black or African American graduates) would be unacceptably sensitive to differences between the imputed value and the actual value. Further, omitting all schools with small numbers of Black or African American graduates does not introduce systematic bias in the Black or African American Equity Index. This resulted in the exclusion of fourteen neighborhood schools for which data were collected.

Data were used from schools that reported more than ten Black or African American graduates in either 2011 or 2012 but omitted numbers less than ten from the other year. In these cases, analysis was limited to data from the year for which the number of black graduates was available. This included the use of only 2011 data in computing the Black or African American Challenge Index and Equity Index for seven

schools. This also included the use of only 2012 data in computing the Black or African American Challenge Index and Equity Index for one school.

The Hispanic or Latino Challenge Index and Equity Index were not calculated for schools reporting a total of fewer than ten Hispanic or Latino graduates. While values can be imputed for observations below a detection limit or below a reporting threshold, the Equity Index values calculated using small imputed values for the denominator would be unacceptably sensitive to differences between the imputed value and the actual value. Further, omitting all schools with small numbers of Hispanic or Latino graduates does not introduce systematic bias in the Hispanic or Latino Equity Index. This resulted in the exclusion of 27 neighborhood schools for which data were collected.

Data were used from schools that reported more than ten Hispanic or Latino graduates in either 2011 or 2012 but omitted numbers less than ten from the other year. In these cases, analysis was limited to data from the year for which the number of Hispanic or Latino graduates was available. This included the use of only 2011 data in computing the Hispanic or Latino Challenge Index and Equity Index for three schools. This also included the use of only 2012 data in computing the Hispanic or Latino Challenge Index and Equity Index for two schools.

The next data issue arose from observations for which the total number of AP Exams taken by Hispanic or Latino students at a particular high school was less than ten in a particular year. Omitting these observations would bias analysis results because only comparatively large numbers of AP Exams taken by Hispanic or Latino students at schools with low numbers of Hispanic or Latino graduates would be used in analysis, systematically biasing the result toward artificially high Hispanic or Latino Challenge

Index values for schools with small numbers of Hispanic or Latino students. The alternative is to impute data values, and a common practice is to impute data values of half the detection limit or half the reporting threshold. The reporting threshold for these values was ten, so values of five were imputed in place of low or missing numbers of AP Exams administered to Hispanic or Latino student in a particular year. Values were imputed for a total of twenty-three schools.

### **Study Results**

Nothing in the available literature suggested an expected direction of the relationships, if any, for the research questions in this study. The findings for each research question are presented below.

#### **First Research Question**

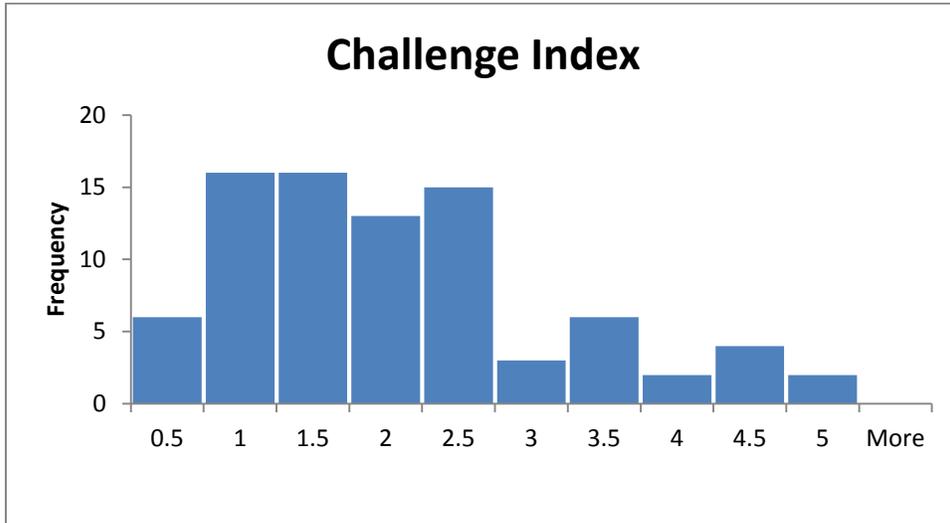
Research Question Number One: Is there an association between the average level of participation in AP programs at a high school and the level of racial equity in AP participation for Black or African American students at that school.

$H_{01}$ :  $\rho_B=0$ . There is no association between the rank order of AP Challenge Index values for individual schools and the rank order of Black or African American equity index values for the same schools among the Mid-Atlantic state's neighborhood schools.

$H_{a1}$ :  $\rho_B \neq 0$ . There is an association between the rank order of AP Challenge Index values for individual schools and the rank order of Black or African American equity index values for the same schools among the Mid-Atlantic state's neighborhood schools.

Data analysis to answer this research question included responses representing 83

neighborhood high schools. The variables of interest were the overall Challenge Index and the Black or African American Equity Index for the 83 schools for which usable data were obtained.

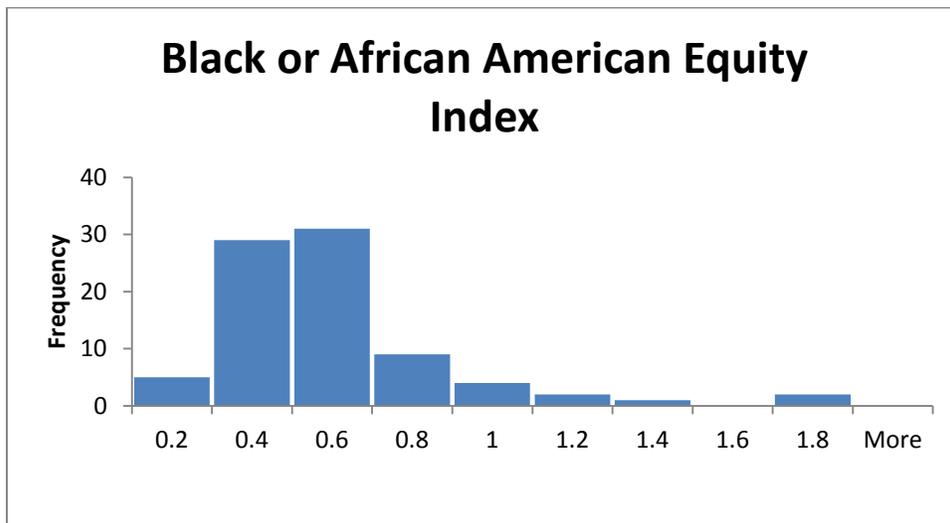


*Figure 4.* Histogram depicting the distribution of Challenge Index values used in addressing the first research question.

Figure 4 illustrates the distribution of Challenge Index data, including a visible skew to the right and a slight positive excess kurtosis. Descriptive statistics for these data are presented in Table 1 and confirm the impression conveyed by the histogram.

<i>Challenge Index</i>	
Mean	1.83
Standard Error	.12
Median	1.57
Std Deviation	1.12
Sample Variance	1.25
Excess Kurtosis	.37
Skewness	.94
Range	4.62
Minimum	.32
Maximum	4.94
Count	83

*Table 1.* Descriptive statistics for Challenge Index values used in addressing the first research question.



*Figure 5.* Histogram depicting the distribution of Black or African American Equity Index values.

Figure 5 illustrates the distribution of Black or African American Equity Index data and shows a strong skew to the right and a much larger positive excess kurtosis. Table 2 presents descriptive statistics for these data and confirms the impression conveyed by the histogram.

<i>Equity Index</i>	
Mean	.50
Standard Error	.03
Median	.43
Std Deviation	.29
Sample Variance	.08
Excess Kurtosis	6.47
Skewness	2.17
Range	1.63
Minimum	.12
Maximum	1.75
Count	83

*Table 2.* Descriptive statistics for Equity Index values used in addressing the first research question.

Figure 6 shows no clear relationship between the two quantities: African American Equity Index and Challenge Index.

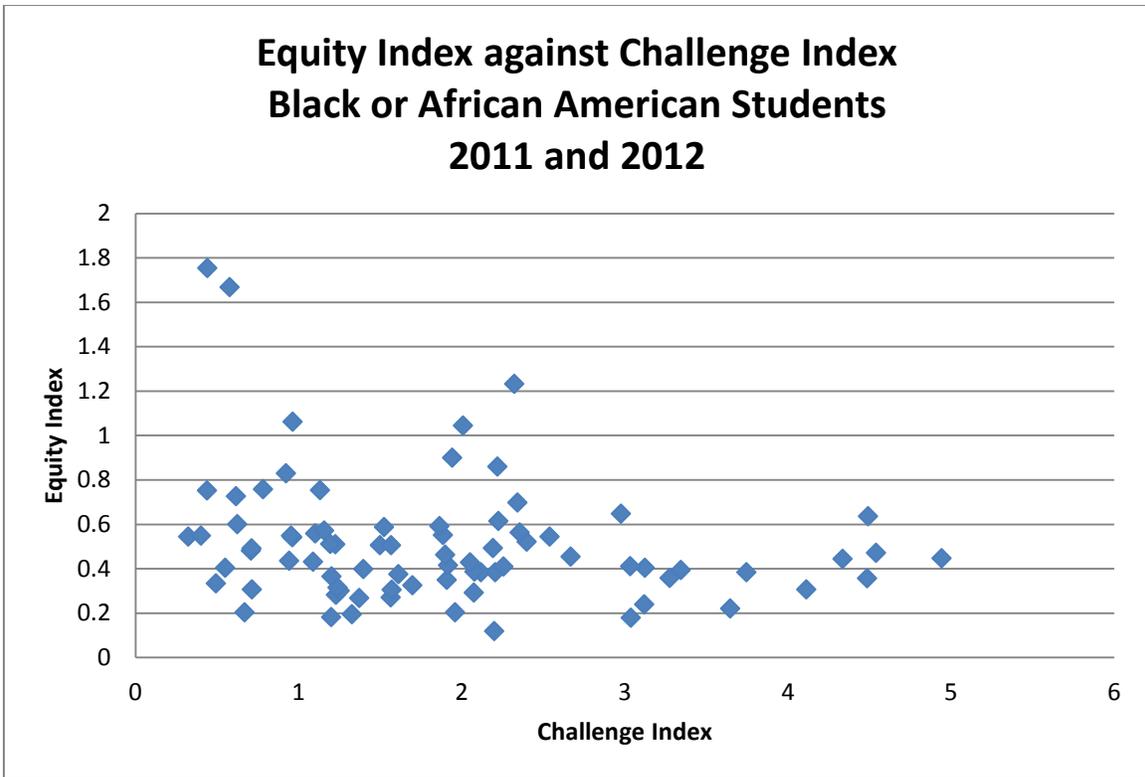


Figure 6. Scatterplot of Black or African American Equity Index against Challenge Index.

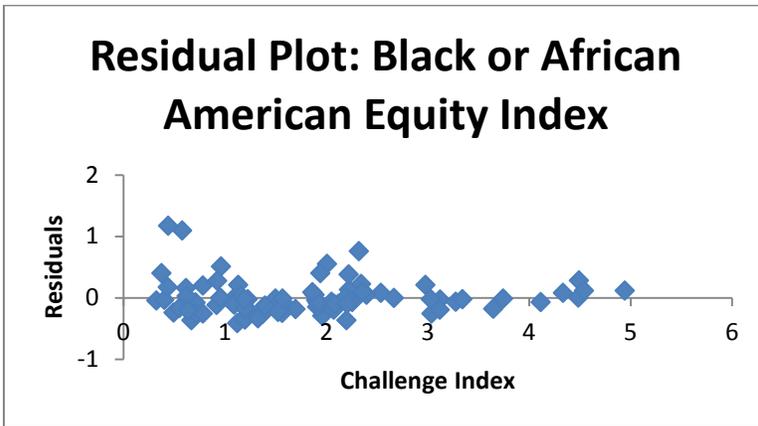


Figure 7. Residual Plot from the regression of Black or African American Equity Index against Challenge Index.

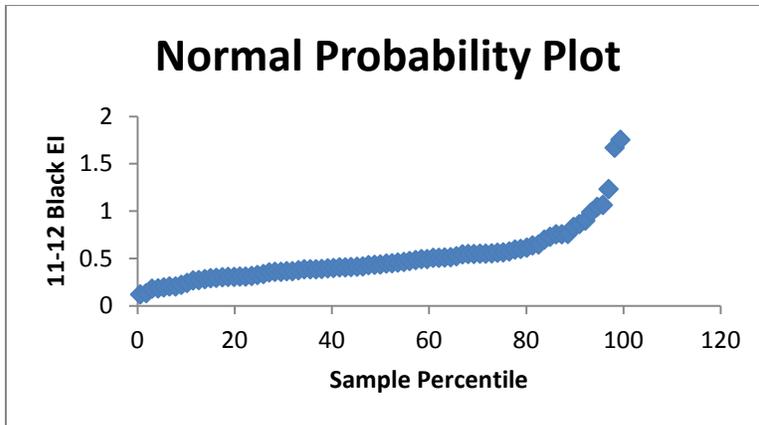


Figure 8. Normal Probability Plot from the regression of Black or African American Equity Index against Challenge Index.

Figure 6 and Figure 7 both show significant heteroscedasticity, with 180 percent higher variability associated with Black or African American Equity Index values for the 57 lowest Challenge Index values than was observed in Black or African American Equity Index values for the 16 highest Challenge Index values. In Figure 6, the median Black or African American Equity Index associated with AP Challenge Index values from 0 to 2.5 was .40 (SD = .38), while the median for Black or African American Equity Index for the AP Challenge Index values from 2.5 to 5.0 was .36 (SD=.13), illustrating a small difference in median relative to the standard deviation but a much larger difference in variability over the range of AP Challenge Index values. Similarly, the curve down on the left of Figure 8 and the large curve up on the right side of Figure 8 indicate the possibility of both a skew to the right and high excess kurtosis. Given the values of skew at 2.17 and excess kurtosis at 6.47 for Black or African American Equity Index, both of which were greater than 2; the Shapiro-Wilk statistic of .81,  $df=81$ ,  $p<.001$ ; and the clear heteroscedasticity in the scatterplot and residual plot, these data were unsuitable for a t-test on the slope of the linear regression. Instead, Spearman's rank correlation coefficient

was used in evaluating the relationship between these two variables. The evaluation of Spearman's rho revealed no statistically significant relationship between the rank order of the Challenge Index and the rank order of the Black or African American Equity Index at high schools in this Mid-Atlantic state during the 2010-2011 and 2011-2012 school years ( $r_{s[81]} = -.18, p = .10$ ).

I considered removing the two apparent outliers in Figure 6, the observations with Challenge Index values between 0.4 and 0.6 and Equity Index values between 1.6 and 1.8. Repetition of the statistical tests without the two apparent outliers found no change in the statistical conclusions without those two points. Since there was no objective reason to remove those points and their presence did not affect the statistical conclusions, I retained both observations for data analysis. These two outliers represented valid observations with high AP participation among Black or African American students. Given the low value for Spearman's rho and the two-tailed p-value of .10, there was insufficient evidence to conclude that there is an association between the rank order of AP Challenge Index values for individual schools and the rank order of Black or African American equity index values for the same schools among the Mid-Atlantic state's neighborhood schools.

### **Study Results - Second Research Question**

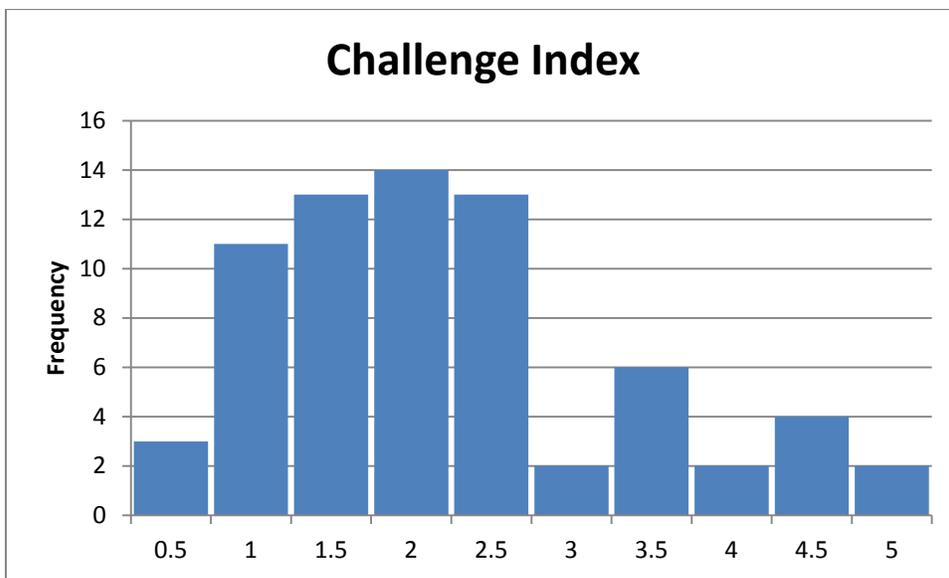
Research Question Number Two: Is there an association between the average level of participation in AP programs at a high school and the level of racial equity in AP participation for Hispanic or Latino students at that school.

$H_{02}$ :  $\rho_{H/L}=0$ . There is no association between the rank order of AP Challenge Index values for individual schools and the rank order of Hispanic or

Latino equity index values for the same schools among the Mid-Atlantic state's neighborhood schools.

$H_{a2}$ :  $\rho_{H/L} \neq 0$ . There is an association between the rank order of AP Challenge Index values for individual schools and the rank order of Hispanic or Latino equity index values for the same schools among the Mid-Atlantic state's neighborhood schools.

Data analysis to answer this research question included responses representing 70 neighborhood high schools. The variables of interest were the overall Challenge Index and the Hispanic or Latino Equity Index for the 70 schools for which usable data were obtained. Note that these constitute a different collection of schools than for the first research question, so the descriptive statistics for Challenge Index in this research question are different than reported above.



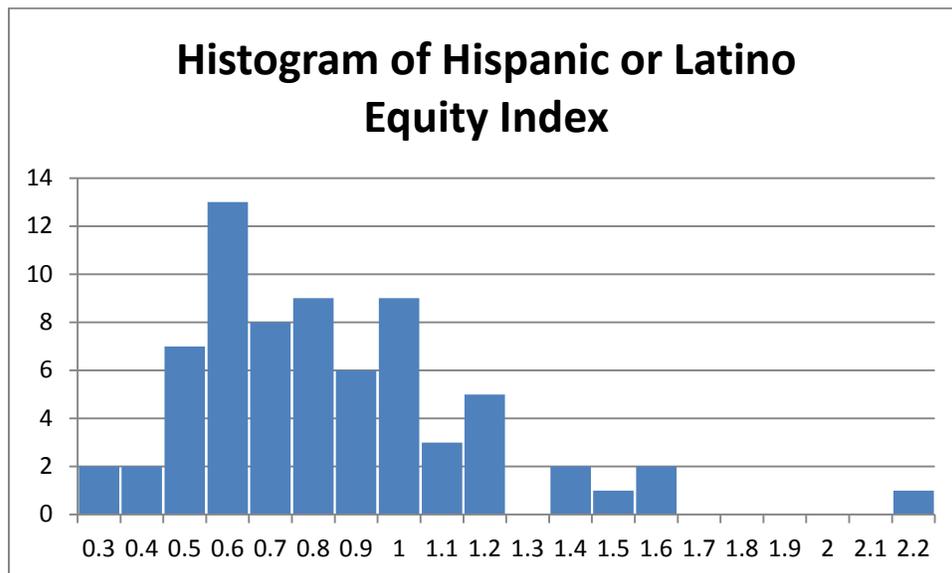
*Figure 9.* Histogram depicting the distribution of Challenge Index values used in addressing the second research question.

Figure 9 illustrates the distribution of Challenge Index data for the second research question and shows a moderate skew to the right and a slight positive excess kurtosis.

Table 3 presents descriptive statistics for these data and confirms the impression conveyed by the histogram.

<i>Challenge Index</i>	
Mean	1.97
Standard Error	.13
Median	1.89
Std Deviation	1.13
Sample Variance	1.28
Excess Kurtosis	.19
Skewness	.89
Range	4.54
Minimum	.40
Maximum	4.94
Count	70

*Table 3.* Descriptive statistics for Challenge Index values used in addressing the second research question.



*Figure 10.* Histogram depicting the distribution of Hispanic or Latino Equity Index values.

Figure 10 illustrates the distribution of Hispanic or Latino Equity Index data for the second research question and shows a moderate skew to the right and a much larger positive excess kurtosis. Table 4 contains descriptive statistics for these data and confirms the impression conveyed by the histogram.

<i>Descriptive Statistics for Equity Index</i>	
Mean	.79
Standard Error	.04
Median	.72
Std Deviation	.33
Sample Variance	.11
Excess Kurtosis	2.88
Skewness	1.31
Range	1.91
Minimum	.22
Maximum	2.13
Count	70

*Table 4.* Descriptive statistics for Equity Index values used in addressing the second research question.

Figure 11 shows the values of Hispanic or Latino Equity Index against Challenge Index and does not indicate any clear relationship between the two quantities.

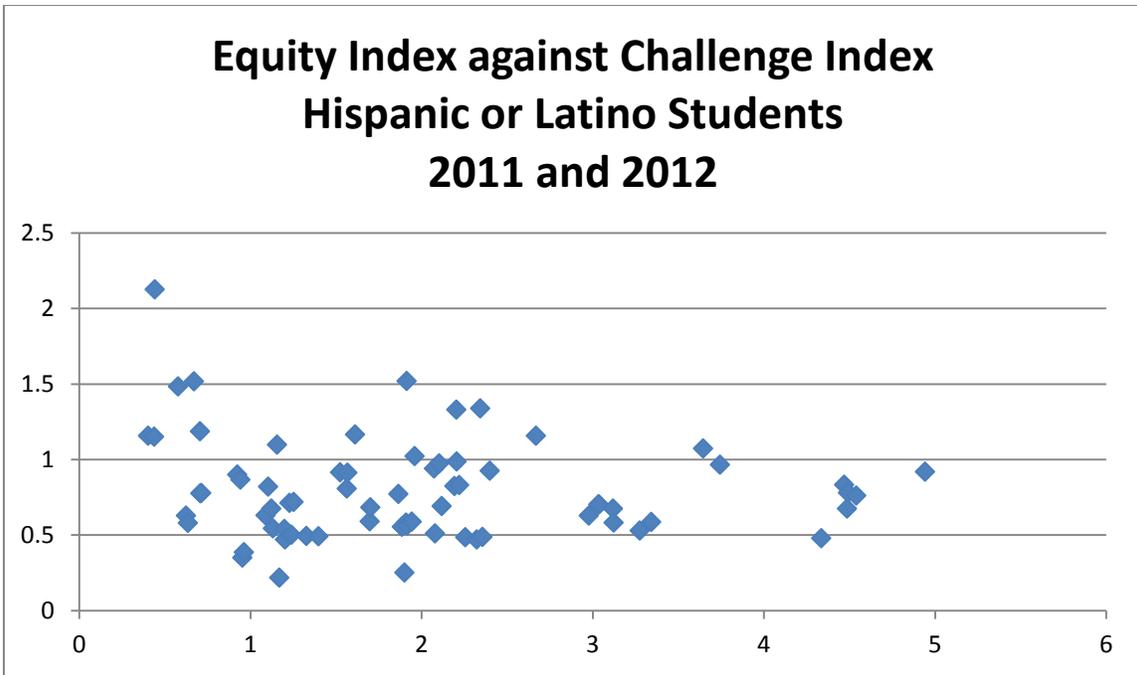


Figure 11. Scatterplot of Hispanic or Latino Equity Index against Challenge Index.

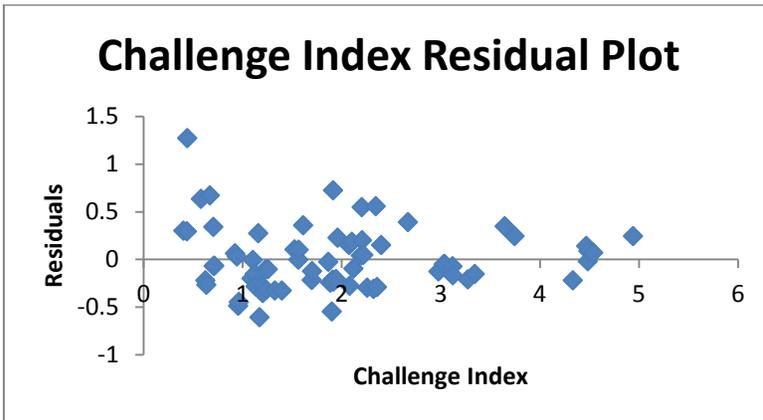


Figure 12. Residual Plot from the regression of Hispanic or Latino Equity Index against Challenge Index.

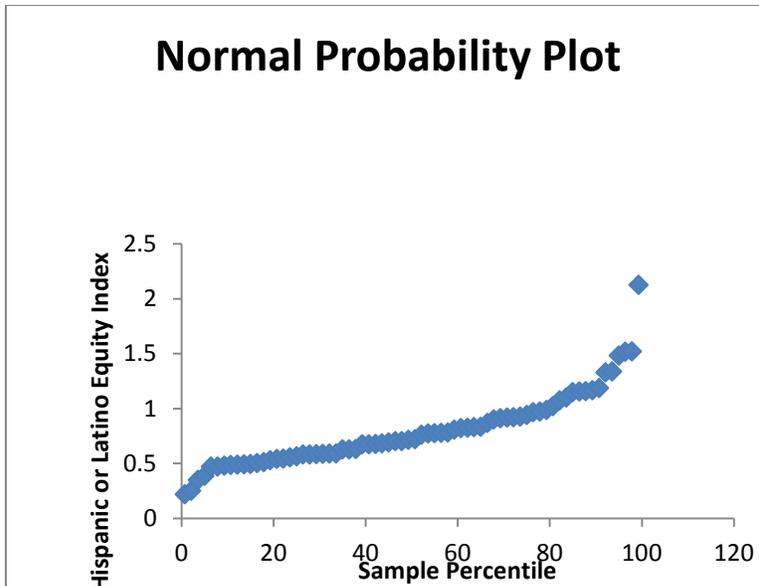


Figure 13. Normal Probability Plot for the regression of Hispanic or Latino Equity Index against Challenge Index.

Figures 11 and 12 both showed significant heteroscedasticity, with 88 percent higher variability associated with Hispanic or Latino Equity Index values for the 54 lowest Challenge Index values, from 0 to 2.5, than was observed in Hispanic or Latino Equity Index values for the 16 highest Challenge Index values, from 2.5 to 5. The median Hispanic or Latino Equity Index associated with AP Challenge Index values from 0 to 2.5 was .75 (SD = .36), while the median for AP Challenge Index values from 2.5 to 5.0 was .70 (SD=.19), illustrating a small difference in median relative to the standard deviation but a much larger difference in variability over the range of AP Challenge Index values. Similarly, the curve down on the left of Figure 13 and the large curve up on the right side of Figure 13 indicate the possibility of both a skew to the right and high excess kurtosis. Given the values of excess kurtosis at 2.88 for Hispanic or Latino Equity Index, which was greater than 2, the Shapiro-Wilk statistic of .92,  $df=68$ ,  $p<.001$ ; and the clear heteroscedasticity in Figures 11 and 12, these data were unsuitable for a t-test on the

slope of the linear regression. Instead, Spearman's rank correlation coefficient was used in evaluating the relationship between these two variables. The evaluation of Spearman's rho revealed no statistically significant relationship between the rank order of the Challenge Index and the rank order of the Hispanic or Latino Equity Index at high schools in this Mid-Atlantic state during the 2010-2011 and 2011-2012 school years ( $r_s[68] = -.07, p = .56$ ). Given this low value for Spearman's rho and the two-tailed p-value of .56, there is insufficient evidence to conclude that there is an association between the rank order of AP Challenge Index values for individual schools and the rank order of Hispanic or Latino Equity Index values for the same schools among the Mid-Atlantic state's neighborhood schools.

### **Study Results - Third Research Question**

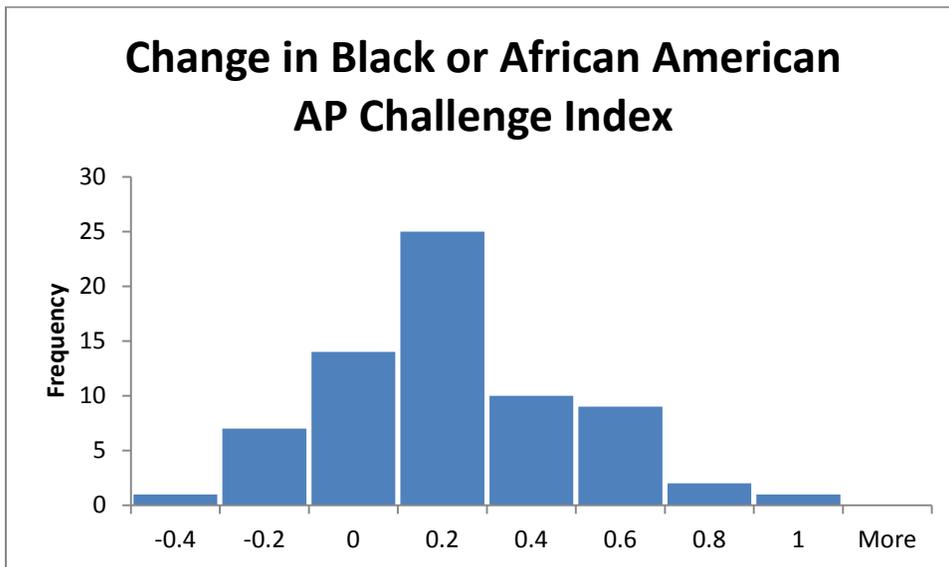
Research Question Number Three: Is there an association between changes in the average level of participation in AP programs at a school and changes in the level of racial equity in AP participation for Black or African American students at that school.

$H_{03}$ :  $\rho_{\Delta B} = 0$ . There is no association between the rank order of changes in the AP Challenge Index values for individual schools and the rank order of changes in the Black or African American Equity Index values for the same schools among the Mid-Atlantic state's neighborhood schools.

$H_{a3}$ :  $\rho_{\Delta B} \neq 0$ . There is an association between the rank order of changes in the AP Challenge Index values for individual schools and the rank order of changes in the Black or African American Equity Index values for the same schools among the Mid-Atlantic state's neighborhood schools.

Data analysis to answer this research question included the same responses as the

first research question except that data for fourteen schools were removed from the analysis because the data from either 2011 or 2012 represented fewer than ten black or African American graduating seniors. The variables of interest were the Change in AP Challenge Index between 2011 and 2012 and the Change in Black or African American Equity Index over the same time period for the 69 schools for which usable data were obtained.

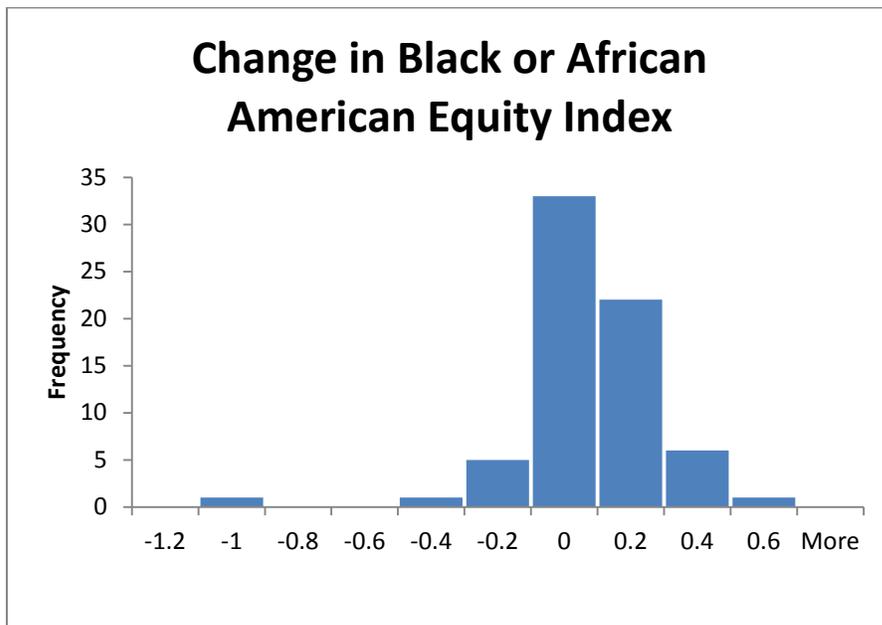


*Figure 14.* Histogram depicting the distribution of change in Challenge Index values used in addressing the third research question.

Figure 14 illustrates the distribution of change in AP Challenge Index data and shows a roughly symmetric distribution with near zero excess kurtosis and only a slight skew to the right, consistent with data from a normal distribution. Table 5 provides descriptive statistics for these data and confirms the impression conveyed by the histogram.

<i>Change in Challenge Index</i>	
Mean	.11
Standard Error	.03
Median	.09
Std Deviation	.26
Sample Variance	.07
Excess Kurtosis	-.10
Skewness	.43
Range	1.26
Minimum	-.42
Maximum	.85
Count	69

*Table 5.* Descriptive statistics for change in Challenge Index values used in addressing the third research question.

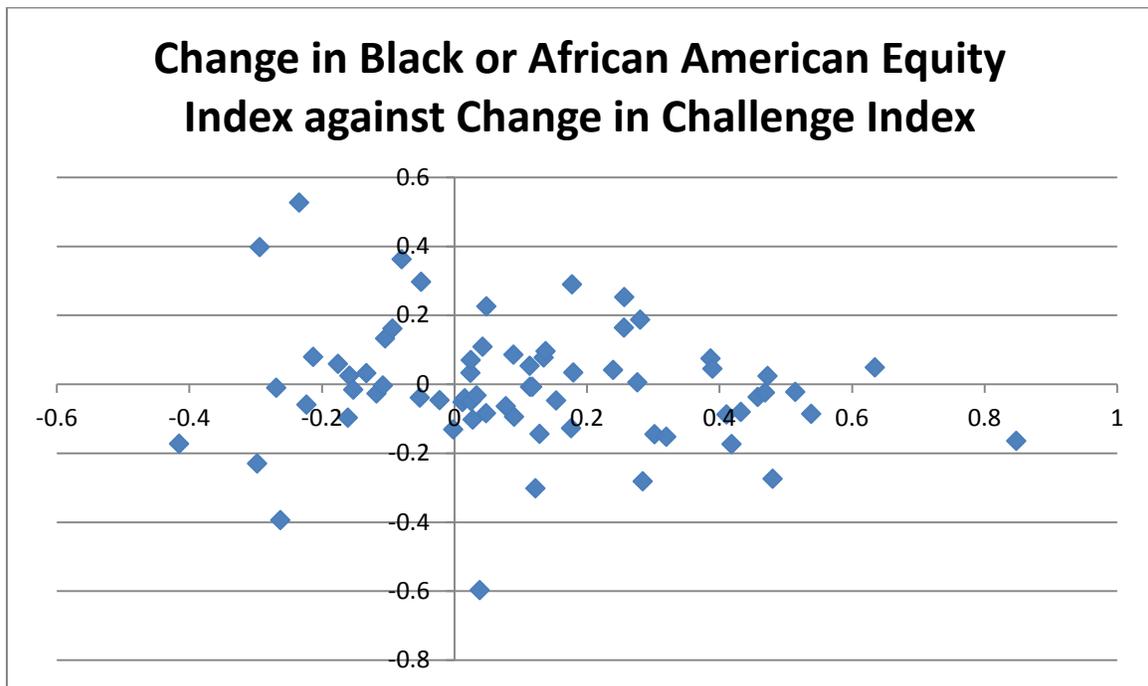


*Figure 15.* Histogram depicting the distribution of change in Black or African American Equity Index values.

Figure 15 illustrates the distribution of change in Black or African American Equity Index data and shows a low outlier and a large positive excess kurtosis. Table 6 provides descriptive statistics for these data and confirms the impression conveyed by the histogram.

<i>Change in Equity Index</i>	
Mean	-.02
Standard Error	.03
Median	-.02
Std Deviation	.22
Sample Variance	.05
Excess Kurtosis	7.74
Skewness	-1.51
Range	1.59
Minimum	-1.06
Maximum	.53
Count	69

*Table 6.* Descriptive statistics for change in Equity Index values used in addressing the third research question.



*Figure 16.* Scatterplot of change in Black or African American Equity Index against change in Challenge Index.

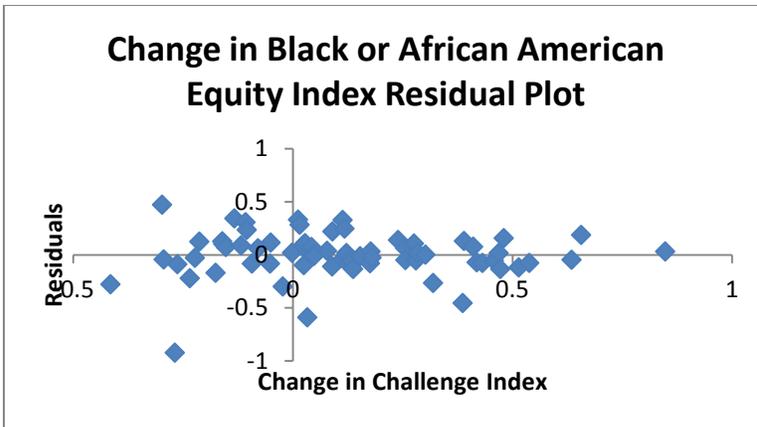


Figure 17. Residual Plot from the regression of Change in Black or African American Equity Index against Change in Challenge Index.

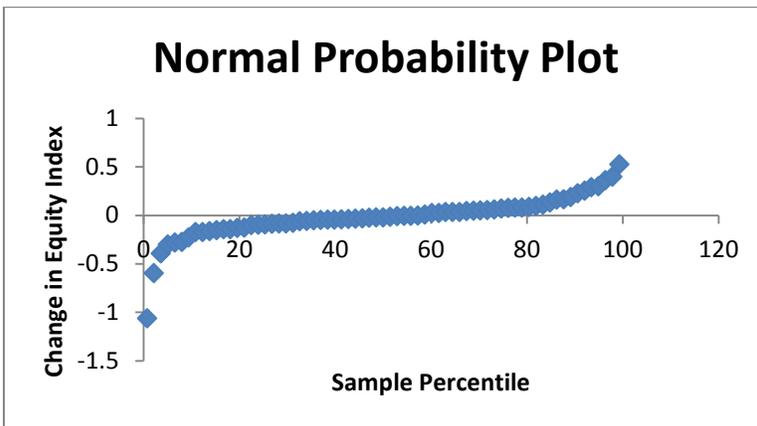


Figure 18. Normal Probability Plot for the regression of change in Black or African American Equity Index against change in Challenge Index.

Figures 16 and 17 both showed possible heteroscedasticity, although this is difficult to judge given the low outlier among the Change in Black or African American Equity Index values for one point with a high Change in Challenge Index. Similarly, the curve up on the right of Figure 18 and the much larger curve down on the left side of the same figure indicate the possibility of both a skew to the left and high excess kurtosis. Given the excess kurtosis at 4.95 for Change in Black or African American Equity Index, which was greater than 2, these data were unsuitable for a t-test on the slope of the linear regression. Instead, Spearman's rank correlation coefficient was used in evaluating the

relationship between these two variables. The evaluation of Spearman's rho revealed no statistically significant relationship between the rank order of the Change in Challenge Index and the rank order of the Change in Black or African American Equity Index at high schools in this Mid-Atlantic state between the 2010-2011 and 2011-2012 school years ( $r_s[67] = -.16, p = .19$ ). Given the low magnitude for Spearman's rho and the two-tailed p-value of .19, there is insufficient evidence to conclude that there is an association between the Change in AP Challenge Index values for individual schools and the Change in Black or African American equity index values for the same schools among this Mid-Atlantic state's neighborhood schools.

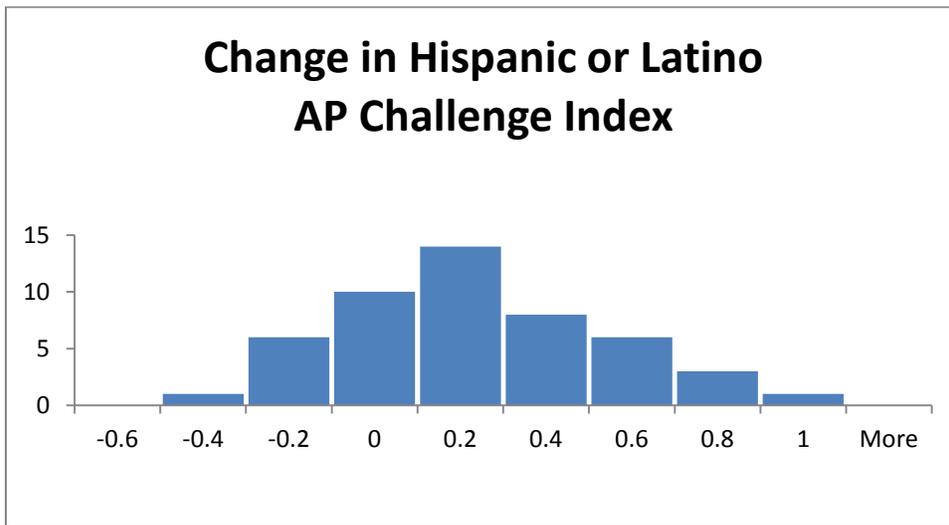
#### **Study Results - Fourth Research Question**

Research Question Number Four: Is there an association between changes in the average level of participation in AP programs at a high school and changes in the level of racial equity in AP participation for Hispanic or Latino students at that school.

$H_{04}$ :  $\rho_{\Delta H/L} = 0$ . There is no association between changes in AP Challenge Index values (or the rank order of these values) for individual schools and changes in the Hispanic or Latino Equity Index values (or the rank order of these values) for the same schools among the Mid-Atlantic state's neighborhood schools.

$H_{a4}$ :  $\rho_{\Delta H/L} \neq 0$ . There is an association between changes in AP Challenge Index values (or the rank order of these values) for individual schools and changes in the Hispanic or Latino Equity Index values (or the rank order of these values) for the same schools among the Mid-Atlantic state's neighborhood schools.

Data analysis to answer this research question included used the same responses as the second research question except that data for 21 schools were removed from analysis because the data from either 2011 or 2012 represented fewer than 10 Hispanic or Latino graduating seniors. The variables of interest were the Change in AP Challenge Index between 2011 and 2012 and the Change in Hispanic or Latino Equity Index over the same time period for the 49 schools for which usable data were obtained.

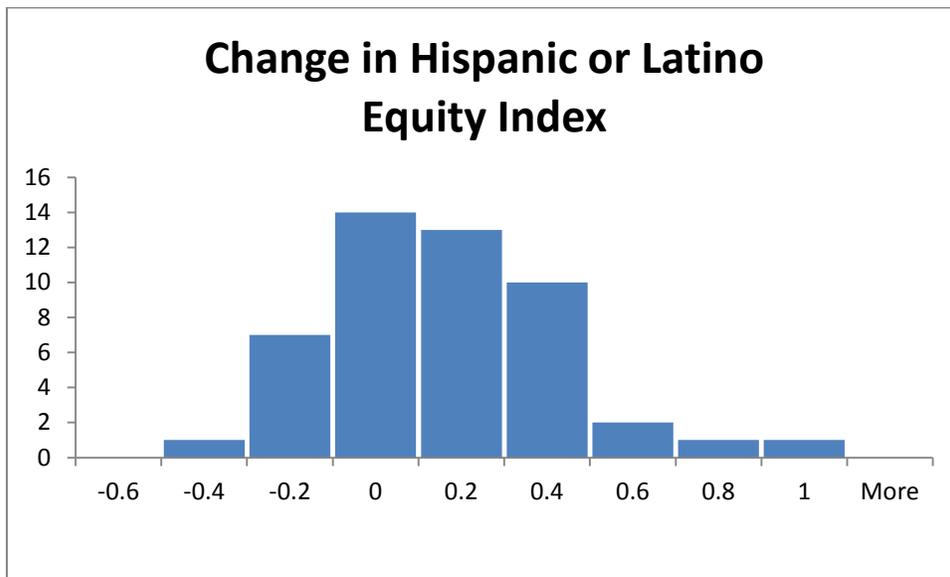


*Figure 19.* Histogram depicting the distribution of change in Challenge Index values used in addressing the fourth research question.

Figure 19 illustrates the distribution of change in AP Challenge Index data and shows a roughly symmetric distribution with minimal kurtosis and only a slight skew to the right, consistent with data from a normal distribution. Table 7 provides descriptive statistics for these data and confirms the impression conveyed by the histogram.

<i>Change in Challenge Index</i>	
Mean	.13
Standard Error	.04
Median	.08
Std Deviation	.30
Sample Variance	.09
Excess Kurtosis	-.49
Skewness	.44
Range	1.26
Minimum	-.42
Maximum	.85
Count	49

*Table 7.* Descriptive statistics for change in Challenge Index values used in addressing the fourth research question.

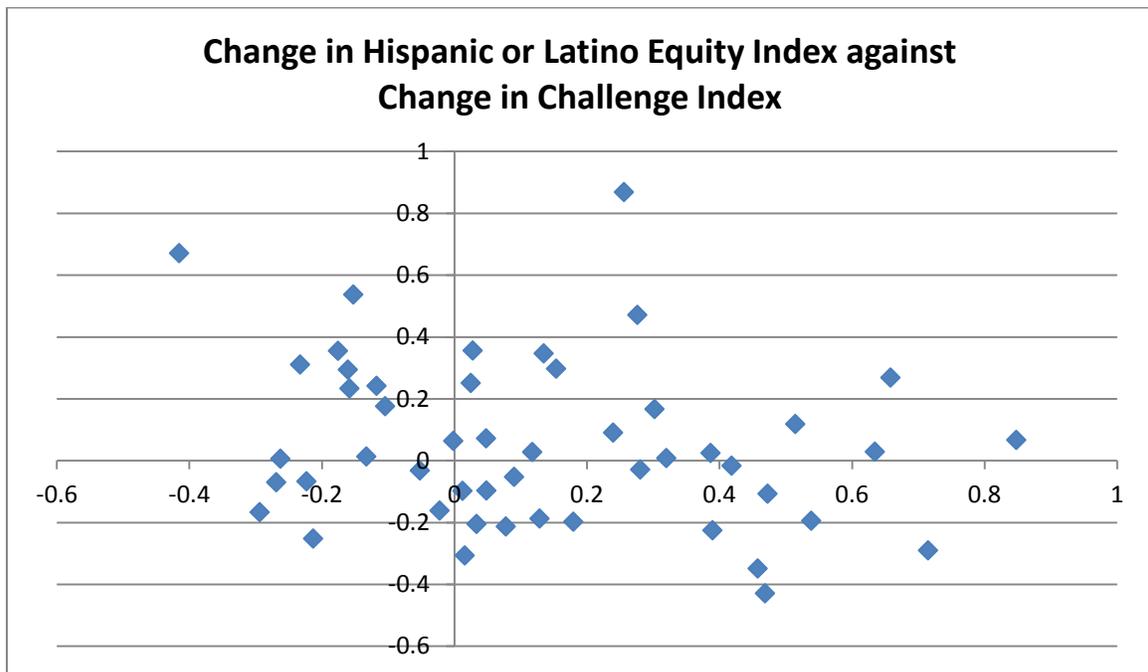


*Figure 20.* Histogram depicting the distribution of change in Hispanic or Latino Equity Index values.

Figure 20 illustrates the distribution of change in Hispanic or Latino Equity Index data and is consistent with data from a normal population. Table 8 provides descriptive statistics for these data and confirms the impression conveyed by the histogram.

<i>Change in Equity Index</i>	
Mean	.05
Standard Error	.04
Median	.01
Std Deviation	.27
Sample Variance	.07
Excess Kurtosis	.74
Skewness	.77
Range	1.30
Minimum	-.43
Maximum	.87
Count	49

*Table 8.* Descriptive statistics for change in Equity Index values used in addressing the fourth research question.



*Figure 21.* Scatterplot of change in Hispanic or Latino Equity Index against change in Challenge Index.

Figure 21 shows no clear relationship between the two quantities: change in Hispanic or Latino Equity Index and change in Challenge Index.

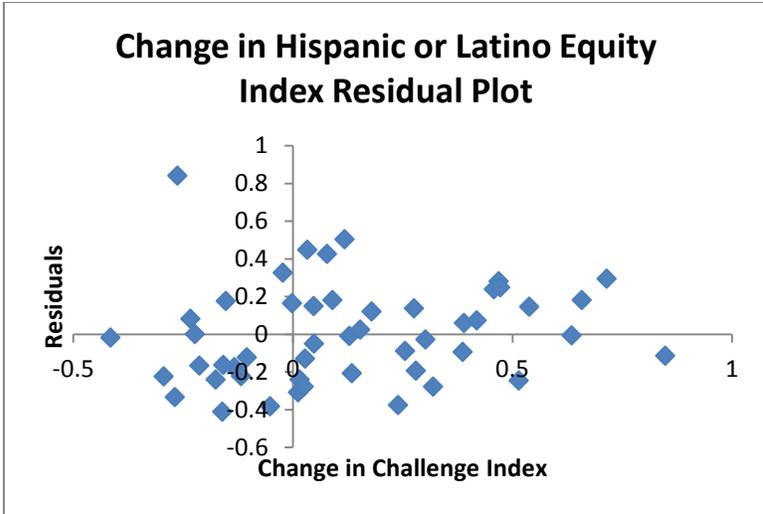


Figure 22. Scatterplot for regression of Change in Hispanic or Latino Equity Index against Change in Challenge Index.

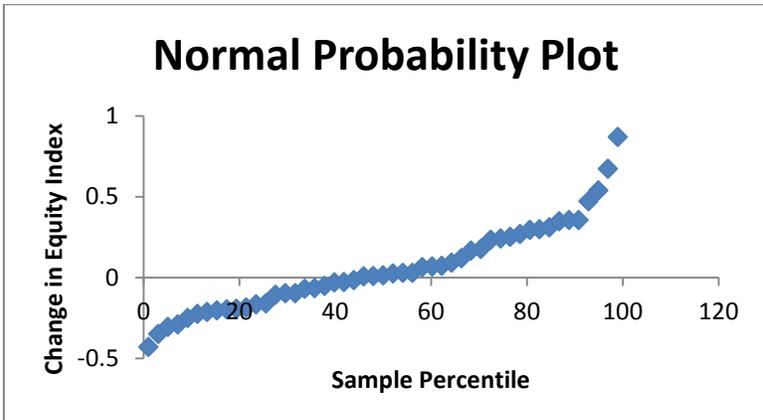


Figure 23. Normal Probability Plot for the regression of change in Hispanic or Latino Equity Index against change in Challenge Index.

The graphs in Figure 21 and Figure 22 do not display the clear indications of heteroscedasticity found in the previous research questions. Further, the curve down on the left of Figure 23 and the slightly larger curve up on the right side of Figure 23 indicate both a skew to the right and some excess kurtosis, but these deviations from normality are less pronounced than in the data associated with previous research questions. Given the excess kurtosis at .74 and skewness of .77 for Change in Hispanic or

Latino Equity Index, both less than 2, these data were suitable for a t-test on the slope of the linear regression. This test on the Pearson correlation was conducted, but for consistency with the first three hypothesis tests, Spearman's rank correlation coefficient was conducted in parallel to evaluate the relationship between these two variables. The Spearman's rho revealed no statistically significant relationship between the rank order of the Change in Challenge Index and the rank order of the Change in Hispanic or Latino Equity Index at high schools in this Mid-Atlantic state during the 2010-2011 and 2011-2012 school years ( $r_s[47] = -.19, p = .19$ ). Given the low magnitude for Spearman's rho and the two-tailed p-value of .19, and the similar results for Pearson's product moment correlation coefficient ( $t[47] = -1.63, p = .11$ ), there is insufficient evidence to conclude that there is an association between the change in AP Challenge Index values for individual schools and the change in Hispanic or Latino equity index values for the same schools among this Mid-Atlantic state's neighborhood schools.

### **Study Results - Fifth Research Question**

Research Question Number Five: How did the proportions of AP Exams allocated to particular subjects or subject areas change as a school's AP Challenge Index increased?

The intended population for this research question was the 142 neighborhood schools in this Mid-Atlantic state. However, there were ten neighborhood schools that did not respond to my request for data and also did not provide AP Exam data on the state Department of Education website ("Maryland Report Card," 2015), so that a total of 132 high schools comprised the sample for at least the initial part of this research question - exploring the proportions of exams within particular subject areas. The 98 high schools

that provided data on individual AP Exam numbers comprise the sample for all discussions on individual AP exam topics within subject areas. According to the state website, a total of 200,530 AP exams were administered in this Mid-Atlantic state in 2011 and 2012 combined, including 4,878 fine arts exams, 43,671 English exams, 6,363 foreign language exams, 27,926 mathematics exams, 54,007 science exams, and 63,685 social studies exams. Missing values for number of exams at individual schools in particular subject areas were imputed under the assumptions that (1) the total number of exams equaled the sum of the numbers of exams in each area, and (2) if more than one number was missing in a particular school, the missing numbers were integers and roughly in proportion to the statewide exam proportions. These imputed values were used to generate descriptive data presentations and were not used in any statistical tests.

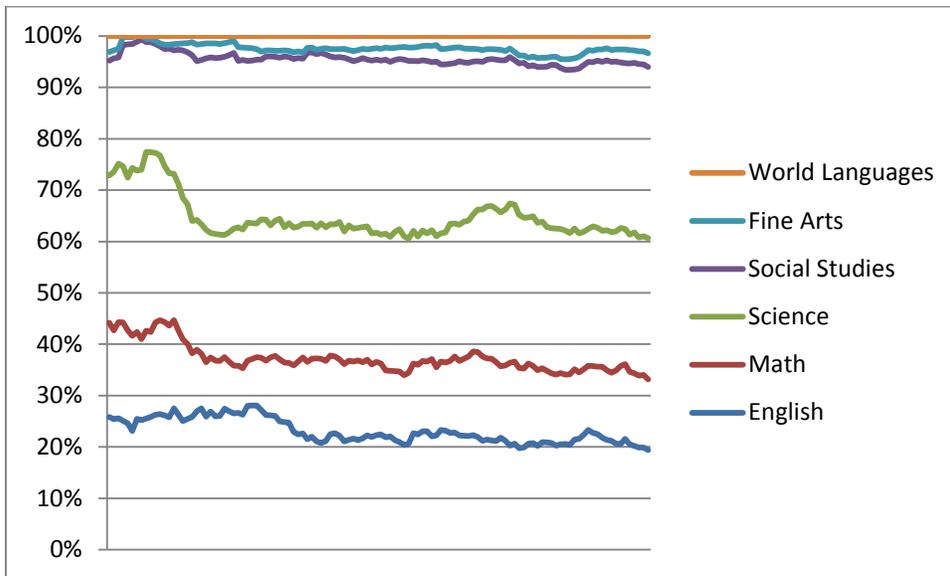


Figure 24. Stacked line plot for the relative frequency of exams from the various subject areas.

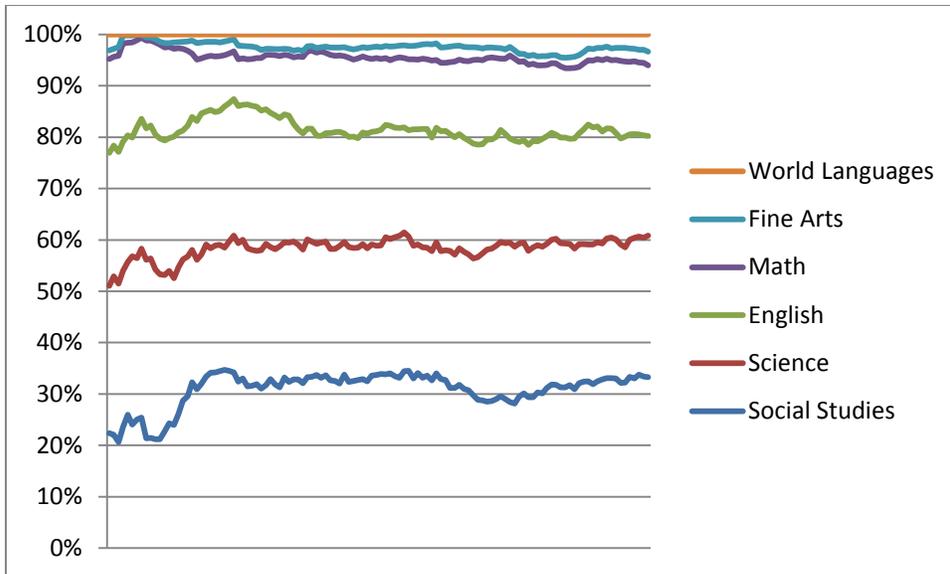


Figure 25. Stacked line plot for the relative frequency of exams from the various subject areas.

The horizontal axis in Figure 24 and in Figure 25 is an ordinal scale for AP Challenge Index, sorted from smallest to largest, but numerical values are not given because this is not an interval scale. This graphic shows a general downward trend in the proportion of exams from Math and English as the value of AP Challenge Index increases, and a possible upward trend for Social Studies at low values of the AP Challenge Index.

These stacked line plots show the percentage of all AP exams in each of the six subject areas, with the same data in both plots, but shown vertically in different orders. The schools were sorted by AP Challenge Index and then a weighted average was taken over fifteen consecutive schools to smooth out random fluctuations and improve readability. Figure 24 most clearly shows the general downward trend in the percentage of AP Exams given in English and Mathematics as AP Challenge Index increases, while

Figure 25 provides a better display of the increase in the percentage of Social Studies exams for schools with an AP Challenge Index above roughly 1.2.

### *Fine Arts*

The Fine Arts subject area consists of Art History, Music Theory, Studio Art 2-D Design, Studio Art 3-D Design, and Studio Art Drawing. As illustrated in Figure 24, these exams constitute only 2.4 percent of all AP exams administered in this Mid-Atlantic state. There is no clear relationship between the size of a school's AP program and the proportion of AP exams administered in the Fine Arts. Further, given the small numbers of exams administered in this field, and the decision of many school systems to omit small individual exam numbers, not much can be said about individual subjects within the Fine Arts beyond the observation that there is no clear trend.

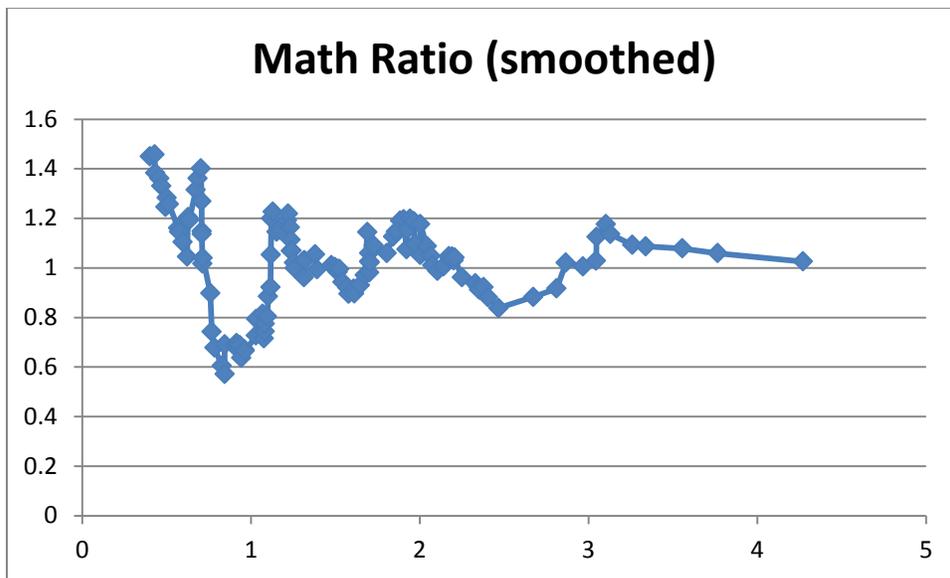
### *World Languages*

The World Language subject area consists of Chinese Language and Culture, French Language and Culture, German Language and Culture, Italian Language and Culture, Japanese Language and Culture, Latin, Spanish Language and Culture, and Spanish Literature and Culture. As illustrated in Figure 24, these exams constitute only 3.2 percent of all AP exams administered in this Mid-Atlantic state. There appears to be a general trend that as the size of a school's AP program increases, the proportion of AP exams administered in World Languages also increases. World Language AP Exams in most cases involve several years of study in the same language, and this extended commitment may affect the relative rate of participation in World Language AP Exams over the range of AP Challenge Index values. Alternatively, the availability of multiple languages from which to choose may also be a factor in the apparent growth of

participation in World Language AP exams in schools with higher AP Challenge Index values. However, given the small numbers of exams administered in this field, and the decision of many school systems to either omit small individual exam numbers, not much can be said about the trend for individual subjects within World Languages.

### *Mathematics*

The Mathematics subject area consists of Calculus AB, Calculus BC, and Statistics. These exams constitute 13.9 percent of all AP exams administered in this Mid-Atlantic state. Figures 24 and 26 appear to show a general trend that the percentage of AP exams administered within mathematics declines as size of a school's AP program increases.



*Figure 26.* Scatterplot showing the ratio of the proportion of AP Exams in Math to the average proportion of exams in Math for this state, against the AP Challenge Index, with values averaged over multiple schools.

The number of Mathematics exams at each school, as shown in Figure 26, has been normalized so that matching the statewide proportion with 13.9% of exams within Mathematics would display as a Mathematics Ratio of 1.0. Further, schools have been

sorted in order by AP Challenge Index before taking a weighted average of this ratio over eleven consecutive schools to improve the readability of the display. The AP Calculus course is taught in some school districts as two sequential courses, Calculus AB and then Calculus BC, and in others as a single course that is divided in the middle of the year between students who will only complete Calculus AB and students who will complete both Calculus AB and Calculus BC in the remainder of the same school year. Within Mathematics, the proportion of Statistics exams shows a general upward trend, illustrated in Figure 24, from roughly 25% of all math exams for low values of AP Challenge Index to roughly 35% of all math exams for high values of AP Challenge Index. Within Mathematics, Figure 28 shows for the proportion of Calculus BC exams a substantial upward trend, from roughly 15% of all math exams for low values of AP Challenge Index to over 25% of all math exams for values of AP Challenge Index near 1.2, and then a decline to 20% of all math exams for higher values of AP Challenge Index. This change in Calculus BC participation corresponds to an increase from 20% of all Calculus exams for low values of AP Challenge Index to 40% of Calculus exams for values of AP Challenge Index between 1.2 and 2, and a decline to about 35% of all Calculus exams for high values of the AP Challenge Index, as illustrated in Figure 29. The observed decline in the proportion of mathematics exams administered in Calculus BC for higher AP Challenge Index numbers could have several explanations. These possibilities include students selecting Statistics over Calculus when given that choice in schools with larger AP programs, students shifting from Calculus AB to Statistics after exposure to their first Calculus course, or students consciously choosing to obtain exposure to both Calculus

and Statistics. Further research might provide insight into the reason for this change in the relative distribution of AP Mathematics exams.

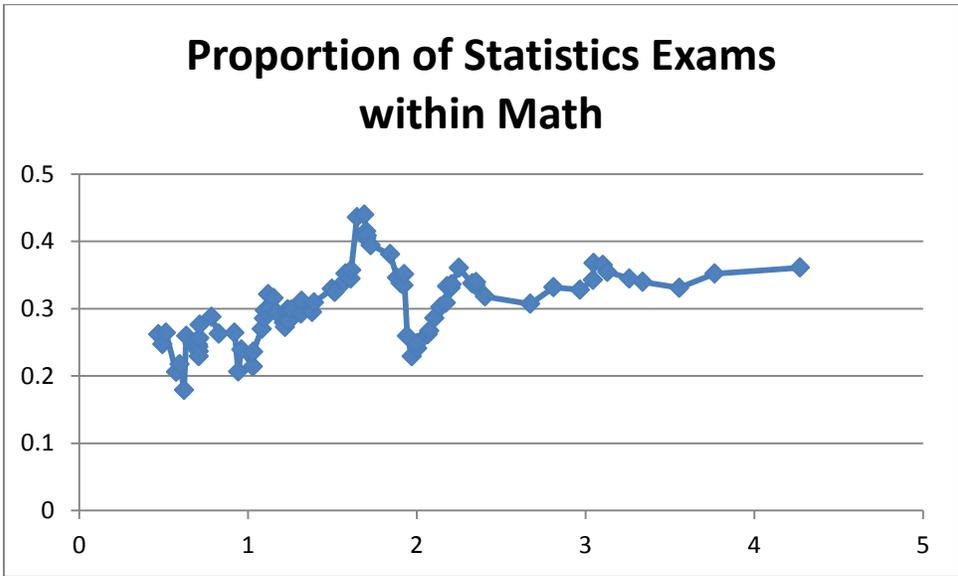


Figure 27. Scatterplot showing the ratio of the number of AP Exams in Statistics to the total number of exams in Math for each school, against the AP Challenge Index, with values averaged over multiple schools.

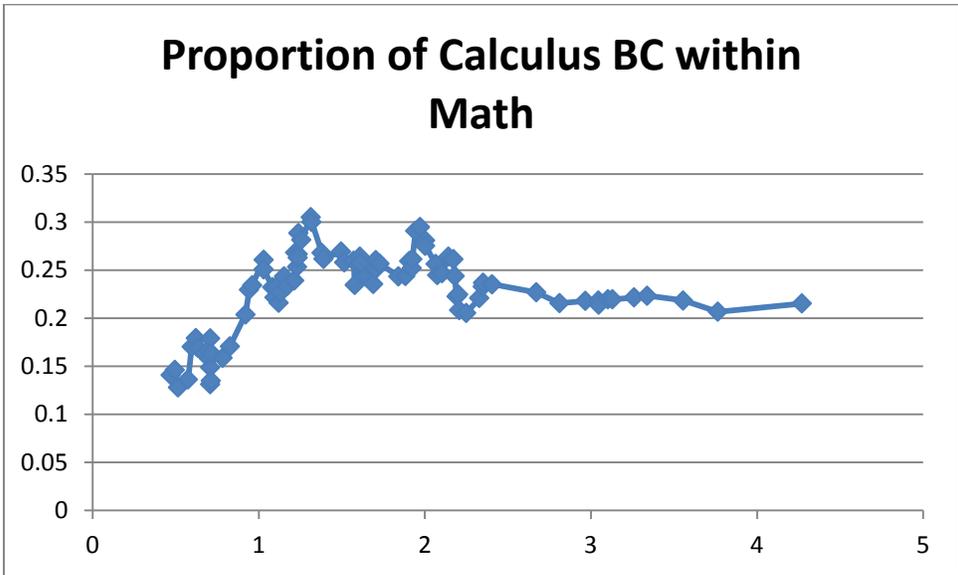


Figure 28. Scatterplot showing the ratio of the number of AP Exams in Calculus BC to the total number of exams in Math for each school, against the AP Challenge Index, with values averaged over multiple schools.

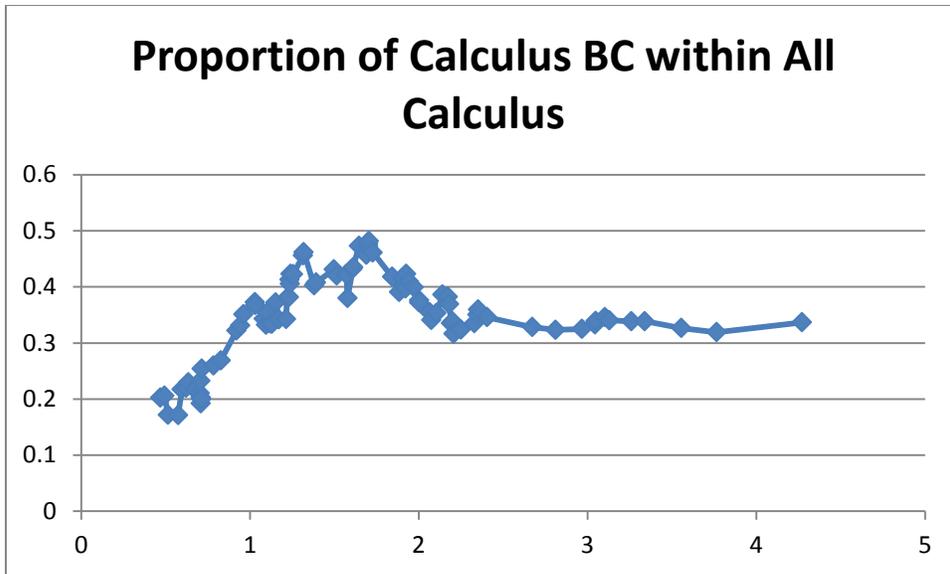
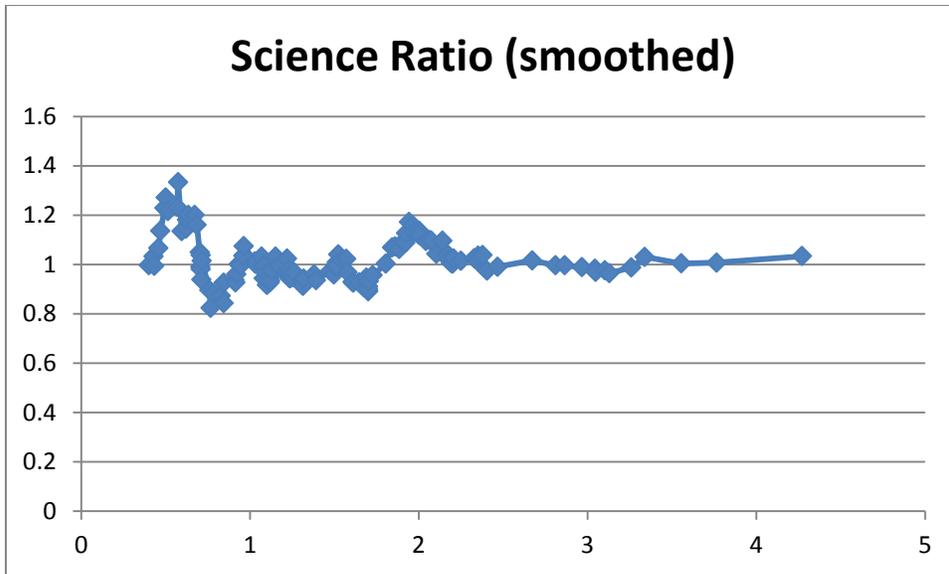


Figure 29. Scatterplot showing the ratio of the number of AP Exams in Calculus BC to the total number of exams in Math for each school, against the AP Challenge Index, with values averaged over multiple schools.

### *Science*

The Science Exams consist of Biology, Chemistry, Computer Science, Environmental Science, Physics B, Physics C Electricity and Magnetism, Physics C Mechanics, and Psychology [Note: The College Board lists AP Psychology under “History and Social Sciences,” but the category totals on the state Department of Education website are incompatible with that classification]. These exams constitute 26.9 percent of all AP exams administered in this Mid-Atlantic state.



*Figure 30.* Scatterplot showing the ratio of the proportion of AP Exams in Science to the average proportion of exams in Science for this state, against the AP Challenge Index, with values averaged over multiple schools.

In Figure 30, the number of Science exams at each school has been normalized so that matching the statewide proportion with 26.9% of exams within Science would display as a Science Ratio of 1.0. Further, schools have been sorted in order by AP Challenge Index before taking a weighted average of this ratio over eleven consecutive schools to improve the readability of the display.

There are several apparent trends in the proportions of individual subjects within the Science subject area. AP Psychology exams show a pattern within all Science similar to that of Calculus BC within Mathematics. Figure 31 shows that Psychology exam participation increases from 30% of all science exams for low values of AP Challenge Index to 45% of science exams for values of AP Challenge Index between 1 and 2.3, and then decreases to just over 40% of all science exams for high values of the AP Challenge Index. Within science, Figure 29 shows a general decline in Biology from over 20% of all science exams to roughly 15% of all science exams, while Figure 30 shows for

Environmental Science a general increase from 8% of all science exams to over 15% of all science exams. Further research might provide insight into the reason for these changes in the relative distribution of AP Science exams.

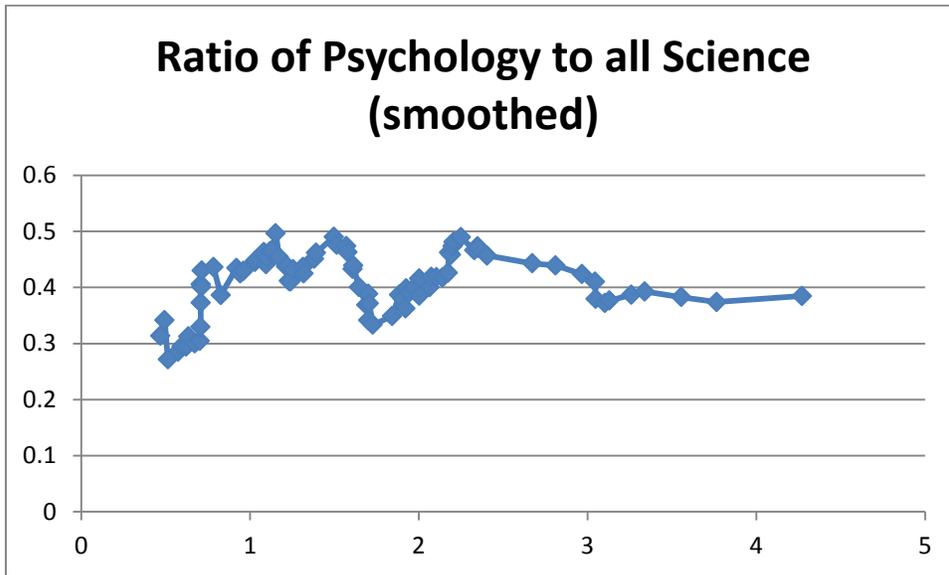


Figure 31. Scatterplot showing the ratio of the number of AP Exams in Psychology to the total number of exams in Science for each school, against the AP Challenge Index, with values averaged over multiple schools.

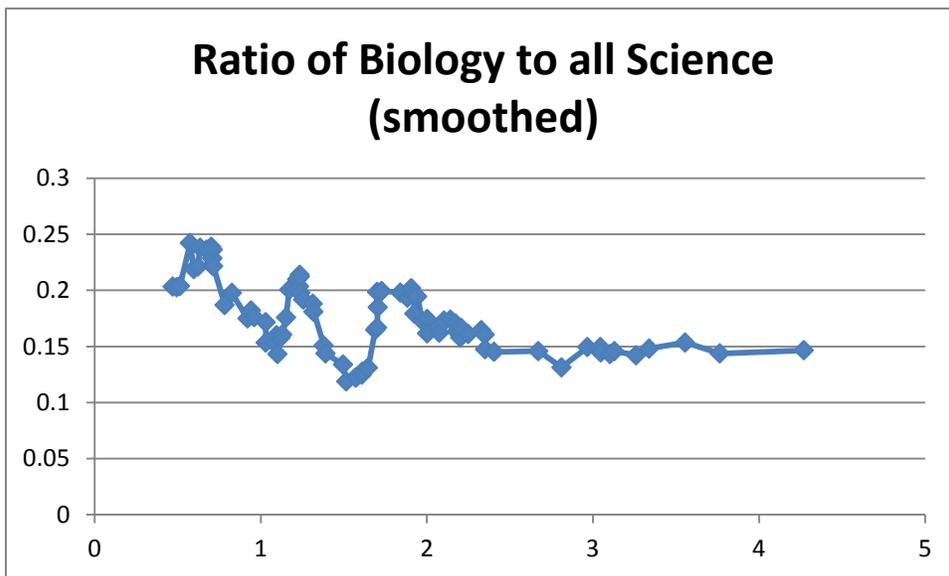


Figure 32. Scatterplot showing the ratio of the number of AP Exams in Biology to the total number of exams in Science for each school, against the AP Challenge Index, with values averaged over multiple schools.

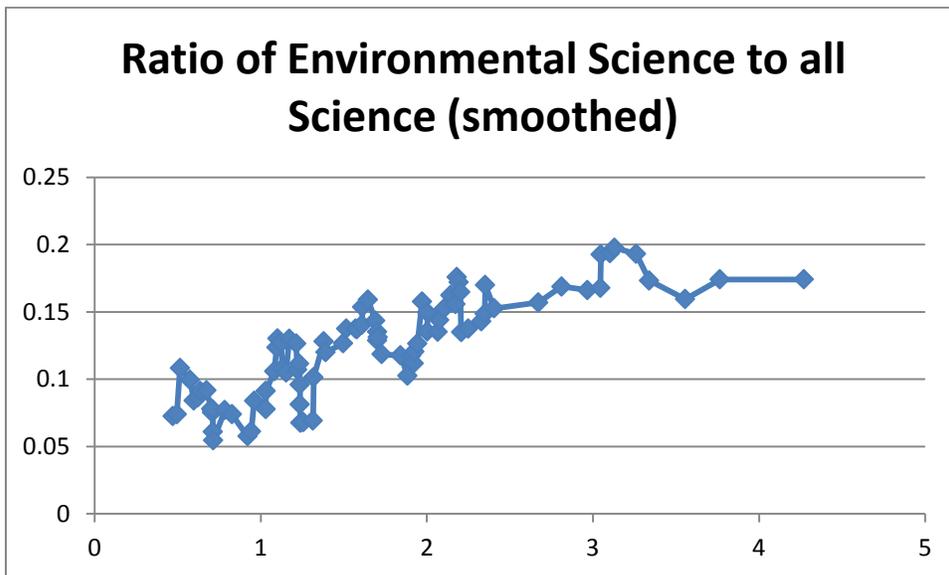
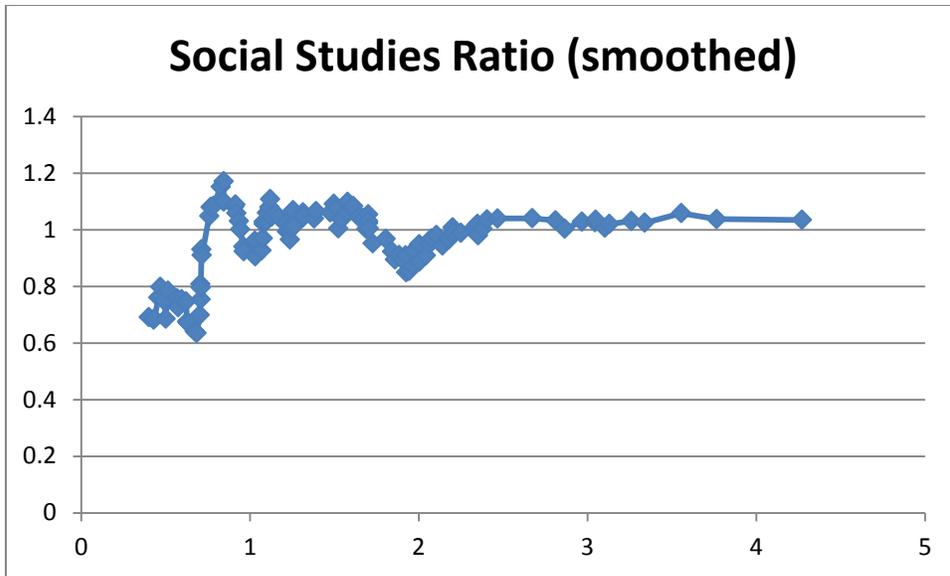


Figure 33. Scatterplot showing the ratio of the number of AP Exams in Environmental Science to the total number of exams in Science for each school, against the AP Challenge Index, with values averaged over multiple schools.

### *Social Studies*

The Social Studies Exams consist of Comparative Government & Politics, European History, Human Geography, Macroeconomics, Microeconomics, United States Government & Politics, United States History, and World History. These exams constitute 31.8 percent of all AP exams administered in this Mid-Atlantic state. Figures 25 and 34 show that, except possibly for very low values of AP Challenge Index, there is no clear relationship between the size of a school’s AP program and the proportion of AP exams administered in Social Studies.



*Figure 34.* Scatterplot showing the ratio of the proportion of AP Exams in Social Studies to the average proportion of exams in Social Studies for this state, against the AP Challenge Index, with values averaged over multiple schools.

The number of Social Studies exams at each school has been normalized so that matching the statewide proportion with 31.8% of exams within Social Studies would display as a Social Studies Ratio of 1.0. Further, schools have been sorted in order by AP Challenge Index before taking a weighted average of this ratio over eleven consecutive schools to improve the readability of the display.

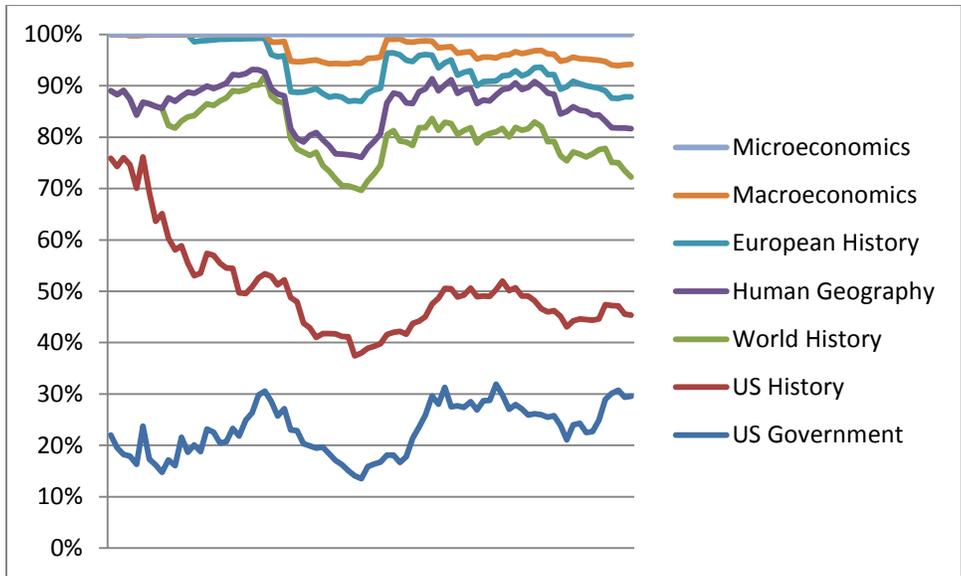


Figure 35. Stacked line plot for the relative frequency of exams within Social Studies.

Figure 35 shows the relative distribution of the various Social Studies exams over the range of AP Challenge Index values observed in this Mid-Atlantic state. The plot shows a slight upward trend in US Government exams, a much stronger upward trend in World History exams, and a substantial downward trend in US History exams. All other Social Studies exams combined grow from about 10% of Social Studies exams for small values of AP Challenge Index to more than 25% of Social Studies exams for large values of AP Challenge Index. Further research might provide insight into the reason for these changes in the relative distribution of the various exams within Social Studies.

*English*

The English Exams consist of English Language & Composition, and English Literature & Composition. These exams constitute 21.8 percent of all AP exams administered in this Mid-Atlantic state. Figures 24 and 36 illustrate a distinct negative

relationship between the size of a school's AP program and the proportion of AP exams administered in English.

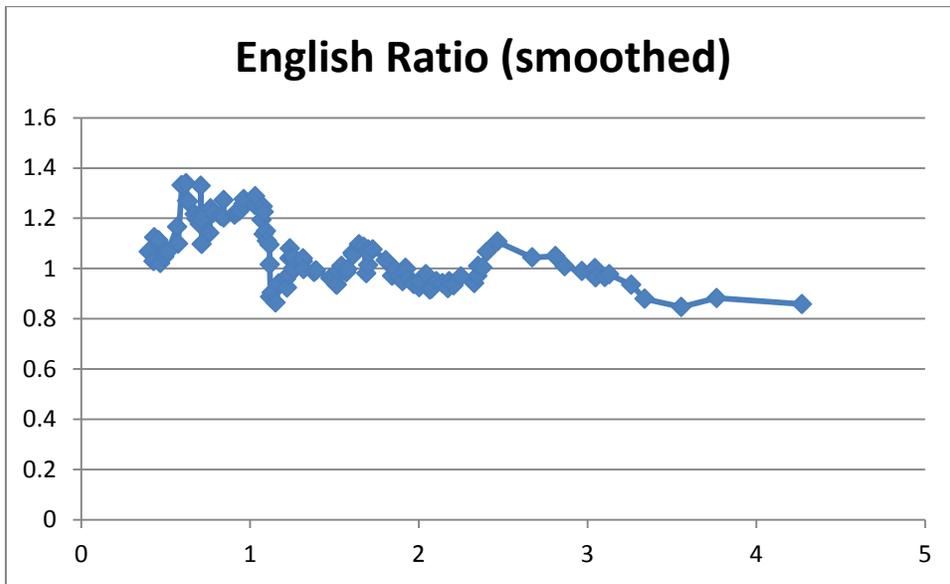


Figure 36. Scatterplot showing the ratio of the proportion of AP Exams in English to the average proportion of exams in English for this state, against the AP Challenge Index, with values averaged over multiple schools.

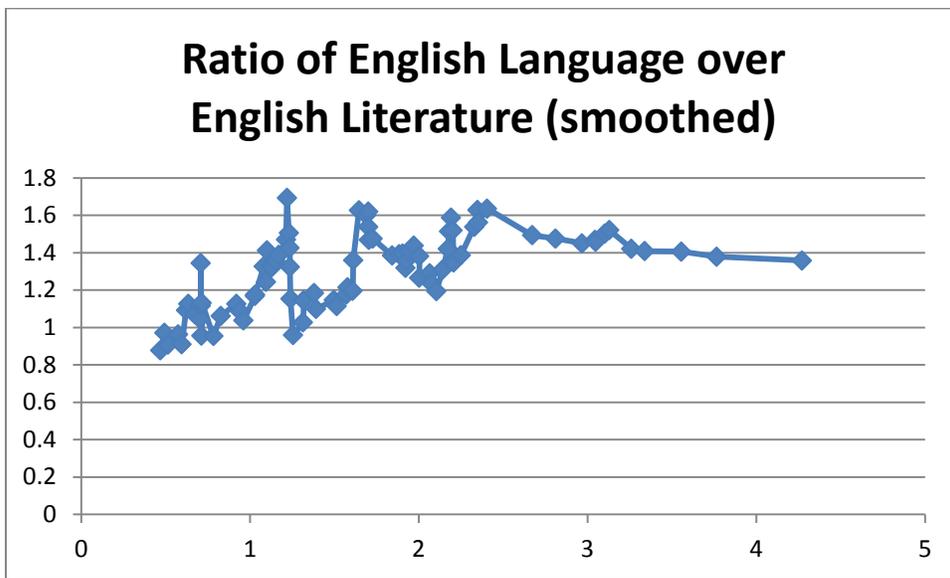


Figure 37. Scatterplot showing the ratio of the number of AP Exams in English Language to the number of exams in English Literature for each school, against the AP Challenge Index, with values averaged over multiple schools.

In Figure 36, the number of English exams at each school has been normalized so that matching the statewide proportion with 21.8% of exams within English would display as a English Ratio of 1.0. Further, schools have been sorted in order by AP Challenge Index before taking a weighted average of this ratio over eleven consecutive schools to improve the readability of the display. Within English, Figure 37 shows an apparent upward trend in the ratio of English AP exams that are administered in English Language compared to exams in English Literature. Further study might identify the reason for the differential preference for English Language over English literature in schools with larger AP programs.

### **Summary**

The goal of this study was to determine whether there is an association between the average level of participation in AP programs at neighborhood high schools and the level of racial equity in AP participation for Black or African American students and for Hispanic or Latino students at the same schools. For this study, responses representing 98 of the 132 neighborhood schools in a Mid-Atlantic state (69% response rate) were analyzed. Statistical analyses addressed the following research questions:

1. Is there an association between the average level of participation in AP programs at a high school and the level of racial equity in AP participation for Black or African American students at that school?
2. Is there an association between the average level of participation in AP programs at a high school and the level of racial equity in AP participation for Hispanic or Latino students at that school?
3. Is there an association between changes in the average level of

participation in AP programs at a high school and changes in the level of racial equity in AP participation for Black or African American students at that school?

4. Is there an association between changes in the average level of participation in AP programs at a high school and changes in the level of racial equity in AP participation for Hispanic or Latino students at that school?

Descriptive statistics were used to explore the fifth research question:

5. How do the proportions of AP Exams allocated to particular subjects or subject areas change as a school's AP Challenge Index increases? I addressed this question through graphical displays of data and a discussion of those displays.

The independent variable in each of the first four research questions was the overall AP Challenge Index for the individual high school, defined as the number of AP Exams administered in a given year divided by the number of graduating seniors for that year, or the year-to-year change in that AP Challenge Index. The dependent variable for each test was the Black or African American Equity Index (or Hispanic or Latino Equity Index), defined as the ratio of the AP Challenge Index for Black or African American students (or for Hispanic or Latino students) at that high school to the AP Challenge Index for all other students in the same school, or the year-to-year change in those equity indices.

The four hypothesis tests using these variables found no statistically significant relationship between (1) the size of a high school's AP program and the rate of Black or

African American participation in that program, (2) the size of a high school's AP program and the rate of Hispanic or Latino participation in that program, (3) changes in the size of a high school's AP program and changes in the rate of Black or African American participation in that program, (4) changes in the size of a high school's AP program and changes in the rate of Hispanic or Latino participation in that program. This neutral result on all four questions implies that educational leaders can deal with AP planning and with educational gaps among subgroups of students as separate issues rather than as interrelated topics.

Descriptive statistics in response to the fifth research question illustrated several trends in the distribution of AP Exams over the range of AP Challenge Index values. There may be an upward trend in the proportion of AP Exams administered in World Languages at schools with higher AP Challenge Index values, no clear pattern for Fine Arts, Science or Social Studies, and a general decrease the proportion of all exams administered within English and Mathematics over the range of AP Challenge Index values. Certain exams, such as Statistics and Environmental Science show a general upward trend across the range of AP Challenge Index values. Other exams, including Calculus BC and Psychology show a peak in the middle of the range for AP Challenge Index, and Biology shows a general downward trend across the range of AP Challenge Index values.

## Chapter 5: Conclusions

As school administrators, leaders, and parents respond to demands to both improve school rankings and increase educational equity, they may consider the degree to which these goals either support or conflict with each other. Despite significant and continuing growth in college-level instruction within high schools, well-documented gaps remain in access and equity, particularly for Black or African American students ("8<sup>th</sup> Annual AP Report to the Nation," 2012, p. 16-22). A review of existing literature has confirmed a strong positive association between AP participation by students and positive outcomes in high school and in college. AP participation has demonstrated links with improvements in achievement; in college performance; in science, technology, engineering, and mathematics performance; and in college graduation (e.g., Christiansen, 2009; Dutkowsky et al., 2009; Fowler & Luna, 2009; O'Keefe, 2009; Preston, 2009; Thompson & Rust, 2007). However, that literature review also showed an absence of research addressing whether there is an association between the size or expansion of an AP or IB program and the racial or ethnic equity of that program.

The objective of this quantitative research was to identify any relationship between the size of a school's program to provide college-level instruction, or changes in that program's size, and the level of racial equity, or changes in racial equity, for that school. I operationalized these concepts by first narrowing the category of college-level instruction to Advanced Placement only. I then represented rigor with the number of AP exams administered for each graduating senior at individual public high schools in a Mid-Atlantic state, and equity by comparing the levels of Black or African American AP participation and of Hispanic or Latino AP participation to the corresponding levels for

non-Black or non-Hispanic students. For the independent variable at each high school in the study, I defined that school's AP Challenge Index as the ratio of the number of AP exams administered at the school in 2011 and 2012 to the total number of seniors at the school in those two years, in order to obtain a measure of the number of AP exams administered per student. I based this measure on the familiar Challenge Index used by Jay Mathews in ranking America's best high schools for Newsweek and the Washington Post (Mathews, 2012, para. 1), except that my AP Challenge Index included only Advanced Placement exams. I then defined the Black or African American Equity Index as the ratio of the Black or African American AP Challenge Index to the school's Challenge Index for all students other than Black or African American students, and similarly for Hispanic or Latino students.

I obtained data from the school systems and from individual schools in the selected Mid-Atlantic state. To avoid the complexity of addressing the significant potential differences between public and private schools and between magnet or charter schools and neighborhood schools, I restricted my analysis to traditional, non-magnet, public schools. For this study, responses representing 98 of the 132 neighborhood schools in this Mid-Atlantic state (69% response rate) were obtained and analyzed.

This study also explored how the proportions of AP Exams allocated to particular subjects and subject areas changed when comparing those proportions for schools with smaller AP programs to those for schools with larger AP programs. This exploration produced descriptive information on the relative distribution of various AP exams within high schools at various levels of the AP Challenge Index.

This quantitative research was conducted to answer the following research questions:

1. Is there an association between the average level of participation in AP programs at a high school and the level of racial equity in AP participation for Black or African American students at that school?
2. Is there an association between the average level of participation in AP programs at a high school and the level of racial equity in AP participation for Hispanic or Latino students at that school?
3. Is there an association between changes in the average level of participation in AP programs at a high school and changes in the level of racial equity in AP participation for Black or African American students at that school?
4. Is there an association between changes in the average level of participation in AP programs at a high school and changes in the level of racial equity in AP participation for Hispanic or Latino students at that school?
5. How do the proportions of AP Exams allocated to particular subjects or subject areas change as a school's AP Challenge Index increases?

The results of this study were generated using existing data from neighborhood schools in a Mid-Atlantic state, as provided by the school districts within that state and by individual schools.

## **Research Conclusions**

### **Research Question One**

Is there an association between the average level of participation in AP programs at a high school and the level of racial equity in AP participation for Black or African

American students at that school?

Of the 98 neighborhood schools that provided data for the sample, 83 included data useable in addressing this research question, with the remainder excluded because they had too few Black or African American graduates for analysis. Because these data, particularly the data for Equity Index, failed the criteria for normality (skewness=2.17, excess kurtosis=6.47, Shapiro-Wilk statistic of .81,  $df=81$ ,  $p<.001$ ), and because of clear heteroscedasticity in the scatterplot of Black or African American Equity Index against AP Challenge Index, Spearman's rank correlation was used to evaluate this relationship. The resulting statistics ( $rs[81] = -.18$ ,  $p = .10$ ) provided insufficient evidence to conclude that a relationship exists between the AP Challenge Index and the Black or African American Equity Index values in individual neighborhood schools.

### **Research Question Two**

Is there an association between the average level of participation in AP programs at a high school and the level of racial equity in AP participation for Hispanic or Latino students at that school?

Of the 98 neighborhood schools in the sample, 70 included data useable in addressing this research question. Because the data, particularly for Equity Index, failed the criteria for normality (excess kurtosis=2.88, Shapiro-Wilk statistic of .92,  $df=68$ ,  $p<.001$ ), and because of clear heteroscedasticity in the scatterplot of Hispanic or Latino Equity Index against AP Challenge Index, Spearman's rank correlation was used to evaluate this relationship. The resulting statistics ( $rs[68] = -.07$ ,  $p = .56$ ) provided insufficient evidence to conclude that a relationship exists between the AP Challenge Index and the Hispanic or Latino Equity Index values in individual neighborhood

schools.

### **Research Question Three**

Is there an association between changes in the average level of participation in AP programs at a high school and changes in the level of racial equity in AP participation for Black or African American students at that school?

Of the 98 neighborhood schools in the sample, 69 included data useable in addressing this research question. Because the data, particularly for Equity Index, failed the criteria for normality (excess kurtosis=4.95, Shapiro-Wilk statistic of .87,  $df=67$ ,  $p<.001$ ), and because of clear heteroscedasticity in the scatterplot of change in Black or African American Equity Index against change in AP Challenge Index, Spearman's rank correlation was used to evaluate this relationship. The resulting statistics ( $r_s[67] = -.16$ ,  $p = .19$ ) provided insufficient evidence to conclude that a relationship exists between the change in AP Challenge Index and the change in Black or African American Equity Index values in individual neighborhood schools.

### **Research Question Four**

Is there an association between changes in the average level of participation in AP programs at a high school and changes in the level of racial equity in AP participation for Hispanic or Latino students at that school?

Of the 98 neighborhood schools in the sample, 49 included data useable in addressing this research question. Given the near normal distribution of the data (excess kurtosis = .74, skewness = .77, Shapiro-Wilk statistic of .96,  $df=47$ ,  $p = .11$ ) for change in Hispanic or Latino Equity Index, and the absence of clear heteroscedasticity in the scatterplot of change in Hispanic or Latino Equity Index against change in AP Challenge

Index, these data were suitable for a t-test on the slope of the linear regression, For consistency with the other three hypothesis tests, Spearman's rank correlation was used to evaluate this relationship. The resulting Spearman's rho statistics ( $r_s[47] = -.19, p = .19$ ), and the similar results for Pearson's product moment correlation coefficient ( $t[47] = -1.63, p = .11$ ), provided insufficient evidence to conclude that a relationship exists between the change in AP Challenge Index and the change in Hispanic or Latino Equity Index values in individual neighborhood schools.

These neutral results on all four research questions imply that educational leaders can make plans to expand AP programs and plans to address educational gaps among subgroups of students as separate issues rather than as interrelated topics.

#### **Research Question Five**

How do the proportions of AP Exams allocated to particular subjects or subject areas change as a school's AP Challenge Index increases?

Descriptive statistics in response to the fifth research question illustrated several apparent trends in the distribution of AP Exams over the range of AP Challenge Index values. There may be an upward trend in the proportion of AP Exams administered in World Languages at schools with higher AP Challenge Index values, no clear pattern for Fine Arts, Science or Social Studies, and a general decrease the proportion of all exams administered within English and Mathematics over the range of AP Challenge Index values. Certain exams, such as Statistics and Environmental Science show a general upward trend across the range of AP Challenge Index values. Other exams, including Calculus BC and Psychology show a peak in the middle of the range for AP Challenge Index, and Biology shows a general downward trend across the range of AP Challenge

Index values.

### **Conceptual Framework**

The conceptual framework for this study provided a context for the research questions and an explanation for the potential relationships among justice, education, and equity. Under Human Capital Theory, the economic benefits to society from investing in people provide a justification for those investments (Sweetland, 1996, p. 341). Further, classical philosophy has described a just society as one that emphasizes education (Plato, trans. 1951) and one that includes equal or proportionate access and opportunity (Aristotle, trans. 1931, pp. 1006-1007). Legal requirements for equal educational opportunity reinforce these factors (e.g., *Brown v. Board of Education of Topeka*, 347 U.S. 483, 1954). Thus, educational approaches that affect equity include economic, moral, and legal dimensions.

I expected to find that college-level instruction in high schools expanded through either or both of two natural strategies:

- School leaders might expand advanced education by providing additional advanced offerings to students who are already receiving some advanced instruction, reasoning that those students have demonstrated both the ability and the willingness to benefit from rigorous academic offerings.
- Educational leaders might also expand their advanced education programs by reaching out to underserved students, whether motivated by equity considerations or by a pragmatic belief that the law of diminishing marginal returns (Harris, 2007, pp. 31-32) implies a greater potential gain from this strategy.

My research found no evidence of a significant relationship between the size of a school's AP program and the equity of that program. If the hypothesized factors existed at all, their effects were too small to measure or cancelled each other. Thus decisions on expanding advanced educational opportunities such as AP programs can be made independently from decisions regarding educational equity. The absence of a relationship may indicate that AP programs grow organically rather than purposefully. Organic growth might come from a general demand from parents or administrators to offer new AP classes or to expand existing classes, from students requesting new AP classes, or from teachers requesting the opportunity to teach additional AP classes. If a school's AP program expanded because the departments individually chose to add AP Statistics, more specialized AP science options, additional AP Social Studies electives, and AP art classes, whether those offerings were triggered by internal or external requests, and if those new options were attractive to students who were already taking AP courses and to their siblings, one would not expect a substantial change in the demographic distribution of AP students. While Aristotle's statement that "Most noble is that which is justest" (trans. 1931, p. 945) still applies, this research provided no new insight on how to expand justice.

The data did not support the existence of a significant statistical relationship between educational rigor and educational equity. Given the sample sizes of  $n=49$  to  $n=83$ , which should have permitted detection of any substantial relationship, I modified the graphic organizer representing my conceptual framework to reflect the absence of observed interactions.

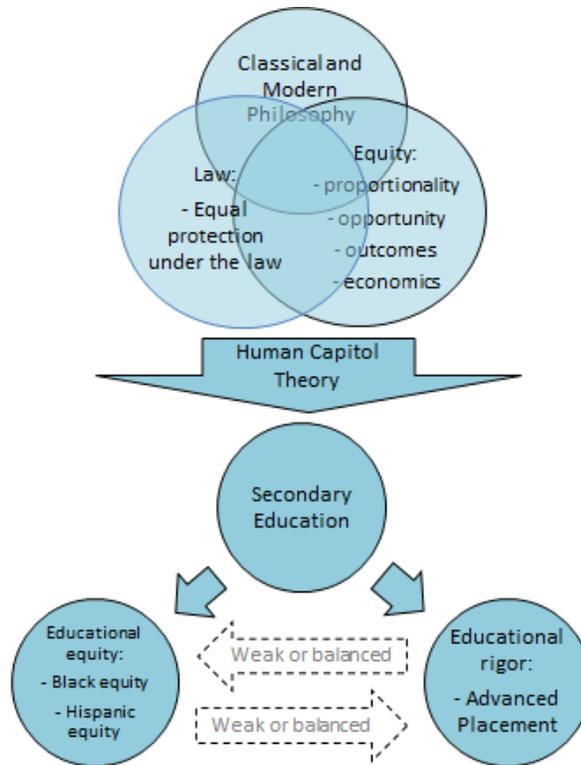


Figure 38: Relationship between conceptual framework and research questions.

### Limitations

While many potential limitations were avoided by conducting research based on existing data, several significant limitations remained. First, educational leaders could reasonably question the appropriateness of the measures used in this study, in particular whether absolute or proportionate participation in AP programs provides a better measure of equity. Second, the exclusion of IB, charter, and magnet schools may limit the applicability of this research to other school systems, particularly to school systems with large programs in those areas or with strong similarities to schools in those categories. Third, the population in this Mid-Atlantic state may have significant differences from the population in other states, or educational conditions may change over time so that a study conducted based on data from 2011 and 2012 may become less applicable over time.

Finally, the sample size may have limited the ability of this study to detect small effects.

Researchers and educational leaders might debate the appropriateness of the Black or African American and Hispanic or Latino Equity Indices as defined, arguing that absolute changes in the Black or African American AP Challenge Index and in the Hispanic or Latino AP Challenge Index constitute a better measure of equity than the proportional approach used in defining the Equity Indices for this research, and those who disagree with this selection may question whether this research measures what it purports to measure. My choice to use a ratio representation of Black or African American and Hispanic or Latino student participation in AP exams is consistent with many commentaries on justice, but this was fundamentally a values decision. Exploring the same issues with different value assumptions could form the starting point for interesting supplemental research.

The choice of non-IB neighborhood schools for the regression analysis introduced a potential differential selection bias. If magnet schools, charter schools, and IB schools tend to cluster in particular regions of the state or in non-representative school districts, then the exclusion of these schools might have biased the research so that the results fail to represent either schools outside the sample or those in other states. Further, the absence of data from two large school districts with high proportions of Black or African American students might have affected the range of school systems to which this research could be generalized, or there might have been significant differences between students or schools in this Mid-Atlantic state and students or schools in other states. Also, I have implicitly assumed that the results from the selected years for this study apply to education in future years, but a major change in public education between the years of

this study and the years of interest for applying study results could affect the applicability of the results to the target population. Finally, the sample size in this study limited the ability of this research to detect small effects. It is possible that a study based on a larger sample size could have detected an effect that was too small to detect in this research. The practical value of a larger study must, however, be considered before undertaking a larger study in order to detect small effects. A researcher should consider whether the possibility of statistically significant results from such a study would be justified by the educational significance of detecting a weak effect.

### **Recommendations for Further Research**

Several options exist for further study. The most interesting such options would expand upon the following key observations from this research.

First, in the absence of any statistical association between the size of a school's AP program and the racial equity of that program for Black or African American or Hispanic and Latino students, a natural follow up question would be whether individual schools with high levels of AP equity have some other characteristic that promotes racial equity in educational opportunity or achievement. These policies could include either particularly effective internal policies, or external factors that promote educational equity. Also, the current research looked only at the numbers of AP exams taken. Further research could evaluate both the relative participation of minority students and their relative performance on AP exams when they participate. Five schools in the current research had Black or African American Equity Index values above one, fourteen schools had Hispanic or Latino Equity Index values above one, and several other schools came close to Equity Index values of one. Exploration of the reasons for high equity in these

individual schools would most likely involve a mixed-methods or qualitative study, first quantitatively determining whether the individual schools have sustained higher levels of equity and then inquiring into the reasons for that sustained performance.

On the other end of the equity spectrum, one could investigate the unusually low levels of racial equity in schools with well below average relative participation for Black or African American students in AP exams. The mean Black or African American Equity Index was .50, and nine schools had equity index values less than half of that mean. Two schools had Hispanic or Latino Equity Index values less than half of the .79 mean for Hispanic or Latino students. A century after Booker T. Washington, this echoes his concerns that “Negro men and women were educated in literature, in mathematics and in the sciences . . . but few as engineers and blacksmiths” (1903, p. 7), where “engineers and blacksmiths” represented practical job skills. As an AP Calculus teacher, I have seen the practical employment value of a rigorous calculus course, when taught over a 180-day high school academic year. Research has confirmed the utility of courses such as AP Calculus, when taught well, including in a majority-minority school (Cavazos, 1990). A mixed-methods or qualitative study could lead to important insights about the reasons for a larger than average educational gap in some schools, and the characteristics of schools, including majority-minority schools, with smaller equity gaps. Conducting such research in low-equity schools might present significant challenges, given the sensitive nature of the questions, but a good-faith investigation into the causes of the observed gap, conducted without unnecessarily apportioning blame, could help to close that gap. Any such research should keep in mind that the populations of Black or African American students and of Hispanic or Latino students are not homogeneous populations, and

unusually large equity gaps may result from factors outside the school. Low scores on the Equity Index, as defined in this study, might have resulted from situations such as an unusually mobile minority population, or an English Language Learners program that concentrated students new to the country in a single school but was not formally classified as a magnet program. Researchers could have better success in obtaining data, complete information, and interviews for such studies from within their own school district, or by partnering with researchers within a school district, rather than as outsiders. Finding the reasons for these educational gaps matters. As Aristotle said “The just, then, is a species of the proportionate . . . the unjust is what violates the proportion” (trans. 1931, p. 1007). That violation of proportion is substantial in most schools and much larger in some schools than in others; we have a moral obligation to determine the cause of that apparent injustice.

This research disproportionately omitted schools from majority-minority school districts, due to an inability to obtain those data, so the results may not generalize to those schools or districts. I would like to see this study expanded to include the majority-minority school districts in this Mid-Atlantic state, or to study other majority-minority school districts. A researcher working inside such a school district might have more success in obtaining data and cooperation from such school districts than I had, and the results of such a study could fill in the gap in my research. Such an exploration could continue the test for a quantitative relationship between the size of an AP program and its racial equity. An investigator could start with a metric such as the Equity Index to determine the levels of racial equity within individual schools and then follow up with qualitative studies to look for characteristics common to comparatively high equity

schools that distinguish them from demographically similar schools with a larger gap in AP participation. Research interviews and surveys of teachers and leaders in otherwise similar high-equity and low-equity schools might provide useful qualitative information on what works to engage minority students in college-level studies. Given the extensive research documenting positive effects of AP education on college performance for AP students (e.g., Christiansen, 2009; Dutkowsky, Evensky, & Edmonds, 2009; Fowler & Luna, 2009; O’Keefe, 2009; Preston, 2009; Sadler & Tai, 2007b; Thompson & Rust, 2007), and further research documenting a positive relationship between the size of a school’s AP program and overall performance for that school’s non-AP students (Christiansen, 2009; Shaw, Marini, & Mattern, 2013), this issue merits further research.

On a related topic, only one school with Equity Index values greater than one had Challenge Index values in the top 20%. Quantitative research might provide insight into whether these proportions are statistically significant, or qualitative research might explore the possible reasons for this difference and options to reduce the apparent effect.

Further, an increased understanding of why the proportions of AP exams changes with changes in AP Challenge Index could provide insight into the AP topics that interest students and thus into which AP courses could be offered to attract more students, and in particular underrepresented students to AP courses. Qualitative research exploring the reasons why students in schools with larger AP programs are increasingly likely to select exams such as Statistics and Environmental Science and proportionately less likely to select Biology or United States History could help educational leaders in identifying the best course offerings to meet the educational needs of their students. These questions can be addressed from an equity perspective, considering the general racial or ethnic gaps in

some AP Exam topics and the over-representation of certain ethnic groups in other AP Exam topics. This focus on participation by subject or subject area could support Dewey's statement that "An educational aim must be founded upon the intrinsic activities and needs (including original instincts and acquired habits) of the given individual to be educated" (1916, p. 49). Nationwide and school-system trends could provide insight into which AP courses would attract new AP students from particular demographic groups, while comparisons to the gap for that subject in an individual school might illuminate opportunities for growth. Given research suggesting that AP instruction may help to bridge economic, racial, and ethnic educational gaps (e.g., Christiansen, 2009; Dutkowsky et al., 2009; Fowler & Luna, 2009; Ohrt et al., 2009; O'Keefe, 2009; Preston, 2009; Taliaferro and DeCuir-Gunby, 2008; Thompson & Rust, 2007), and that this may be true even for students at the bottom of a below-average high school (Hale, 2007), opportunities to expand AP instruction are worth continued exploration. The Equity Indices used in this study may provide a useful lens for evaluating efforts to expand that instruction.

This research did not address any gender gap in AP participation because the research focused on overall AP participation, and there is no overall gender gap ("4<sup>th</sup> Annual AP Report to the Nation," 2008, p. 15-47). Education has progressed substantially since Adam Smith's observation that, "there are no public institutions for the education of women, and there is accordingly nothing useless, absurd, or fantastical in the common course of their education" (1776, p. 340). However, gaps remain in particular subjects and subject areas. Further research might modify the Equity Indices used in this research to produce, for example, a *Technology Equity Index*. This could be

used to measure the gender gap in technical courses such as the various AP Physics courses and AP Computer Science, allowing for identification of schools with more uniform participation in those courses and an exploration of the factors present in such schools that may influence girls to choose those advanced classes in some schools to a much greater relative extent than in other schools.

To broaden this research, studies could be conducted that include IB schools and a range of college-level instructional options to test whether the conclusions of this research hold under more general conditions. Expansion of this research to include charter schools and magnet schools might not be justified because research has shown that students from different racial or ethnic groups tend to select magnet and charter schools for differing reasons, so observed differences might not be meaningful.

Finally, the conclusions of this research may imply that a focus on educational equity earlier in a student's education could be the most effective option to promote AP educational equity. This would be consistent with existing research showing that high school AP participation is determined by preparation prior to entering high school and that middle school interventions are associated with increased high school AP participation (e.g., Klopfenstein, 2004; Li et al, 2009; Shiu et al., 2009). If, as suggested by Conger, Long, and Iatarola (2009), after controlling for the fixed effects of confounding variables such as eighth grade test scores "blacks and Hispanics are advantaged by the schools they attend . . . within a given high school, blacks and Hispanics are more likely to take advanced courses" (p. 567), then high school may be too late in a student's education to restore equity effectively. This would suggest that intensive interventions in elementary and middle school might provide the best answer

for producing educational equity at the AP level, and longer-term research studies to determine both the optimal age for such interventions and the most effective options for those efforts might have significant value.

### **Summary**

Advanced Placement (AP) curricula have become significant components of instruction for high school students in the United States, offering advanced instruction to participating students. This study evaluated the connection between the size of a school's AP program and the racial equity of that program. This research did not find any statistically significant relationships between those two quantities, either for Black and African American students or for Hispanic and Latino students. This means that educational leaders can make decisions on the expansion of AP programs and on reducing the racial and ethnic educational gaps independently, rather than treating the two issues as if they might interact. Further research might explore the characteristics of individual high-equity schools to determine the characteristics of these schools that support their success.

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