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TRENDS IN MATHEMATICS ENROLLMENT AND ACHIEVEMENT GAP IN ST
LOUIS AREA PUBLIC HIGH SCHOOLS, 2000 - 2014

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A Dissertation Submitted to the Graduate School at the University of Missouri – St.
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Doctor of Philosophy in Education

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CHAPTER 1: INTRODUCTION

In today's American society, a high quality of education is no longer just a pathway to one's social mobility, it is a prerequisite for social justice. Because social advancement and academic achievement are closely linked, assuring that traditionally disadvantaged and under-served students graduate from high school prepared for college and career is essential for the progress toward racial equality. The struggle for equity in education began long before *Brown v. Board of Education*. It received additional support during the Civil Rights era and it materialized in the legal cornerstone of today's education, *The Elementary and Secondary Education Act (ESEA)*. Introduced by President Lyndon B. Johnson as part of his administration's "War on Poverty", the law ensured access to a basic education for all, and established a system of federal financial support to schools serving low socio-economic status students (Cross, 2010; Jennings, Stark, Rentner & Kober, 2002). Although Black students and the conditions of their education were not identified as intended beneficiaries of the law, they became so de facto due to the economic living conditions. It is important to note that the terms African-American and Black will be used interchangeably in this paper, as well as the purposeful capitalization of the term Black when referring to a group of students. Since the initial enactment, ESEA has been reauthorized eight times, most recently in 2015 when on December 10th President Barak Obama signed "Every Student Succeeds Act" (ESSA) into the law. ESSA replaced a long-standing previous version of the law better known as the "No Child Left Behind" which governed national education from 2002. The purpose of the NCLB as stated in the law was "to ensure that all children have a fair, equal, and

significant opportunity to obtain a high-quality education and reach, at a minimum, proficiency on challenging State academic achievement standards and state academic assessments” (NCLB, 2002). This purpose was to be accomplished through closing the achievement gap between minority and nonminority students, providing children with enriched and accelerated educational programs and elevating the quality of instruction. The law also included several new and expanded programs. However, the rigid and unrealistic benchmark for students’ achievement of 100% proficiency by 2014, mandates for standardized testing, accountability and punitive sanctions for failure to demonstrate improvement received the most attention and criticism. As the dissatisfaction with the NCLB grew, the topic of the next ESEA reauthorization moved to the forefront of the public and political debates.

In 2010, President Obama outlined his vision for better schools in the “Blueprint for Reform” (*A Blueprint for Reform: The Reauthorization fo the Elementary and Secondary Education Act*, 2010) where he identified preparing students for college and career, assuring that every school has great teachers and leaders and providing equity and opportunity to high quality education as his top priorities. Almost fifty years after the passage of the ESEA, and over a decade after the NCBL, the question is whether the implementation of the “No Child Left Behind” had an effect on the reducing the achievement gap.

Statement of the Problem

As the ear of the NCLB is over, there is a need to examine what impact its’ policies had on the achievement gap. Although many studies have been conducted to date, the vast majority used White-Non-White comparison framework. There is a

void in research literature dealing with the question of how achievement of different racial groups changed in absolute and in comparison with each other.

The National Center for Educational Statistics (NCES, 2013) defines the educational achievement gap as “the achievement gap that occurs when one group of students outperforms other groups, and the difference in average scores for the two groups is statistically significant” (p. 210). Although achievement gap can be seen in standardized test scores, grade point averages, course taking patterns and college acceptance rates, most researchers use test scores when talking about achievement gap. Administered since the 1960s, the National Assessment of Educational Progress (NAEP) shows a clear and persistent discrepancy in academic achievement between white and minority students. Tables 1.1 & 1.2 show reading and math proficiency of 8th and 12th grade students between 2005 and 2013.

Table 1.1

Percentage distribution of students at or above proficiency in reading. National Assessment of Education Progress (NAEP) reading achievement by race/ethnicity and grade, 2005 – 2013.

Grade & Year	Total	Asian	Black	Hispanic	White
8th grade					
2005	32	45	14	17	41
2009	34	47	15	19	43
2013	36	52	17	22	46
12th grade					
2005	35	36	16	20	43
2009	38	49	17	22	46
2013	38	47	16	23	47

Source: U.S. Department of Education (2013); National Center of Education Statistics (NCES, 2014).

Table 1.2

Percentage distribution of students at or above proficiency in mathematics. National Assessment of Education Progress (NAEP) reading achievement by race/ethnicity and grade, 2005 – 2013.

Grade & Year	Total	Asian	Black	Hispanic	White
8th grade					
2005	34	54	12	17	44
2009	35	55	13	20	44
2013	35	60	14	21	45
12th grade					
2005	23	36	7	8	29
2009	26	52	6	11	33
2013	26	47	6	12	33

Source: U.S. Department of Education (2013); National Center of Education Statistics (NCES, 2014).

These results indicate that although the achievement gap remains, there is unequal progress experienced by different ethnic groups nationally. While there are some research studies that found increased achievement among minority groups (Wells & Crain, 1994; Braddock & Elite 2004), the inequities and inequalities in education persist at an alarming rate.

According to the U.S. Department of Education Office for Civil Rights:

- Nationwide only half of high schools offer calculus, however 81% of Asian-American and 71% of white high school students attend schools that do. Only 57% of African-American students are enrolled in schools with full range of offerings in mathematics.
- Black and Latino students combined represent 37% of national high school enrollment, but only 26% take Advanced Placement exams and 18% receive

a qualifying score of 3 or above. In Missouri, the numbers are 20%, 15% and 7%.

- Twelve percent (12%) of Black students are retained in grade 9 compared to two percent of Asian-Americans and four percent of white students.
- Nationwide, one percent of white students and four percent of African-American students are enrolled in schools with more than 20% of first-year teachers. In Missouri, the numbers are two percent for white students and 12% for Black.
- Black students are suspended and expelled at a rate three times greater than white students. In Missouri, the ratio of white to Black suspensions is 7 to 27 for boys and 2 to 16 for girls. In plain terms, four Black boys are suspended from school for each white boy and eight Black girls for each white girl.

(Civil Rights Data Collection: Data Snapshot (College and Career Readiness), 2014; Civil Rights Data Collection: Data Snapshot (School Discipline), 2014)

Previous studies compared achievement gap based on racial segregation (Borman et al. 2004; Brown-Jeffy, 2006; Hanushek et al. 2002; Borman & Dowling, 2006), concentration of poverty (Kahlenberg, 2001; Orfield & Lee, 2004; Rumberger & Palardy, 2005; Sterbinsky et al., 2006), and the racial composition of the teachers and students (Finn and Voelkl, 1993; Weiher, 2000). In examining the achievement gap, most if not all studies framed White students as the norm and compared results of the Non-White students to them. Among many methodological problems associated with making one racial group as a norm, whiteness being one of them, Gloria Ladson-

Billings (2006) points to the conceptualization of students of color as deficient. Deficit theory introduced and refuted by Ladson-Billings states that the race-neutral approaches to instructional pedagogy cause teachers to see deficiency as individual phenomenon. Instruction is viewed as a set of skills and techniques designed to work for all students. Therefore, when they do not, and students do not perform well on assessments, they are assumed to be deficient. In addition to the systemic instructional design that is geared toward white students, white teachers (who constitute the majority of K-12 teachers) are not prepared to deal with students that differ from them. Rather than reflect on their own teaching styles, they treat students as lacking certain skills, or being deficient (Ladson-Billings, 1998). Therefore, deficit theory allows for an explanation of the achievement gap by shifting focus from inequitable systems, policies and practices onto individual students or racial groups. The proposed study attempted to present a different view on the achievement gap by comparing racial groups to each other and investigating enrollment patterns in high-school mathematics.

Purpose of the Study

The purpose of this study is to examine trends in the achievement gap in mathematics among public high school students in St. Louis city and county in 2000 – 2014. The study objective was to compare the trends among four major racial groups (Asian, Black, Hispanic and White) between males and females through enrollment in advanced level of mathematics, and scores received on state and national exams using publicly available databases (U.S. Department of Education Office of Civil Rights, National Center for Educational Statistics, College Board,

Missouri Department of Elementary and Secondary Education and ACT). The study then aimed to compare achievement trends in St. Louis area to similar trends on a state and national level. The trends on local level were be further stratified by the racial composition of the school to allow for comparison within each racial group.

Research Questions

1. How did the enrollment in high school advanced level mathematics classes changed for students of color?
2. What are the changes in the achievement among four racial groups (Asian, Black, Hispanic and White) and between males and females as evidenced by the scores on NAEP, AP Exams and ACT tests?

Theoretical Frameworks

To properly frame this study of examining trends in high school mathematics achievement for non-white students it was appropriate to review Critical Race Theory and Effectively Maintained Inequality.

Critical Race Theory (CRT) developed as an offshoot of an earlier legal movement called critical legal studies (Ladson-Billings, 1998; Tate, 1997), which challenged the traditional legal understanding of laws as a “neutral and objective set of rules” (Price, 2010, p. 150). Scholars in critical legal studies (CLS) and CRT have concurred that the law serves the interests of those in power in society; however, scholars in the CRT movement have argued that the critique of the oppressive structures in the CLS does not adequately address the experiences of people of color. The CRT supports the CLS’ focus on deciphering legal doctrines to reveal how “legal ideology has helped create, support, and legitimate America’s present class structure”

(Crenshaw, 1988, p. 1350), and uses storytelling to challenge, expose and mock the said class structure (Delgado, 2012) and to “change the bond that exists between the law and racial power” (Crenshaw, 1988, p. viii). According to Richard Delgado (2001), there are five main tenets of the CRT:

1. Racism is a permanent fixture in society, it is deeply embedded in everyday practices, national policies and actions, and it contributes to people’s experiences in society;
2. Interest convergence or material determinism. Because racism advances the interests of the dominant groups in society, there is little incentive to eradicate it. Therefore, any changes beneficial to the minority groups will happen only if the majority has an invested interest in it;
3. The “social construction” thesis holds that race is a social category that society invents, manipulates or discards at convenience, rather than a biological concept (Delgado, 2012).
4. Differential racialization based on the needs of labor market. Racial classifications change with the political, social and economic changes in society.
5. People of color have a unique voice that is used to combat popular discourses through personal experiences and counter-stories and therefore have their experimental knowledge validated (Delgado, 2012).

Race is a socially constructed concept; human interaction rather than biological traits are the source and continued basis for racial categorization. As a consequence, many racial categories in the U.S. have changed to either include or exclude various

groups of people. At different times in history Mexican Americans, Asian Americans, and Arab Americans were considered White as U.S. Census reports demonstrate. For example, before 1997, Mexicans, or Hispanics in modern terms, had their own racial category only once in 1930. All other times, they were considered White. Arab Americans could identify with the country of their origin, however on the official Federal documents, they are considered White. (*Revisions to the Standards for the Classification of Federal Data on Race and Ethnicity; Notice of Decision*, 1997) Notably, only two racial categories remained stable throughout the American history – Black and White. Critical Race scholars assert that the origins of the Black-White racial categorization are rooted in the property rights of the colonial U.S. (Bell, 1987; Harris, 1993; Ladson-Billings, 1985). In the early history, only White male property owners were eligible to participate in the democratic process. “Although not all Africans were slaves, virtually all slaves were not white” (Harris, 1993, p.1717) and therefore, not only they owned no property, they were also considered as property. As the country developed its’ legal system, “Black” denoted those who were subject to enslavement, and “white” marked those who were “free”. These categories later evolved from “slave” and “free” to “Black” and “white” through numerous legal codes and regulations. The institute of slavery and the economic needs it protected allowed for the creation of social reality where subordination of Black people was acceptable. Furthermore, the interconnectedness of property interests, political discourse and social order allowed for legal construction of “whiteness” as an objective fact (Anderson, 1994; Harris, 1993). Being white became a property in itself and gave power and privilege to those who

possessed it. Critical Race scholars argue that the concept of whiteness as property is not confined to nation's early history. They insist that because of the white-property symbiosis, people of color do not have the same experiences in citizenship, access and opportunities as whites (Ladson-Billings, 1998, Williams 1995). The notions of whiteness and Blackness do not map neatly onto bio-genetics or cultural associations, so other conceptual categories serve to represent them. As Gloria Ladson-Billings (1998) states:

Conceptual categories like “school achievement”, “middle classness”, “maleness”, “beauty”, “intelligence”, and “science” become normative categories of whiteness, while categories like “gangs”, “welfare recipients”, “basketball players” and “the underclass” become the marginalized and de-legitimized categories of Blackness. (p.9)

Critical Race Theory researchers use the concept of whiteness to deconstruct the oppressive structures, reconstruct the human agency and construct equitable and socially just relations of power (Ladson-Billings, 1998). The field of CRT is relatively new, yet it is experiencing a growing interest from educators and school administrators due to emerging research on the causes, consequences and manifestations of race in education (Dixon, 2006; Parker, 1999; Taylor, 2009), mathematics (Berry, 2008; Martin, 2009; Rousseau, 2003; Stinson, 2008, 2013) and how students of color experience and respond to the educational system (Solorzano, 2002). CRT offers new insights for educational researchers and practitioners, similar to what feminists' studies did for female empowerment. For example, research by feminist scholars in the 1970s and 1980s highlighted the way in which the problem of

girls' success in mathematics took on a different turn. Until then, most researchers concerned with gender inequities in mathematics would focus their attention on the differences between boys and girls, exploring difference in learning styles, confidence levels and cognitive strategies that helped boys to be successful in math. In other words, researchers looked for ways of making girls to be more like boys, something that most people would recognize far from equity now (Gutierrez, 2014). Present day educational policies look for ways to reduce the achievement gap and in doing so focus on raising academic achievement of students of color to resemble that of white students. Critical race scholars argue vehemently against comparing achievement of the minority students to their white counter-parts while making the latter to be the standard. They focus on the richness of the cultural, cognitive and social background of minority students, highlight their strengths and resilience, and advocate against the subversion to the dominant culture (Dixon & Rousseau, 2006; Ladson-Billings, 1998; Ladson-Billings & Tate, 1995; Martin, 2003, 2009; Solorzano & Yosso, 2002).

CRT in education is a theoretical and analytical framework that challenges the ways race and racism impact educational structures, practices, and discourses (Yosso, 2005). Discourses include more than talking and words, they also refer to institutions, actions, and the ways we interact and operate. Discourses can be thought of paradigms in which we operate and what we accept as normal. CRT views the achievement gap as a discourse that is prominent in education today. It is accepted as normal state of things because it has been repeated, reported and researched in so many ways.

Once accepted as truth, the discourse structures the world: if the existence of the achievement gap is the current discourse in education, a new discourse is created presuming that African American students are academically deficient. CRT refutes the deficit theory and offers an alternative discourse to it.

According to Gloria Ladson-Billings (1998):

CRT suggests that current instructional strategies presume that African American students are deficient. As a consequence, classroom teachers are engaged in a never-ending quest for 'the right strategy or technique' to deal with (read: control) "at-risk" (read: African-American) students. Cast in a language of failure, instructional approaches for African American students typically involve some aspect of remediation. (p. 19)

The achievement gap is not the only reason for the popularity of the academic deficiency discourse in children of color. Long before the focus on achievement became prominent, scholars had debated the intellectual inferiority of African American, Native Americans, Latinos, and other people of color. Intelligence testing became popular in the middle of the twentieth century, and intelligence quotient (IQ) scores were used to explain stark differences in educational attainment between white and non-white children (Herrnstein, 1994; Jensen, 1969). Despite the fact that these theories have been subjected to considerable scholarly critique, the discourse of intellectual inferiority became a part of a larger, binary opposition of White and Black. The present study used CRT concepts to present a challenge to meritocracy and colorblindness that is embedded in national educational policy documents and

attempted to offer a counter-narrative of the trends in high school mathematics achievement.

Effectively Maintained Inequality (EMI), a theory proposed by Samuel R. Lucas to explain social background effects on educational attainment and curriculum tracking in schools. According to EMI “socioeconomically advantaged actors secure for themselves and their children some degree of advantage wherever advantages are commonly possible” (Lucas, 2001, p. 1652). As long as a particular level of schooling is not common for everyone, i.e. college, those who are better off socioeconomically will use their advantaged position to secure that level of schooling. When a particular level of schooling becomes universal, i.e. K – 12, the socioeconomically advantaged will seek out qualitative differences and use their advantages to secure for themselves similar but qualitatively better education. Although, Lucas’ research pertained more to predicting educational outcomes on the basis on social background, the EMI theory can be applied to other areas. Specifically, EMI may explain students’ enrollment trends in advanced placement classes after the NCLB.

“*Whiteness* is conceptualized as a set of processes and practices including basic rights, values, beliefs, and socially legitimized perspectives, standpoints, and experiences purported to be commonly shared by all but that are actually only afforded in any consistent way to White people” (Banks, 2012). Historically, whiteness was legitimized and equated with property in colonial America when being white meant having a legal status of a free person. “The dominant paradigm of social relations however, was that although not all Africans were slaves, virtually all slaves

were not white” (Harris, 1993, p. 1717). Slavery as a system of ownership over other human beings caused the merger of white as a biological trait and property. Because the system of slavery was rooted in racial identity, being white became the characteristic, the attribute, and the property of being free (Harris, 1993, p. 1771). Over time, whiteness as property encompassed a slew of abstract concepts and privileges that are associated with property in addition to physical objects. Such concepts as reputation, status and absolute right to exclusion are just a few examples of non-tangible benefits of being white.

In education, whiteness as property has become an indication of who benefited from schooling dependent on the value of property owned. Communities with higher property values were able to provide more funding for schools, which led to more resources, higher quality of curriculum and instruction, better teaching staff and access to technology (Ladson-Billings & Tate, 1995; Subini, 2014). Whiteness as property allowed exclusion of others from benefits of whiteness by having the freedom to choose where to live and send children to school and thus maintaining inequitable distribution of resources (Donnor, 2013; Lucas, 2001).

Significance of the Study

By some measures the achievement gap has shrunk, however it has done so very slowly. Data from the most recent NAEP assessments reveal that in 1992, the difference between the average reading score for white and Black students was 28 points. In 2012, that difference had narrowed to 23 points (NAEP, 2012). There is an outcry for extreme caution when using pre-packaged national assessment reports. Standardized tests, such as NAEP, show achievement gap in one of two ways: (1)

through norm-referenced terms, by expressing the gap in terms of standard deviations from white achievement, or (2) by reporting the percent of students who meet the proficiency requirements (Banks, 2012). The first way of measuring the achievement gap most certainly produces results that show Black and Hispanic students lagging behind white students.

Trend studies have been done to investigate changes in students' achievement in reading and math for students in 4th and 8th grades (Bank, 2011; Lee, 2002, 2006). The only study that examined high school students' achievement gaps was done before NCLB (Berends, 2005). Most, if not all, trend studies have been done on a national and state level using achievement gap between white students and the other groups (Black and Hispanic). The current study will expand the analysis of the achievement trends to school levels and among racial groups rather than white-non-white comparisons. Achievement comparisons among racial groups will help district and school administrators improve students learning and increase achievement for students who need it most.

The present study aimed to provide a counter-story to the dominant narrative of students of color being academically deficient by shifting the focus from the standardized tests results to the learning experiences through mathematics courses enrollment trends.

Finally, the study offered an experimental methodology for measuring the achievement gap by using non-white racial groups as reference. It has a potential to add to the CRT researchers' toolbox of narratives and counter-stories.

Limitations of the Study

This trend analysis may not be generalized to other researchers due to the following limitations. Researchers who do not use CRT may not reach the same conclusions as in the present study. Publicly available data regarding student achievement may not be of the same type or of the same scope. Some agencies, such as ACT and College Board, report students' achievement results yearly while others like NAEP and the Office of Civil Rights conduct their survey every three years or over a period of 10 years (National High School Transcript Study, National Curriculum Study, etc.). The availability and the nature of data will limit the chronological scope of the study and the number of trends studied.

Another limitation of this study is a limited analysis of student achievement and enrollment patterns based on gender. The findings are reported as a total enrollment or achievement without a break-down by race or school demographics. There is an opportunity for future research in this area.

Delimitations of the Study

Although the achievement gap refers to the educational outcomes and includes graduation rates, college placement and remedial rates in post-secondary settings, this study limited its scope to students' achievement results on standardized tests and access to higher levels of classes. The achievement gap also refers to all core subject areas of reading, mathematics, science and technology classes. In order to narrow the scope of this study, only results and students' enrollment in mathematics courses were reviewed. The research differentiated between white and minority students with the breakdown for each major racial group: Asian, Black, Hispanic and White. The

research reported gender differences without a more detailed investigation into the roots and causes, as there were ample studies available on the subject. As it is well documented in the literature, minority students live predominantly in the urban areas. Therefore, in order to study local trends in achievement and enrollment, the study focused on St. Louis area schools. There were 13 high schools in the City and 35 in the districts immediately surrounding it and in the county. Examination of the local trends in course enrollments included looking at all 48 high schools, depending on the availability of the data. The study also differentiated between high- and low- poverty schools.

Definition of Terms and Abbreviations

Achievement Gap – “the disparities in educational outcomes between students of differing demographic characteristics such as gender, ethnicity, nationality, socio-economic status, and immigration status” (Banks, 2012, p. 16). It can be observed on a variety of measures, including standardized test scores, grade point average, dropout rates and college access. The issue of the achievement gap gained public spotlight with the passage of the “No Child Left Behind” Act. However, the increased focus on Black – White, and Hispanic - White achievement gap contributed to the presumption that Black and Hispanic students are academically deficient and are in need of remedial help.

ACT – Originally established as American College Testing program in 1964 by E. F. Lindquist, ACT is a college readiness test administered worldwide.

AP – Advanced Placement are classes that adhere to college-level curriculum and are taught in high school. College Board supervises and approves syllabi for AP classes,

and administers AP Exams at the end of the course. Students receiving a score of 3 or above are considered ready for college-level work and in many cases are granted a college credit from participating University. Advanced level classes are high school courses that follow a core mathematics sequence of Algebra-Geometry-Advanced Algebra. Although the specific titles for these courses differ, the Office of Civil Rights database lists them by topics covered: pre-calculus, calculus, trigonometry, statistics, etc.

Black – I use the term "Black" for the reasons articulated by Kimberle Crenshaw that “Blacks, like Asians, Latinos, and other 'minorities,' constitute a specific cultural group and, as such, require denotation as a proper noun.” (Crenshaw, 1988, p. 1332).

College Board – An American private nonprofit corporation founded in 1900 as the College Entrance Examination Board to expand access to higher education. College Board administers SAT and Advanced Placement program.

CRT – Critical Race Theory is an intellectual discourse that accepts racism as inherent in society, advocates for people of color and provides researches with tools to develop counter-narratives to the dominant theories.

Deficit Theory – a theory that refutes a presumption that African American students are academically deficient. Such presumption stems from the view of instructional strategies as a set of teaching skills that should work for all students. When these strategies fail to work, the students are viewed as responsible for the lack of learning (Ladson-Billings, 1988).

Detracking – purposeful dismantling of a system in which students are placed in classes using inequitable mechanisms (i.e. ability grouping) through opening up

access to advanced placement classes, standardization of curriculum and mastery-based teaching.

DESE – Missouri Department of Elementary and Secondary Education, a state agency that oversees public schools.

Differentiated Instruction – a form of instruction that maximizes each student's learning by recognizing that students learn and respond to instruction in different ways.

EMI – effectively maintained inequality, a theoretical framework developed by Samuel R. Lucas that postulates that socioeconomically advantaged members of society secure for themselves and their children some degree of advantage wherever advantages are commonly possible.

EOC – End-of-Course assessment, administered to comply with the No Child Left Behind legislation. Students' achievement data from the tests is used to determine schools' performance and progress toward academic goals.

IB – Founded in 1968, the International Baccalaureate is a non-profit educational foundation offering four programs of international education to high school students. Schools must be authorized by the IB organization to offer any of the programs.

IQ – a number used to express the apparent relative intelligence of a person as: (a) the ratio of the mental age (as reported on a standardized test) to the chronological age multiplied by 100, (b) a score determined by one's performance on a standardized intelligence test relative to the average performance of others of the same age, (c) proficiency in or knowledge of a specific subject (Merriam Webster Online Dictionary, n.d.).

MAP – Missouri Assessment Program, designed to measure how well students acquire the skills and knowledge described in Missouri’s Learning Standards. The assessments produce information on students’ academic achievement. This information is used to assess the overall quality of education throughout Missouri.

NCLB – No Child Left Behind Act of 2001, is one of the iteration of the Elementary and Secondary Education Act of 1965, the major federal law authorizing federal spending on programs to support K – 12 schooling.

NCES – the National Center for Education Statistics, is the primary federal entity for collecting and analyzing data related to education in the U.S. and other nations. NCES is located within the U.S. Department of Education and the Institute of Education Sciences.

Non-White Students – traditionally refers to all non-white students. However, in this paper the group includes Black and Hispanic students only. As this research shows, Asian students outpaced all other racial categories in academic achievement and access to advanced mathematics courses, and therefore reversed the achievement gap in their favor.

Qualifying Score (on AP exam) – A score of 3 or higher is considered to be a qualifying score by the College Board.

Race – a socially constructed category of identification based on physical characteristics, ancestry historical affiliation, or shared culture.

Racism – a belief or doctrine that inherent differences among the various human racial groups determine cultural or individual achievement, usually involving the idea

that one's own race is superior and has the right to dominate others or that a particular racial group is inferior to the others.

Tracking – educational practice of assigning students to curriculum paths with a pre-determined outcome and therefore limiting students' access to high-quality education for all.

CHAPTER 2: REVIEW OF LITERATURE

Equity in Education

Education is one of the few remaining ways that allow for social mobility, economic advancement and improvement of one's quality of life. For African-Americans access to high quality of education holds a special significance. It has long been viewed as a way to equal citizenship and a civil right (Anderson, 1988; Moses, 2001). Much has been done in the past 50 years to improve the state of education for minority students. The *Brown v. Board of Education*, Elementary and Secondary Education Act of 1965 (ESEA), Title I, the Coleman Report, "Nation At Risk", No Child Left Behind are just a few examples of public laws, policy documents and reports that aimed at improving education for the poor, minority and other disadvantaged groups. ESEA of 1965 was the first step toward greater involvement of the federal government in the matters of education. It represented a dramatic increase in the federal financial commitment by establishing direct financial grants to schools serving poor students (Title I) and focused national attention on the educational needs of children from low-income families. Measured against the history of resistance to federal interference in state educational matters, racism and inequality in education, this was a monumental accomplishment (Halperin, 1975). However, the Act failed to establish accountability measures to ensure that local schools receive the funding needed and left the program design largely in the hands of local educators (Kantor, 1991). Two major amendments in 1968 and 1972 initiated new programs to increase the number of certified education specialists and other supportive services to close the achievement gap between racial/ethnic groups (Cross, 2010). However, it wasn't until the publication of a report produced by the National

Commission on Excellence in Education, titled “A Nation At Risk” that public attention was called to higher standards, more rigorous curriculum and standardized testing to measure academic progress in schools (Mehta, 2013). Among some of the findings, the report pointed out to the fact that:

“Twenty-five percent of the credits earned by general track high school student are in physical and health education, work experience outside the school, remedial English and mathematics, and personal service and development course, such as training for adulthood and marriage.” (*A nation at risk: The imperative for educational reform: a report to the Nation and the Secretary of Education, United States Department of Education, 1983*)

Notably, the achievement gap addressed in the report was the difference in academic performance between white students in the U.S. and their international counterparts. There was only one instance where the report made a reference to minority students being “functionally illiterate at a rate of 40%” (A Nation At Risk, 1983). Nevertheless, the report gave much needed boost to further reforms, such as the Improving America’s Schools Acts (IASA amended ESEA) in 1994 and the No Child Left Behind Act in 2002. Those documents eventually addressed the problem of the achievement gap between white and students of color. Critical Race Theory researchers call this course of events an example of “interest convergence” (Battey, 2013; Delgado, 2012). Interest convergence happens when the interests of the racial group in power converges with the interests of the minority groups. For example, the publication of “A Nation At Risk” created a situation in which interests of white middle class parents, the U.S. Government and African-Americans albeit different, converged on a common

problem of improving American education. White middle class parents were interested in higher quality of education for their children, the U.S. Government was concerned with too much financial resources being spent on remediation of basic skills in colleges, business and in military, and the African-American community kept struggling for equity in education.

The 2002 reauthorization of the ESEA, better known as the No Child Left Behind (NCLB) was by far the most dramatic and far-reaching of the educational reforms in the past 50 years. It called for “fair, equal and significant opportunity to obtain a high-quality education” through stronger accountability for schools and teachers, closing the achievement gap between minority and nonminority students, providing students an enriched and accelerated educational programs and focus on proven, research-based instructional methods (NCLB, 2002).

Research on the effectiveness of the NCLB presents a mixed and complex picture. Although there are some reports and studies that show increase in students’ achievement as a result of the NCLB Act and other accountability policies (Clotfelter, 2009; Dee, 2010; Ladd, 2010; Reback, 2008), there are also just as many that demonstrate negative consequences of the law. Narrowing of instructional content, increasing direct instruction as a main teaching method and marginalizing low-performing (and often minority) students (Anagnostopoulos, 2006; Booher-Jennings, 2005; Dee, 2010; Diamond, 2007; Neal, 2010) are a few examples of the negative effects of the NCLB. Schools have been shown to shift instructional time spent on language arts and mathematics at the expense of social studies, arts and other elective courses (Diamond, 2007; Diamond & Spillane, 2004; Spillane, Diamond, Burch et al., 2002; Spillane, Diamond, Walker et al., 2001). In

addition, there is a growing body of research that focuses on more indirect, unintended consequences of accountability. It has been well documented that schools under accountability pressure may alter testing conditions, manipulate the student body by reclassifying low-achieving students into special education (Deere and Strayer, 2001; Figlio and Getzler, 2002; Jacob, 2005; Cullen and Reback, 2006) or by giving them longer disciplinary suspensions closer to testing dates (Figlio, 2006). Diamond and Spillane (2004) found that schools on academic probation are more prone to respond to accountability demands in ways that are not beneficial to students, such as focusing instructional time and resources on bubble kids, a term commonly used in practice to refer to the students who are nearing proficiency on assessments, but have not shown consistent results. Their anticipated performance could fall either in proficient or basic category with equal probability. This practice is so common, that researchers identified it by a special term, known as educational triage (Jennings, 2014). According to Jennings (2014), educational triage is educator behavior and organizational strategies that allocate resources and alter teaching practice in ways to maximize students' proficiency rates. It has been well documented that faced with limited resources, teachers focus instruction on the standards most likely to be tested, teach content in the format that is presented on the test, and focus their instructional efforts on the kids who are nearing proficiency and are most likely to demonstrate needed increase in achievement on the state tests. Later works revealed that this practice was not exclusive to under-performing schools (Choi, Seltzer, Herman & Yamashiro, 2007; Ho, 2008; Neal & Shcanzenbach, 2007; Jennings, 2014). Therefore, high stakes testing in mathematics has and will have disproportionately negative impact on under-represented students given that many of these students have

less access to high quality teaching and curriculum and the often punitive in nature consequences for low test performance (Martin, 2003; Gustein, 2003; Tate, 1995; Tate & Rousseau, 2002).

Shifting the focus back to the public policy documents, one finds the abundance of statements about fair and equal opportunity to access high-quality education (NCLB, 2002) and the importance of keeping the American promise of equal opportunity by providing world-class education to every child (Blueprint for Reform, 2010). However, as research shows, there has been persistent and continued misalignment between the goals for equity set by educators and policy makers when said goals apply to the students traditionally underserved in education. None is more visible than in the field of mathematics (Martin, 2003). Public policy documents of the past decade target improving achievement of minority children, students with disabilities, poor children and English language learners by setting learning standards and holding schools accountable for reaching certain performance benchmarks (*A Blueprint for Reform: The Reauthorization fo the Elementary and Secondary Education Act*, 2010; "No Child Left Behind (NCLB) Act of 2001," 2002; *Race to the Top Program Executive Summary*, 2009). The questions that many researchers and critical race scholars especially ask are where do the standards come from, what knowledge qualifies as standard, and who benefits from the standards movement (Ladson-Billings, 1998). By giving public schools a chance to show progress toward standards, students of color are declared failures under a presumed-to-be fair and objective system (Leonardo, 2007). Moreover, schools serving Black students are often disproportionately targeted by high stakes accountability sanctions (Diamond & Spillane, 2004).

College and Career Readiness

Perhaps, no other issue raised more controversy as the NCLB's requirement of 100% proficiency in Communication Arts and Mathematics examinations by 2014. Educators and researchers alike voiced their opinions about improbability and unattainability of such goals and advocated for broader measures of students' achievement. In 2011, the U.S. Congress re-authorized Elementary and Secondary Education Act and outlined how states could get relief from certain provisions of NCLB including the 100% proficiency requirement. In order to qualify for the exemption, the states had to demonstrate serious efforts to close achievement gaps, promote rigorous accountability, and ensure that all students are on track to graduate ready for college and career. In Missouri, student achievement now includes results from communication arts, mathematics and science tests as well as Advance Placement (AP), International Baccalaureate (IB), American College Testing (ACT) and Scholastic Aptitude Test (SAT) scores as an added measure of college readiness.

There is no one definition of college readiness, but many of them have common threads. Conley (2012) defines a student who is college ready as one who "can qualify for and succeed in entry-level, credit-bearing college courses leading to a baccalaureate or certificate, or career pathway-oriented training programs without the need for remedial or developmental coursework". This definition agrees with what ACT considers college readiness, namely "acquisition of the knowledge and skills that students need in order to enroll and succeed in credit-bearing first-year courses at a postsecondary institution, such as two- or four-year college, trade schools, or technical school" (ACT, 2011, p.1). The College Board has suggested that obtaining a first-year grade point average of a B- or

higher is indicative of college readiness (Kobrin, 2012). Anticipating that tracking course grades would not be easy, some researchers use academic rigor present in high school as a predictor of college success (Adelman, 1999, 2006; Attawell, 2008).

In today's stratified society, graduating from high school and obtaining a college degree is recognized as one of the few remaining ways of upward social mobility and increasing one's cultural capital, which can be passed down the future generations (Dumais, 2002; Kirsh, Barun, Yamamoto & Sum, 2007; Silva, 2001). College attainment is also related to better health, longevity, happiness and other outcomes (Attawell, 2007; Pallas, 2000; Ross, 1999; Stevens, 2008). Research has shown that students who take more and higher levels of mathematics courses in high school are more likely to enroll in college and to have higher earnings over their lifetime (Adelman, 2006; Joensen, 2009; Rose, 2004). Taking Advanced Placement (AP) courses has become almost a pre-requisite when applying to more selective colleges (Conger, 2009) as it "signals" to the admission committees that a student had experience in a rigorous class and is better prepared for college (Attawell, 2008; Klopfenstein, 2004). For minority students, enrollment in an AP class may provide a more robust learning experience and prepare them for college.

Support for policies requiring rigorous course come from studies that link students' course taking and achievement. These studies document a strong relationship between the type of courses students take in high school (regular, honors, AP, etc.) and their performance on academic tests and in college (Adelman, 1999, 2006; Lee, 2002; Oakes, 1985, 2005; Perkins, 2004). However, several studies have shown that simply mandating a minimum number of courses for graduation or college preparatory track does not

necessarily lead to better student outcomes (Clune, 1992; Hoffer, 1997; Tietelbaum, 2003).

Presently, states are actively defining, implementing and assessing students' college readiness. According to the National Center for Education Statistics (NCES in the 2012-2013 school year, 38 states had clearly defined college readiness standards. Of that number, 16 states required all high school students to take college preparation programs in order to receive a diploma, eight specified courses required for diploma and 21 aligned high school assessments with postsecondary system (NCES, 2012-2013).

The definition of college readiness as being prepared for and successful in entry-level college courses leaves an open door for interpretations of which skills are considered college ready and how to measure the college readiness. According to the National Survey of Student Engagement (2012), college students are expected to have well-developed writing skills, research capabilities and general thinking skills. They will also be expected to work well with others outside the classroom, work in small groups and make presentations (*National Survey of Student Engagement*, 2012). Educators and policy makers alike should be looking for ways to assure that students are acquiring the aforementioned skills before graduating high school and developing effective tools that measure how well the students are prepared for college.

The most common approach to measure college readiness is to define it in terms of high school course taking patterns, including the titles, perceived challenge level, and the number of units required for graduation, combined with the grades students receive in those courses. Missouri requires 24 credits of coursework, including four in Communication Arts, three in Mathematics, and three in Science and Social Studies for

students to receive a high school diploma (*Graduation requirements for students in Missouri public schools*, 2015). However, research indicates that of students who take a core mathematics curriculum, only 16% are ready for a credit-bearing first-year College Algebra course. It is not until students take one full year of additional mathematics courses beyond the core that we see more than half (62%) of ACT-tested students ready for college-level work in mathematics. The impact of an additional credit in communication arts is even more dramatic, changing from 67% to 75% of student ready for college (ACT, 2011). These findings are supported by Clifford Aldeman (1999, 2006), who found that the most advanced math course completed in high school was positively related to college graduation: approximately 83% of students who took calculus graduated from college, compared to 75% of those who took pre-calculus, 60% of students who took trigonometry, and 40% for students whose highest math course was Algebra II.

The state of Missouri has a defined college preparatory course of studies. A College Preparatory Studies Certificate can be awarded to any student who completes 25 credits of coursework (4 in communication arts, 4 in mathematics, and 3 in both science and social studies), earn at least a 3.0 GPA in the core four subjects, score above prior year's national average on ACT or SAT, and maintain 95% attendance. In order to be considered for the College Preparatory Studies Certificate students have to complete four units of mathematics from the following list: algebra 1, geometry, algebra 2, pre-calculus, analytical geometry, trigonometry, calculus, math analysis and statistics. Any mathematics that emphasizes pre-algebra, consumer math, business math, or computer math/programming is excluded from the college track (*Graduation requirements for*

students in Missouri public schools, 2015). The present study examined students' placement in math, their course-taking patterns and how it affected achievement on standardized tests, such as the Algebra End of Course test.

Standardized tests are the next commonly used measurement of students' college readiness. Many states, including Missouri, are currently redesigning their end of course tests to reflect new Common Core State Standards. Results from the ACT, SAT, AP/IB examinations, which are used in the current accountability system in Missouri, are also an important determinant of a student's college readiness. Each year College Board, a for-profit company that runs Advanced Placement and SAT programs, publishes an annual report on the nation's participation in the AP program. While there are no numbers available for overall enrollment in courses, the reports show the number of students who took the AP exams, and earned a qualifying score of three or higher. At first glance the results are quite impressive for increased participations of African American students in AP exams: their numbers more than quadrupled over the past ten years. However, even at such impressive increase, African American students taking AP exams still account for less than 10% of the graduating cohort of students. In contrast to that, 55.9% of white graduates take AP exams. Black students lag behind even other minorities, such as Hispanic students, who increased their AP exam participation to 18.8% of the graduating class overall (College Board, 2014). The present research attempted to find a possible explanation to these trends, such as under-representation of Black students in AP classes through low enrollment rates. Another alarming concern is the lack of progress in earning a qualifying score on AP exams. In Missouri, between 2003 and 2013, the number of Black students taking AP exams increased from 165 to 981, and the number of

students scoring 3 or higher increased from 65 to 217 (Table 2.1 and 2.2). The percent of African-American students who obtained the qualifying scores went down from 40% to 22% of the test takers.

At the same time, the number of Hispanic/Latino students taking the exams and earning a score of 3 or higher increased in both categories. Over the past ten years, roughly half of Latino students who took an AP exam scored 3 or higher.

Table 2.1
Trends in AP Participation and Success: Number of African American, Hispanic and White Students, 2003 – 2013.

<u>Ethnicity</u>	<u>2003</u>	<u>2008</u>	<u>2012</u>	<u>2013</u>
<i>African-American</i>				
Students in the graduating class	7,536	9,178	9,854	9,339
Students taking AP Exam	165	592	1,082	981
Students scoring 3+ on AP Exam	65	95	212	217
<i>Hispanic/Latino</i>				
Students in the graduating class	867	1,498	2,116	2,193
Students taking AP Exam	69	214	310	343
Students scoring 3+ on AP Exam	48	112	160	183
<i>White</i>				
Students in the graduating class	47,569	49,744	47,814	46,558
Students taking AP Exam	3,636	5,130	6,911	7,232
Students scoring 3+ on AP Exam	2,403	3,320	4,613	4,753

Source: College Board, 2014

Table 2.2

Trends in AP Participation and Success: Percentage of African American, Hispanic and White Students, 2003 – 2013.

<u>Ethnicity</u>	<u>2003</u>	<u>2008</u>	<u>2012</u>	<u>2013</u>
<i>African-American</i>				
Students in the graduating class	13.2	14.9	16.0	15.5
Students taking AP Exam	3.9	9.0	11.7	10.3
Students scoring 3+ on AP Exam	2.3	2.4	3.8	3.8
<i>Hispanic/Latino</i>				
Students in the graduating class	1.7	2.9	3.4	3.2
Students taking AP Exam	1.6	3.3	3.4	3.6
Students scoring 3+ on AP Exam	1.5	2.4	2.9	3.2
<i>White</i>				
Students in the graduating class	86.9	84.5	83.1	82.4
Students taking AP Exam	85.4	78.2	74.8	75.8
Students scoring 3+ on AP Exam	83.6	80.6	77.8	77.0

Source: College Board, 2014.

College ready skills, which include reasoning skills, ability to interpret and analyze information, adherence to precision and accuracy, and problem solving are among critical skills required for success in college. They are also the skills that are needed for a productive and successful career after school. For the most part, standardized tests require students to recall or recognize fragmented and isolated information. Performance events that would allow students to use higher-level thinking and problem solving skills are hard to find and even more expensive to score (Conley, 2007). There is a clear disconnect between a rhetoric of students being career and college ready and the kind of skills tested on a high stakes tests. Developing effective policies requires understanding how present reforms affect students' coursework patterns and educational outcomes. This study examined how state accountability requirements impacted students' enrollment in mathematics courses and the type of course taken.

Tracking and Detracking in Schools

As policy organizations called on states and districts to increase students' preparedness for post-secondary success along with the federal government mandating the achievement targets and imposing deadlines, there has been very little discussion of how these policies affect classroom organizations within schools. One of the coping practices is to track students through course assignments. The classical tracking of students through rigid curriculum paths that determined which courses they took has been widely criticized in academic research starting in the early 1970s. Many scholars have documented poor instructional environments in low-track classes (Gamoran, 1989; Oakes, 2005; Rosenbaum, 1976) suggesting that low-ability students may learn more in mixed-ability classrooms. This criticism led to dismantling of the school wide tracking systems, replacing them with leveled courses (Carey, 1994; Hayes, 1990; Lucas, 1999) and to the new research on ability grouping. Educators, facing concerns about tracking, race, SES, and ethnicity offered seemingly logical rationales for ability grouping practice including helping students learn better, promoting equality and making teaching and classroom management easier (Esposito, 1973; Oakes, 1985). In response to tracking and ability grouping research, researchers and educators called for nonability-grouped structures. De-tracking, in which students are placed in heterogeneous classes, has been tried with some success (Alvarez, 2006; Mehan, 1996; Oakes, Wells, Jones, & Datnow, 1997; Rubin, 2006; Wheelock, 1993). Whereas tracking has been criticized for placing low-ability students at a further disadvantage, de-tracking has been shown by scholars to be disadvantageous for students in average and high tracks through boredom, dissatisfaction with schooling and slower achievement growth (Rosenbaum, 1999).

By 1990s, research about ability grouping and tracking has decreased dramatically, giving way to focus on differentiated instructions (Barr, 1995; LeTendre, 2003; Lucas, 1999). However, as educators are striving to respond to the ever-increasing accountability demands, there has been a resurgence of research on ability grouping (Blanchett, 2006; Chorzempa, 2006; Watanabe, 2006). Now tracking has evolved into a more flexible, more frequent, subject-specific system that allocates students to different curricula resulting in variation in students' academic experiences within and across schools (Allensworth, 2009; Lucas, 1999, 2001; Oakes, 1985).

Prior studies suggest that successful de-tracking efforts may require fundamental changes in the organization of schools. Schools often face many difficulties when they attempt to eliminate tracking, including resistance from parents, teachers unable to differentiate in heterogeneous classrooms, and a lack of instructional improvement due to teachers' low expectations for students (Rubin, 2008; Wells, 1996). Class conflict around schools' decisions to track or not track is well documented in research, as socioeconomically advantaged parents often work to maintain tracking in the schools (Wells & Oakes, 1996; Wells & Serna, 1996). As Oakes (1994a, 1994b) argued that tracking was used as a politicized policy to re-segregate desegregated schools along class and racial lines, evidence from the studies Braddock (1990), Lucas and Berends (2007) and Kelly (2009) showed that tracking increased as school diversity increased. Their findings also demonstrated that White students were more likely to be in advanced programs than Blacks. Yonezawa (2002) also observed that the new differentiated curriculum has resulted in considerable social stratification in educational opportunities and outcomes.

Critical Race Theory and Education

As Tate (1997) pointed, because Critical Race Theory is a product of and a response to one of the most politically active and successful era of social change in the United States (Civil Rights movement), it had both academic and social activist goals from its inception. It emerged from the earlier movement of critical legal studies, which attempted to analyze legal ideology and discourse as a mechanism to recreate and legitimate social structures in the United States. CLS scholars largely criticized theories of formalism and objectivism to focus on legal and social injustices directly following the Civil Rights era. Formalism is defined as transposing a method of legal justification on philosophical or ideological debates, whereas objectivism is the belief that the legal system can represent a framework of human interaction (Tate, 1997). Critical Race Theory represented a departure from rights-based theory, which was especially problematic for people of color seeking justice.

Although there are many notable CRT scholars, the ideas of Derrick Bell are the key to understanding the CRT movement due to the permanence of Bell's critique of the traditional civil rights discourse. The three major ideas found in Bell's writings are the contentious relationship between property and human rights (constitutional contradiction), the belief that the Blacks can only achieve progress when their goals are consistent with the needs of whites (interest-convergence principle), and that many whites will not support civil rights policies that appear to threaten their social status (the price of racial remedies). Bell's scholarship called for dismantling the traditional civil rights language, such as color blindness and equal opportunity, and for allowing opportunity for a more persuasive historical and legal analysis (Bell, 1979, 1980, 1989).

Educational research benefited from Bell's work in the areas of educational policy analysis, school finance, desegregation, school choice, college admissions and recruitment (Bell, 1979, 1980, 1989; Clune, 1994; Ladson-Billings & Tate, 1995).

As Derrick Bell laid foundations to legal understanding of the racial patterns in the United States, other scholars added to the development of the CRT. Richard Delgado (2012) argued that the minority voice hasn't been heard in the official historical accounts, that "naming one's own reality" (p. 41) represents a way of dealing with oppression, and that counter-narratives serve as a powerful means to changing mindsets (Delgado, 1987, 1989, 1990; Delgado & Stefancic, 1989). There is a void in educational research about experiences from the perspective of students of color. CRT scholarship provides opportunity to be heard to those whose voices have been silenced by the dominant culture. Kimberle Crenshaw, who focused in her studies on women of color, introduced the concept of intersectionality as a framework for racial studies (Crenshaw, 1988, 1989, 1994). Intersectionality means examining the combinations of race, sex, national origin, and other personal characteristics, and how they play out in various settings (Delgado, 2012). Each of these categories can be a factor that contributes to a person's disadvantage. Crenshaw (1993) posed the following question to explain the purpose of intersectionality in her own studies: "How does the fact that women of color are simultaneously situated within at least two groups that are subjected to broad societal subordination bear upon problems traditionally viewed a monocausal – that is, gender discrimination or race discrimination" (Crenshaw, 1993, p 114).

Mathematics Education

Critical Race Theory appears in mathematics education research through issues of providing equity in access to quality education, developing within learners a concept of political awareness, being able to see humanity behind the data and numbers, using mathematics as a tool for exposing and analyzing the injustices in society, and motivating individual to action (Frankenstein, 1989, 1990, 1995, 2009; Gustein, 2003, 2006; Skovsmose, 1994, 2004). The standards reforms of the last four decades created if not an understanding, then at least an awareness of the “achievement gap” in mathematics between the minority students and their white counter-parts. Hardly any annual meeting of organizations such as the National Council of Teachers of Mathematics, Association of Mathematics Teacher Educators or National Council of Supervisors of Mathematics goes without sessions on promoting increased participation and achievement of students who have historically been marginalized by the school system (Gutierrez, 2014). In writing about standards and equity, Alan Schoenfeld, who is recognized as one of the leaders in the field of mathematics education, stated that “mathematical literacy should be a goal for all students” (2002, p. 13). Robert Moses even likened mathematics literacy to a new form of civil rights (Moses, 2001). Mathematics has been seen as a venue for social mobility and increasing one’s competitiveness in a labor market (Adelman, 2006; Crosnoe, 2010; Rose, 2004). Researchers have argued that the impact of math course-taking on students’ post-secondary experience exhibits itself through higher academic knowledge and better critical reasoning skills (Gaertner, Kim, DesJardins & McClarty, 2014). By taking more advanced courses, students signal to college admission officers that they are capable of challenging themselves and therefore would be more likely

successful in college (Attewell, 2008; Klopfenstein, 2004; Spence, 2002). Other researchers have found that taking AP or IB courses and earning passing score on the AP/IB exams has become almost a prerequisite to gaining entry into highly selective universities (Conger, 2009). Gaertner et al., studied the impact of higher level mathematics on career and college outcomes and found that Algebra II completion was generally a stronger determinant of college success than career success.

Equity in mathematics education remains elusive after almost three decades of the standards reforms (Martin, 2003). Moses and Cobb (2001) examined the high level of mathematical illiteracy in school mathematics and joined by other scholars argued that access to mathematics is a civil rights issue (Moses & Cobb, 2001; Malloy, 2002; Skovsmose & Valero, 2001; Tate & Rousseau, 2002) and that mathematics literacy is deemed the key to participation in a technology-based, capitalist economy (D'Ambrosio, 1990; Frankenstein, 1995; Gustin, 2009; Skovsmose, 1994).

Many scholars, politicians and other social forces that form public opinion consider mathematics and mathematics education as neutral and value free (Ernest, 1991). However, many critical scholars argue that mathematics education in the United States is implicated in the production and reproduction of racial ideologies, hierarchies and identities, and as such mimic the racial structures of society at large (Martin, 2009b, 2009c, 2010, 2011; Martin & Gholson, 2012). As long as accountability policies aim at increasing student achievement, but using comparisons between demographic groups to measure results, there will not be equity in education. Jordan (2010) argues that contemporary definition of equity is not about providing the same education to all children, or even educating them to the same high standards, but rather providing

equitable outcomes that would enable social mobility for all. Without policies, mechanisms and organizational structures that would work toward the goal of equitable outcomes, the effectively maintained inequality in education (Lucas, 2001) will remain unchanged.

Effectively maintained inequality states that socioeconomically advantaged actors secure for themselves and their children some degree of advantage wherever advantages are commonly possible. It also implies that for levels of education that are universal, competition will occur around the type of education attained (Lucas, 2001). For example, high school completion was reserved for the more affluent socio-economic groups in the first half of the 20th century. As K-12 education became widely available and attainable (i.e. common advantage), the socioeconomically advantaged parents began to focus on other features of schooling: advanced level classes, access to technology, college acceptance rates, etc. This stratification perpetuates as the schools become more uniform and more similar to each other. When college access becomes a common advantage, the socioeconomically advantaged look into the type of colleges their children could be accepted. The NCLB aimed at reducing the disparities in the quality of education available to upper and lower socio-economic classes by tying school accreditation to students' achievement. However, the socioeconomically advantaged use the data provided by NCLB mandated testing to selectively support schools and to maintain their advantaged position and therefore inequality in education. In Critical Race Theory terms, "effectively maintained inequality" acts as yet another support mechanism to keeping the advantages of being white and all things related to whiteness (Lucas, 1999, 2001, 2007).

CHAPTER 3: METHODOLOGY

This descriptive longitudinal study examined trends in high school mathematics enrollment and achievement among high school students in St. Louis city and county with specific focus on four major racial groups (Asian, Black, Hispanic and White) and gender from 2000 to 2014 using publicly available data from the U.S. Department of Education Office of Civil Rights, National Center for Educational Statistics, College Board, Missouri Department of Elementary and Secondary Education and ACT. The study also compared students' achievement trends in St. Louis area high schools to the results on the national level. Achievement trends were further stratified by the racial composition of the school to allow for a more in-depth analysis.

Longitudinal trend analysis was selected because it allowed for selected factors (test scores, number of students enrolled in a course) to be studied over time, maintained clarity of focus and made possible prediction and projections on the basis of identified variables. However, the selected research design had a potential to neglect the influence of unpredicted factors, past and future, and therefore not always presented the accurate picture of the events.

Data and Measures

To investigate trends in high school mathematics achievement on the national level, data was obtained from the National Assessment of Education Progress (NAEP) conducted by the U.S. Department of Education. The NAEP is a series of cross-sectional studies initially implemented in 1969 to assess the educational

achievement of U.S. students at grades 4, 8, and 12 in various academic subjects, including reading and mathematics. The assessment is based on frameworks developed by the National Assessment Governing Board (NAGB). Items include multiple-choice and constructed-response. The assessments results are reported as scale scores and on proficiency levels (basic, proficient and advanced). Scores are reported for the nation, participating states, and for subgroups of population (race/ethnicity, gender, students with disabilities). Prior to NCLB (from 1990 to 2001), individual states participation in NAEP assessments was voluntary. In 2002, under one of the provisions of the NCLB, all states were required to participate in the NAEP.

Student achievement data on the state level was obtained from the Missouri Department of Elementary and Secondary Education (DESE). The current Missouri Assessment Program (MAP) took roots in 1993, when the legislature passed the Outstanding Schools Act (Senate Bill 380). The law required the Missouri State Board of Education to adopt challenging academic performance standards that defined the skills and competencies necessary for students to successfully advance through the public school system, prepare for post-secondary education and the workplace, and participate as citizens in a democratic society. The Missouri State Board of Education formally adopted the academic standards known as the Show-Me Standards in January 1996. The first MAP assessments were administered on a voluntary basis in 1998 to students in grades 3, 7 and 10. To comply with the requirements of the NCLB, Missouri's assessment program incorporated Mathematics and Communication Arts assessments at all elementary and middle

school grade levels (grades three through eight) and one at a high school grade level, called End-of-Course exam (EOC). As a result, new grade-level assessments were developed for both content areas. These assessments, called MAP for grades three through eight and EOC in high school, were administered for the first time in Spring 2007. MAP included Algebra, English II, Science and Government EOCs. Student results were reported as scale scores as well as on achievement levels (below basic, basic, proficient and advanced). Publicly available data was also differentiated by race/ethnicity, learning disabilities, English Language Learners, duration in school, gender and giftedness. The results were reported on a building and district level. DESE data was used to examine trends in high school mathematics achievement on the state and school level.

Founded in 1959, the American College Testing Program (ACT) is now one of the largest college readiness non-profit organizations. In 2014, 57% of the students applying to college took ACT assessments. ACT test measures students' knowledge in four main areas: English, reading, mathematics and science. Each year, ACT publishes a "Conditions of College and Career Readiness Report" with average national scores, trends, college choices and course-taking patterns. The reports are also available for each state. The state data is reported as state average scores received on the four subject areas, and is disaggregated by race/ethnicity and gender. Students' results are also reported as College Readiness Benchmark. College Readiness Benchmarks are scores on the ACT subject area tests that would give students a 50% chance of obtaining a B or higher and about 75% chance of obtaining a C or higher in a corresponding college-level course. For mathematics subject test, a

score of 22 indicated that a student is ready for successful completion of College Algebra.

To investigate trends in access to mathematics, students' ACT participation numbers as reported by the ACT were used. Average ACT scores on mathematics subtest and the percent of students meeting College Readiness Benchmarks were used to create trends in mathematics achievement. This three-way combination of data was designed to provide another vantage point for achievement for students of color.

College Board is another mission driven not-for-profit organization that provides students with a wide range of college preparation experience through test preparation, testing services and Advanced Placement (AP) courses in high school. The AP program is often used as an indicator of access to higher-level and more rigorous courses because it allows students to take college-level classes while still in high school and earn college credit. Students take AP exams and receive a score between 1 and 5; a score of 3 is considered the benchmark for college readiness. Each year, the College Board publishes the "AP Report to the Nation" where one can find data on the number of AP exams taken by students broken down by subject, race/ethnicity, average AP scores, and the percent of students meeting college readiness benchmarks. State-specific reports contain similar data on participation, number of exams, scores and how they are broken down by race/ethnicity. The data provided by the College Boards was available for the period between 1994 and 2014. This data was most useful in examining the trends in access to higher-level mathematics classes and evaluating the level of students' college readiness.

Two main sources provided students' course enrollment data. The Office of Civil Rights (OCR) at the U. S. Department of Education surveyed the nation's public elementary and secondary schools since 1968. The survey was first known as the OCR Elementary and Secondary Schools Survey; in 2004, it was renamed to the Civil Rights Data Collection. This bi-annual survey provides information about enrollment of students in public schools disaggregated by race/ethnicity, sex and disability. In recent surveys, the sample includes approximately 6,000 districts and 60,000 schools. To be included in the sample, districts had to have more than 25,000 students in states with more than 25 public school districts. For states with 25 or fewer districts, all were included in the sample. The latest survey results were available for 2011-2012. The summary of data sources is outlined in Table 3.1

Table 3.1
Summary of data sources and trend variables.

Trend Variables	Level of Analysis		
	National	State	Local (District or School)
12 th grade mathematics scores	NAEP	NAEP	
Algebra End-of-Course scores		DESE	DESE
ACT scores on mathematics	ACT	ACT	DESE
Course Enrollment	OCR	OCR	OCR
AP scores	College Board	College Board	College Board

Comparison of NAEP and Missouri State Assessments

State assessments are not only mandated by the NCLB, they also serve as a main tool for evaluating the performance of educational institutions and for making policy decisions. In order to evaluate the state progress toward increasing students' achievement and validate state test results, NCLB specified NAEP as an assessment of choice. Several comparisons of NAEP and state performance results demonstrated a wide range of discrepancies in what is considered proficient (Bandeira de Mello, 2015; Klein, 2000; Linn, 2002). The latest report, the "Mapping State Proficiency Standards Onto NAEP Scales", from the U.S. Department of Education suggest that only three states, New York, Texas and North Carolina have proficiency levels in 4th and 8th grade mathematics and reading that fall in line with NAEP (Bandeira de Mello, 2015). Missouri students scoring 243 points on mathematics assessment in 4th grade and 292 points in 8th grade are considered proficient, while students taking 4th grade mathematics in NAEP need to score 250 in 4th grade and 300 in 8th to be considered proficient. Missouri's proficiency scores fell within 2 standard deviations of the average NAEP scores. Although the report did not include correlations for 12th grade assessments, it provided a framework necessary to map Missouri proficiency standards for Algebra End of Course to NAEP 12th grade mathematics assessment. Review of technical reports revealed that both assessments had similar content frameworks and distribution of items (*2005 National assessment of Educational Progress Mathematics Assessment framework.*, 2005; *Mathematics framework for the 1996 and 2000 National Assessment of Educational Progress.*, 1994; *Mathematics*

framework for the 2013 National Assessment of Educational Progress, 2012). The findings are summarized in Table 3.2.

Table 3.2

Distribution of items on 12th grade NAEP and Missouri state assessment (reported in percent).

Content Area	Content Distribution	
	NAEP	Missouri MAP
Number Properties and Operations	10 – 20	19 - 23
Measurement and Geometry	30 – 35	0 - 21
Data Analysis, Statistics and Probability	20 – 25	16 - 23
Algebra	25 – 35	51 - 54

Source: U.S. Department of Education, National Assessment Governing Board, Missouri Department of Elementary and Secondary Education.

Examination of the scale scores used on NAEP and Missouri assessments revealed wide variations in score ranges. Prior to 2008, Missouri mathematics assessments used a 0 – 1000 scale and 0 – 250 thereafter. NAEP did not assess 12th graders before 2000, and its scoring scale changed from 0 – 500 to 0 – 300 in 2005. Scale scores range were the closest to each other on state and national assessments after 2008 when Missouri switched to Algebra End of Course exams (100 – 250 for state and 100 – 300 for national). Missouri assessments sorted students' performance into the following categories: "below basic", "basic", "nearing proficient", "proficient", and "advanced". NAEP had only three: "basic", "proficient" and "advanced". Sporadic data was also available on students' raw scores, such as the number of items answered correctly. Since reconciliation and alignment of the scale scores was not feasible, another approach by converting each scale score to a percent

was adopted in comparing proficiency levels. The results revealed that Missouri had higher percent on scale scores required for proficient classification of students' achievement than NAEP.

Table 3.3 *Conversions of Missouri MAP and NAEP Scores from Scale to Percent, 1999 – 2013.*

	Scale to Percent Conversion			
	Below Basic	Basic	Proficient	Advanced
1999				
NAEP	NA	288 (58%)	336 (67%)	367 (73%)
Missouri	581 (59%)	593 (61%)	655 (67%)	707 (72%)
2005				
NAEP	NA	141 (47%)	176 (59%)	216 (72%)
Missouri	581 (59%)	701 (72%)	784 (80%)	832 (85%)
2009				
NAEP	NA	141 (47%)	176 (59%)	216 (72%)
Missouri	< 177 (< 70%)	177 (70%)	200 (80%)	225 (90%)
2013				
NAEP	NA	141 (47%)	176 (59%)	216 (72%)
Missouri	< 190 (<76%)	190 (76%)	203 (81%)	226 (90%)

Source: U.S. Department of Education, National Assessment of Educational Progress, Missouri Department of Elementary and Secondary Education.

Sampling Procedures

In order to investigate trends in high school mathematics achievement gap, 48 high schools were selected through purposive sampling from the population of 613 Missouri high schools in 520 districts. The selection criteria included

1. Schools with non-white students representing less than 25%, 26 – 50% and over 50% of total enrollment.
2. Schools located in St. Louis City and surrounding metropolitan area.

There were 24 school districts located St. Louis city and the county. Two of them, St. Louis Special District and Valley Park, were excluded from the sample. St.

Louis Special District provided special education services to schools in St. Louis County, so that students' achievement results were reported at individual district levels. Only a small portion of Valley Park district was located in St. Louis County on the far southeast corner. Therefore, the sample contained 22 school districts with 45 high schools to be included in the study. For a complete list see Table A5 in the Appendix.

Data Collection

All data used in the study was publicly available and was downloaded from the U.S. Department of Education (www.ed.gov), ACT (www.act.org/research/), College Board (www.research.collegeboard.org) and the Missouri Department of Elementary and Secondary Education (www.dese.mo.gov) websites.

Data Analysis

Data available from the four sources mentioned above varied by frequency, level of reporting and by disaggregation methods. The Office of Civil Rights collected data from schools every two years and reported its findings by district, school, race/ethnicity and gender. The ACT provides yearly publications of students' achievement data, reports it on a national and state level, and disaggregates by race/ethnicity and gender. College Board's reports are similar to the ACT reports in frequency, level of reporting and data disaggregation. Table 3.4 shows frequency, level of reporting and data disaggregation.

Table 3.4
Characteristics of data obtained from national and state sources and used in the present research.

Source (Frequency)	What is Reported	Lowest Level	Data disaggregation by		How Achievement is Reported	
			<u>Gender</u>	<u>Race</u>	<u>Scale Score</u>	<u>Proficiency</u>
ACT (Yearly)	Avg. Scores	State	Yes	Yes	Yes	No
College Board (Yearly)	Avg. Scores	State	Yes	Yes	Yes	No
DESE (Yearly)	EOC Scores	School	Yes	Yes	No	Yes
ACT (Yearly)	Avg. ACT Scores	School	No	No	Yes	No
NAEP (Bi-Annually)	Avg. Math Scores	National	Yes	Yes	Yes	Yes
OCR (Bi-Annually)	Enrollment	School	Yes	Yes	No	No

To answer the question of how enrollment in high school advanced level mathematics classes changed for students of color data from two Office of Civil Rights reports (2009 and 2011) was used to create a trend line. Even though, the OCR reports dated back to as early as 1968, Advanced Placement and course enrollment information appeared in the database for the first time in 2009. Another source, College Board provided information on the number of students taking AP exams each year. This data provided indirect evidence of students' enrollment in advanced mathematics classes. Although, the College Board does not require students' to take the class in order to be eligible for the exam, the level and complexity of mathematics skills tested provided for extremely high probability of enrollment.

The majority of data analysis addressed the questions of how the achievement in mathematics changed based on race and gender (research question 2). After the data was downloaded, a table was created for each data source. Each table included year, number of students disaggregated by race, gender, school category (low-, medium-, high-minority), average score, and percent of students in proficient category. From this data trend lines were created for average scores, participation rate, proficiency rates, and college readiness rates to present different vantage points of students' achievement disaggregated by race and gender. In several cases bar graphs were used because they made it easier to display and explain data. Whenever possible, the earliest available data was used with data points arranged in 4-year intervals. It was noted that 4-year interval provided for the easiest and clearest view of charts and figures. For a complete set of data tables used in this study, please refer to the Appendix.

Limitations

The major limitation of this study is the descriptive nature of the research. While the study produced multiple trends in achievement, and course enrollment, it is possible that the picture presented remains incomplete. Some of the increases in achievement had a potential to be artificially high due to small number of students involved. For example, if only four students took AP Calculus exam and all of them received a score of 3 or higher, the graph would show a 100% proficiency rate for that year. In order to avoid such misrepresentation, achievement data for fewer than 10 students was not included in the analysis.

Another weakness of the study was caused by the inconsistency of data available. Some of the achievement trends covered a period of 15 years, and some of the trends were only available for three years. Data reporting format and availability varied between and within sources. ACT started reporting average composite and subject state scores in 1994, student participation rates by race in 2002 and by gender in 2005. Building level ACT scores reported by DESE date back to 2005 and lack disaggregation by gender or race. Thus, some important insights into individual school performance were not available for this research. Timespan of an individual achievement trend can greatly influence how the achievement results are evaluated. Shorter trends may show minimal or no changes; longer trends present a more descriptive picture. Any achievement trends with less than 10 years of data present a potential for future research development.

Due to the particular focus of the study on the achievement of students of color, purposeful sampling was the most suitable. Other researchers may determine that selection criteria would not fit their needs. Therefore, the results produced by this study may not be transferable to other research.

CHAPTER 4: FINDINGS

As stated in Chapter 1, the study examined what changes occurred in high school enrollment in advanced level of mathematics classes for students of color in the St. Louis metropolitan area over the past 15 years. The study also looked at high school mathematics achievement trends among four major racial groups (Asian, Black, Hispanic and White) and by gender. This chapter is organized in terms of the two specific research questions posed in Chapter 1.

1. How did the enrollment in high school advanced level mathematics classes changed for students of color?
2. What are the changes in the achievement among four racial groups (Asian, Black, Hispanic and White) and between males and females as evidenced by the scores on NAEP, AP Exams and ACT tests?

After a brief description of the sample used in this study, the chapter contains a report on students' enrollment trends in advanced mathematics courses divided into Advanced Placement classes and advanced level mathematics classes. Enrollment trends are examined in two ways: program participation and inter-racial access gaps. The second part of this chapter discusses findings in mathematics achievement trends disaggregated by gender and race. Trends in Advanced Placement, ACT, NAEP and Missouri Assessment Program are discussed in three ways: program participation, achievement, and gaps in access and achievement.

Population Demographics

According to the U.S Census estimates, there were 6 million people living in Missouri in 2013. One million people resided in St. Louis County and 317,000 in St. Louis City. All three areas, St. Louis City, St. Louis County and the state of Missouri had similar percent of school-age children (20.3%, 22.5% and 23.1%). African-Americans accounted for 11.7% of the state population, 23.7% in the county and 47.9% in the city. Asians were almost the same for the city and the county, 3.1% and 3.8%, and 1.8% in the state. Hispanics comprised 3.7% of the city residents, 2.7% in the county and 2% in the state. The largest racial group was Whites, accounting for 46.4% in the city, 70.3% in the county, and 83.7% in the state. The most affluent area was St. Louis County, with median income of \$58,910 and 10.9% of residents living below poverty level. Missouri's median income was \$47,380 and 15.5% in poverty. St. Louis City wealth was the lowest, with median income of \$34,582 and 27.4% of people living below the poverty rate.

As Table 4.1 showed, the population demographics revealed a three-tiered pattern for non-white residents. Minorities comprised less than 25% of the state population, about 30% of the county's and over 50% of the city residents. Asian and Hispanic population was not significantly different between the city, county and the state. All three areas had a similar percent of school age children. The poverty rate in the city was twice as high as in the state and three times higher than in the county.

Table 4.1
Comparative Demographics of Population.

	St. Louis		Missouri
	City	County	
Population estimate, 2013	318,416	1,001,491	6,044,917
Race/Ethnicity, percent, 2010			
Asian	3.1%	3.8%	1.8%
Black ^a	47.9%	23.7%	11.7%
Hispanic ^b	3.7%	2.7%	2.0%
White	46.4%	70.3%	83.7%
Persons under 5 years, percent, 2010	6.7%	5.8%	6.2%
Persons under 18 years, percent, 2010	20.3%	22.5%	23.1%
Median household income, 2009 – 2013	\$34,582	\$58,910	\$47,380
Persons below poverty level, percent, 2009 – 2013	27.4%	10.9%	15.5%

Note. Statistical information was obtained from U.S. Census Bureau: State and County Quick Facts (retrieved on July 15, 2015).

^aCensus data are for persons having origins in any of the Black racial groups of Africa. It includes people who indicate their race as “Black, African American, or Negro”; or report entries such as African American, Kenyan, Nigerian, or Haitian. ^bCensus data are for all persons who classified themselves in one of the specific Spanish, Hispanic, or Latino categories listed on the Census 2010 questionnaire – “Mexican”, “Puerto Rican”, or “Cuban” – as well as those who indicate they are another Hispanic, Latino, or Spanish origin.

Sample Demographics

The sample included 45 public high schools in St. Louis city and county.

They were sorted into three groups based on the percent of students of color enrolled so that the sample represented the population. The “Low Minority” group had a minority enrollment of less than 25% and included 16 schools. The “Medium Minority” group had 8 schools with 25 – 50% of minority students. The final “High Minority” group, with over 51% minority enrollment, had 21 schools. Some districts had schools in adjacent groups (“Low” and “Medium”, or “Medium” and “High”).

No districts had schools in both “Low” and “High” groups. Because the “Medium Minority” group had less than 10 schools, I sorted schools into groups based on socio-economic status (SES) using percent of students receiving free and reduced lunch (FRL). The “Low FRL” group had 15 schools, the “Medium FRL” had 8, and the “High FRL” had 22. Sorting schools based on non-white enrollment or SES status produces almost identical results with only a few schools that changed their classification. One of the reasons why the demographics and socio-economic status are so interconnected in St. Louis area public schools can be found is the long history of public school segregation. In short, being poor in St. Louis area coincides with being Black. Selecting and sorting the sample for the study “illustrates how truly separate and unequal our society has become and how difficult it is for the educational system to change that.” (Wells & Crain, 1997, p. 3). For a complete list of public high schools included in the sample, please see Table A5 in Appendix.

Advanced Mathematics Enrollment Trends

Enrollment in Advanced Placement (AP) mathematics courses.

Trends in Advanced Placement mathematics are shown in Figures 4.1 – 4.4 and in Tables A1 and A3 (located in the Appendix). Students’ enrollment in AP mathematics increased across the racial lines. Black students experienced the greatest change in enrollment by increasing their numbers almost six-fold (568%). The second largest increase was demonstrated by Asian students; their numbers tripled (310%). White students showed 195% increase and Hispanic students gained access to AP. There were no Hispanic students enrolled in AP mathematics courses in 2000

in any of the 45 public high schools studied. By 2011, 50 Hispanic students took the courses.

Figure 4.1. Enrollment in AP mathematics courses in St. Louis Metropolitan area.

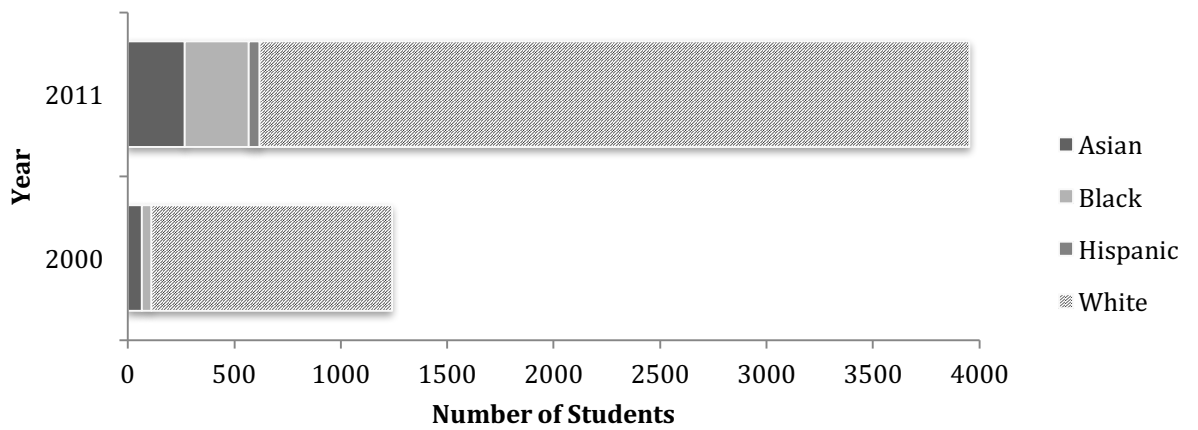
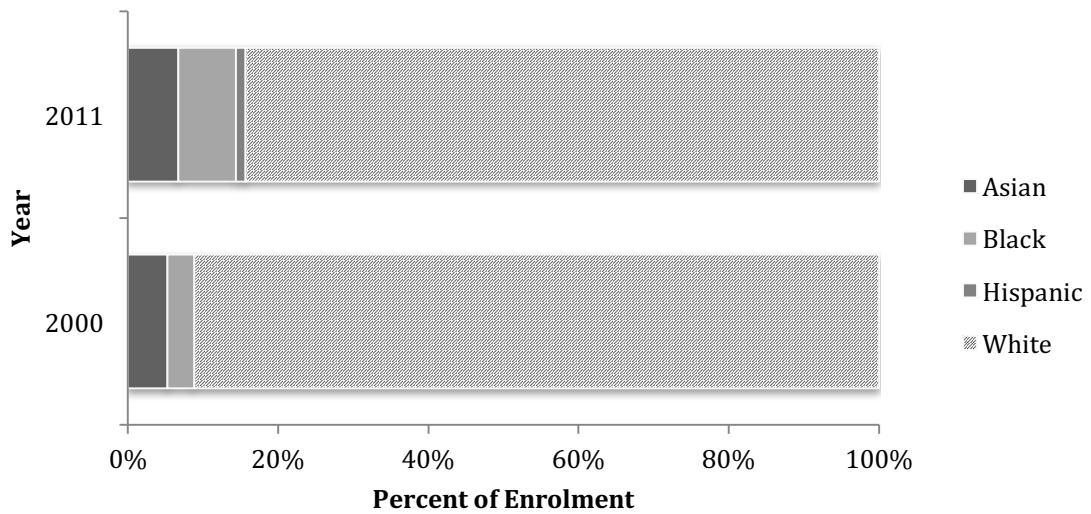


Figure 4.2. Rate of enrollment in AP mathematics courses in St. Louis metropolitan area by race.



Access to Advanced Placement.

Another way of looking at AP enrollment trends is to consider the degree of access to AP that each race experienced between 2000 and 2011. In order to do that, two statistics were compared: percent of each racial group's enrollment in school and how many students of each group were enrolled in AP classes (as percent of total school enrollment for that group). The resulting rate of enrollment is called access rate as it represents the likelihood that a student from a particular race would be enrolled in an AP mathematics class. Asian students experienced the highest access rate of 9% on average in all schools surveyed. Black students had an access rate of 2% or less regardless of school demographics. Even in schools where Black students represented the majority of student enrollment, only 1.2% of them were enrolled in AP mathematics courses (see Table A3).

Enrollment trends by type of school.

In 2000, there were no non-white students enrolled in AP math classes in the "Low Minority" high schools. By 2011, 112 Asian, 35 Black and 20 Hispanic students took AP classes in those schools. The biggest gain in enrollment was demonstrated by Asian students, who saw their share increase from 0% to 10%. Black students' enrollment changed from 0% to 3%, and Hispanics' from 0% to 2%. "Medium Minority" and "High Minority" schools had similar patterns of increased participation in all racial groups with two exceptions. In "High Minority" schools, Asian students had a negative trend in AP enrollment. Second exception happened in "High Minority" schools as well, where white students more than tripled their enrollment in AP mathematics and at the same time saw a 50% drop in their overall

school enrollment. As the NCLB called for the opportunity for all children to obtain a high-quality education, more students gained access to AP mathematics courses, yet the two groups that benefited the most from this increased access were the same groups that were already receiving the benefits of high quality education: white and Asian. For further details, please refer to Appendix (Table A1).

Figure 4.3. Enrollment in AP mathematics courses in St. Louis metropolitan area reported by type of school and race.

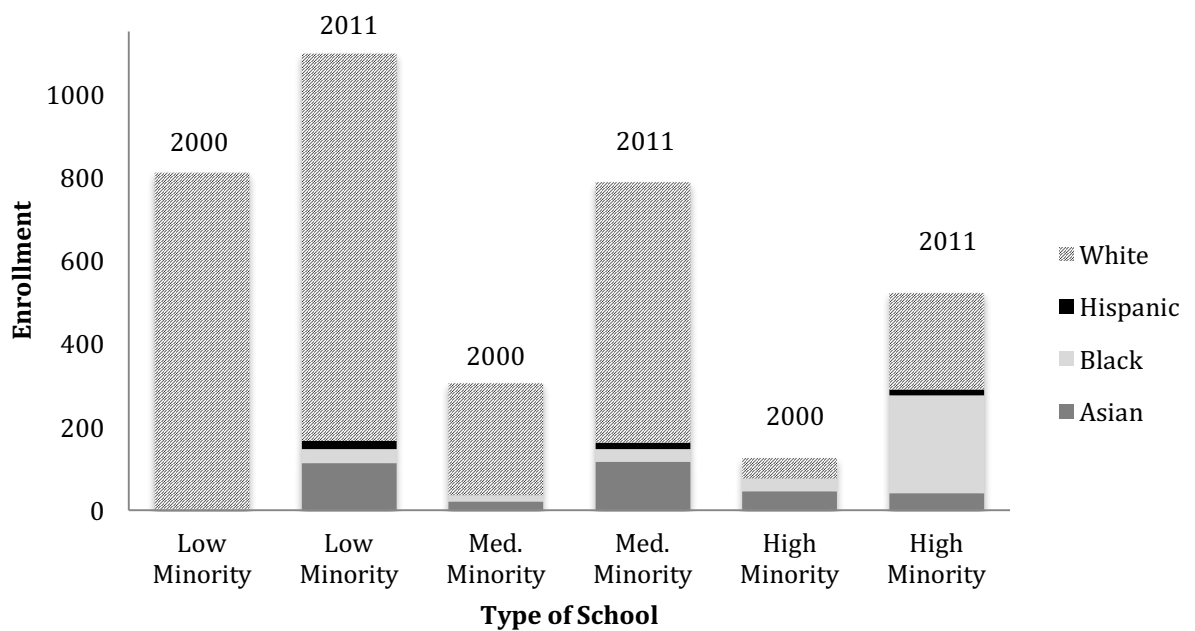
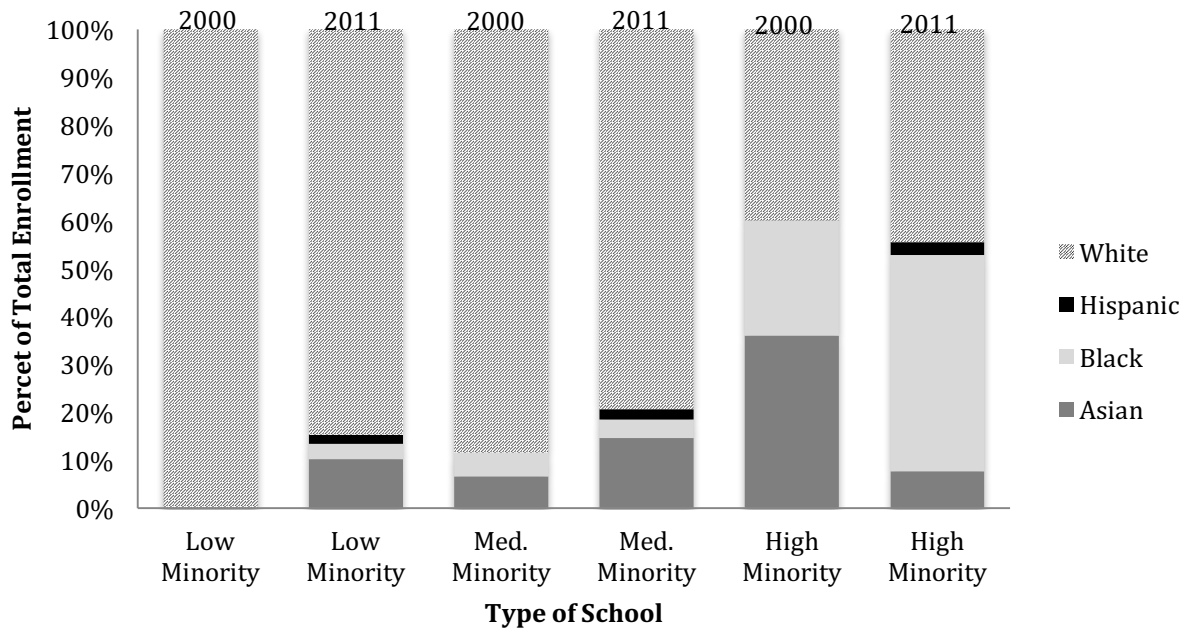


Figure 4.4. Rate of enrollment in AP mathematics courses in St. Louis metropolitan area by race and type of school.



Enrollment in advanced mathematics courses.

Trends in high school advanced mathematics courses enrollment are shown in Figures 4.5 – 4.8 and in Table A2 (see Appendix). Similar to the results in AP enrollment, more students enrolled in Advanced Mathematics courses in 2011 than in 2009 (the earliest detailed enrollment data available from the Office of Civil Rights Data Collection). Asian students' overall enrollment remained the same at 6% of all students enrolled in Advanced Mathematics courses. Black students made significant gains accounting for 25% of all enrolled, up from 19% in 2009. Hispanic students' enrollment numbers remained the same, and white students experienced a decrease in their share.

Figure 4.5. Enrollment in advanced mathematics courses in St. Louis metropolitan area by race.

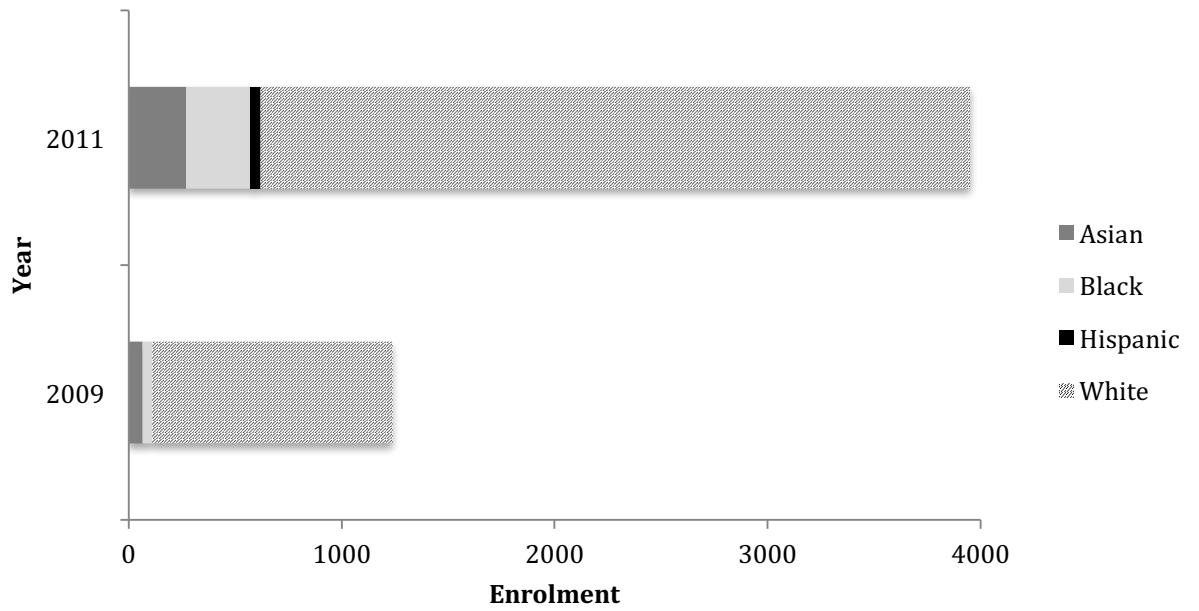
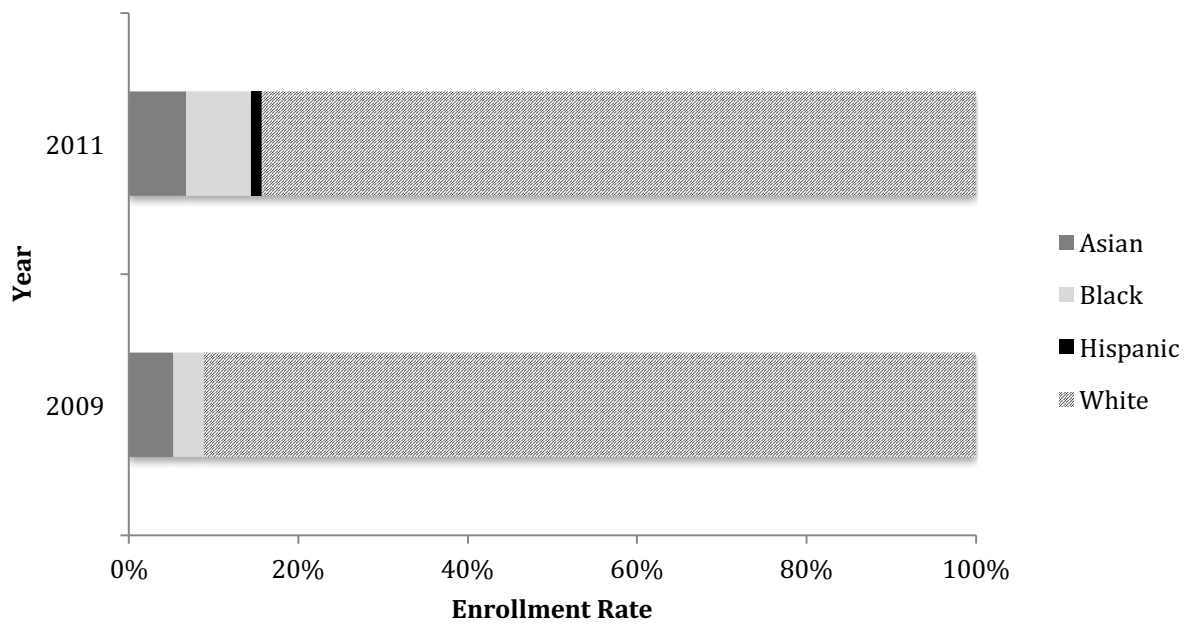


Figure 4.6. Enrollment distribution in advanced mathematics courses in St. Louis metropolitan area by race.



Enrollment trends by type of school.

Black students had the highest rate of increased in “Low Minority” schools, due mostly to the extremely low starting numbers. In 2009, only 65 Black students were enrolled in Advanced Mathematics courses in schools where they represented less than 25% of student body. By 2011, that number increased to 239. It is still extremely low when compared to 3, 257 white students taking Advanced Mathematics courses in the same type of schools. For Hispanic students, enrollment numbers remained unchanged. Instead, they experienced redistribution of enrollment. Hispanic students’ increased their presence in “Low Minority” schools from 40 to 72, an 85% increase and decreased in “High Minority” schools from 80 to 46, a 43% decrease. White students remained the largest group taking advanced mathematics courses. Their numbers increased everywhere except in “High Minority” schools, and their share remained above 70% in “Low” and “Medium Minority” schools. Similar to Hispanic students, White enrollment increased in “Low Minority” schools and decreased in “Medium” and “High Minority”.

Figure 4.7. Enrollment rate in advanced mathematics courses in St. Louis metropolitan area by school type.

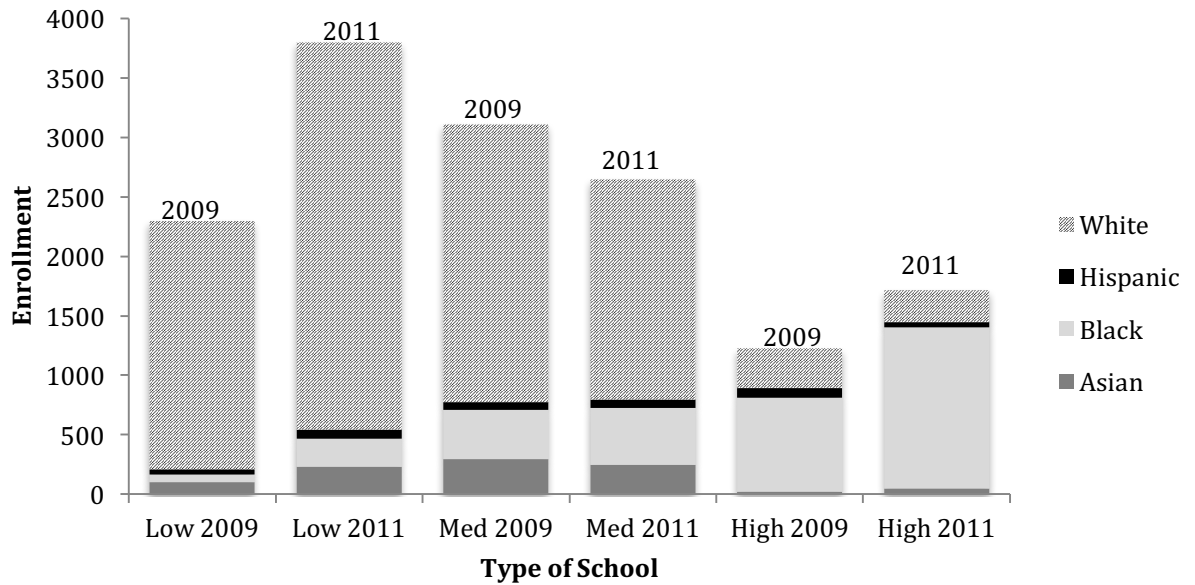
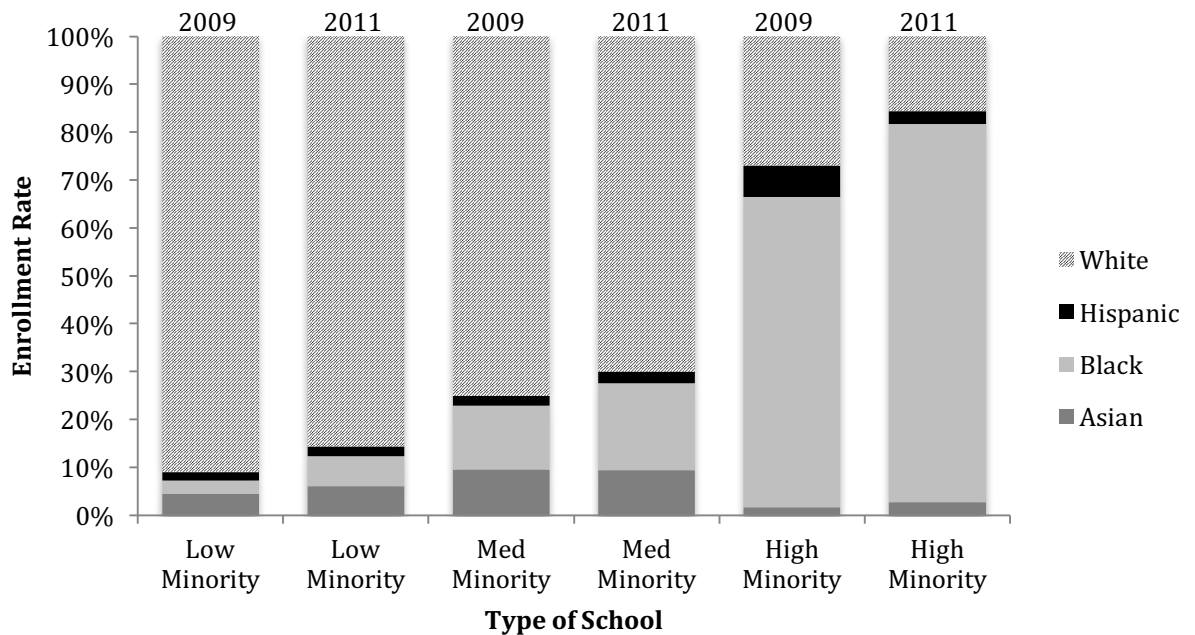


Figure 4.8. Enrollment rates in advanced mathematics courses in St. Louis metropolitan area by school type.



Access trends in advanced mathematics courses.

Examination of the level of access experienced by racial groups revealed a familiar picture. Access rates for each racial group were measured as percent of

students enrolled in advanced mathematics courses compared to their total enrollment in school. On average, an Asian student in St. Louis area public high school has at least 25% chance of taking an advanced mathematics course and as high as 43%. White and Hispanic students had similar rate of enrollment of 15% on average. Black students lagged behind other racial groups, with the lowest average access rate of 12%. The most alarming observation was that Black students had the highest chances (17%) of being in advanced mathematics courses in schools where they had the lowest percent of enrollment, namely in “Low Minority” schools. On the other hand, only 8% of Black students who attended “High Minority” schools took advanced mathematics courses, even though they represented 81% of school enrollment. For a complete set of figures, see Table A3 in Appendix.

High School Mathematics Achievement Trends by Race/Ethnicity and Gender

Advanced Placement

Trends in students’ participation, scores and college readiness on AP Calculus Exam are shown in Figures 4.9 and 4.10. Nationally and locally, all racial groups demonstrated increased program participation. From 2000 to 2014, the number of Asian students taking AP exams rose by 142% nationally and tripled in Missouri. The number of Black students almost doubled nationally and increased seven-fold in Missouri. Hispanic students took five times more AP exams nationally and seven times more in Missouri. White students had 79% increase nationally and 104% locally. Overall, twice as many students took AP Calculus exams in 2014 than in 2000 both nationally and locally. Despite having the largest increase in program participation from 2% to 6%, Black students remained under-represented among

those who took the AP Calculus exam. They accounted for 12% of Missouri population, but only for 6% among the exam-takers. In contrast, Asian and Hispanic students comprised 2% of the state residents, and 9% and 6% of exam-takers respectively. Asian students' share of exam-takers rose from 7% in 2000 to 9% in 2014, Black and Hispanic students' representation changed from 2% to 6%, and White students kept their majority despite a drop from 86% to 78%.

Gender participation showed some positive trends as well. From 2000 to 2014 the number of male students taking AP Calculus exam doubled nationally and locally, female students tripled nationally and more than doubled locally. Even though female students showed significant growth, the gender gap persisted. Sixty-two percent of all students who took the AP Calculus exam in 2000 were males. In 2014 males accounted for 51% of the exam-takers. Nationally, the gender gap narrowed from 24 points to 2, while in Missouri it widened from 6 to 8 points.

Figure 4.9. Missouri student participation trends in AP calculus exam 2000 - 2014 by race.

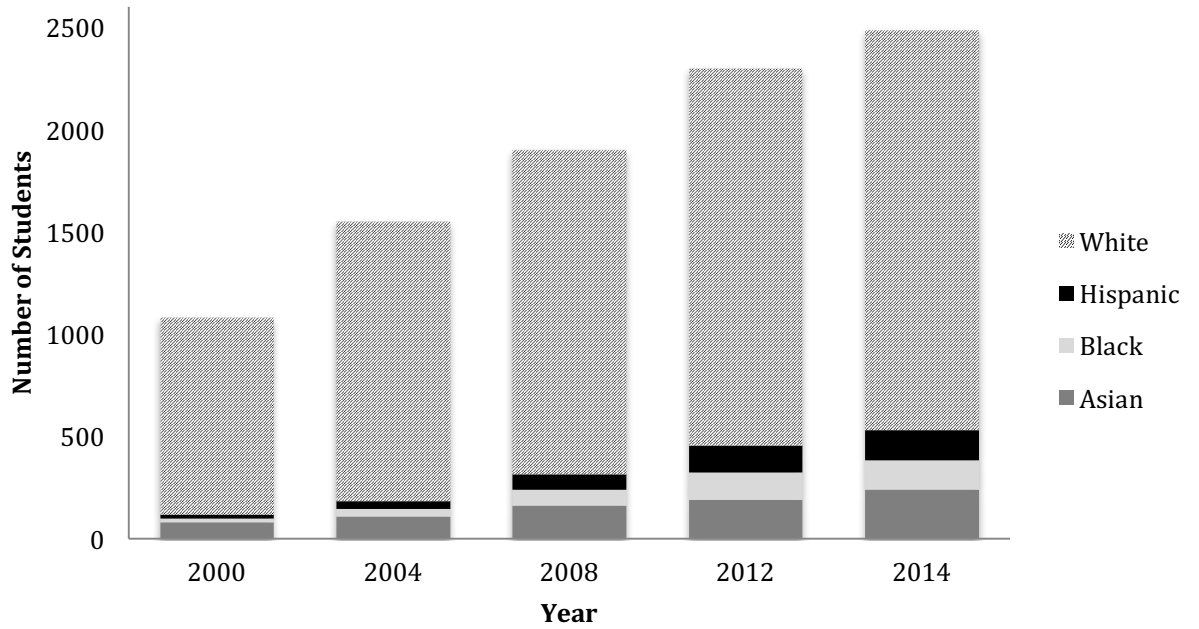
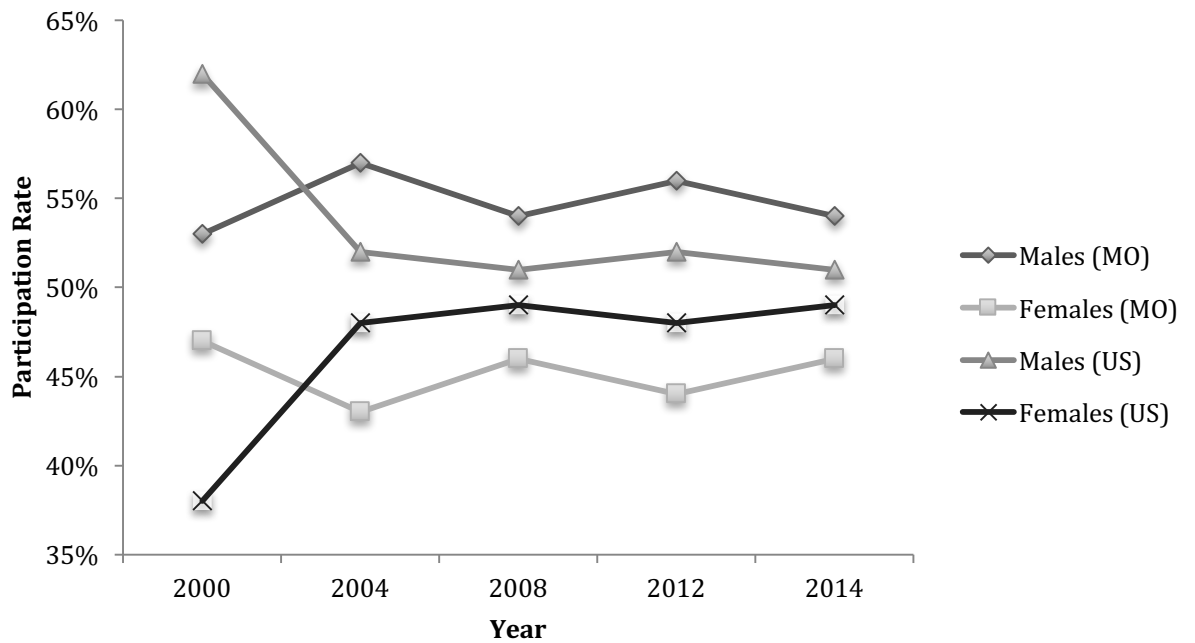
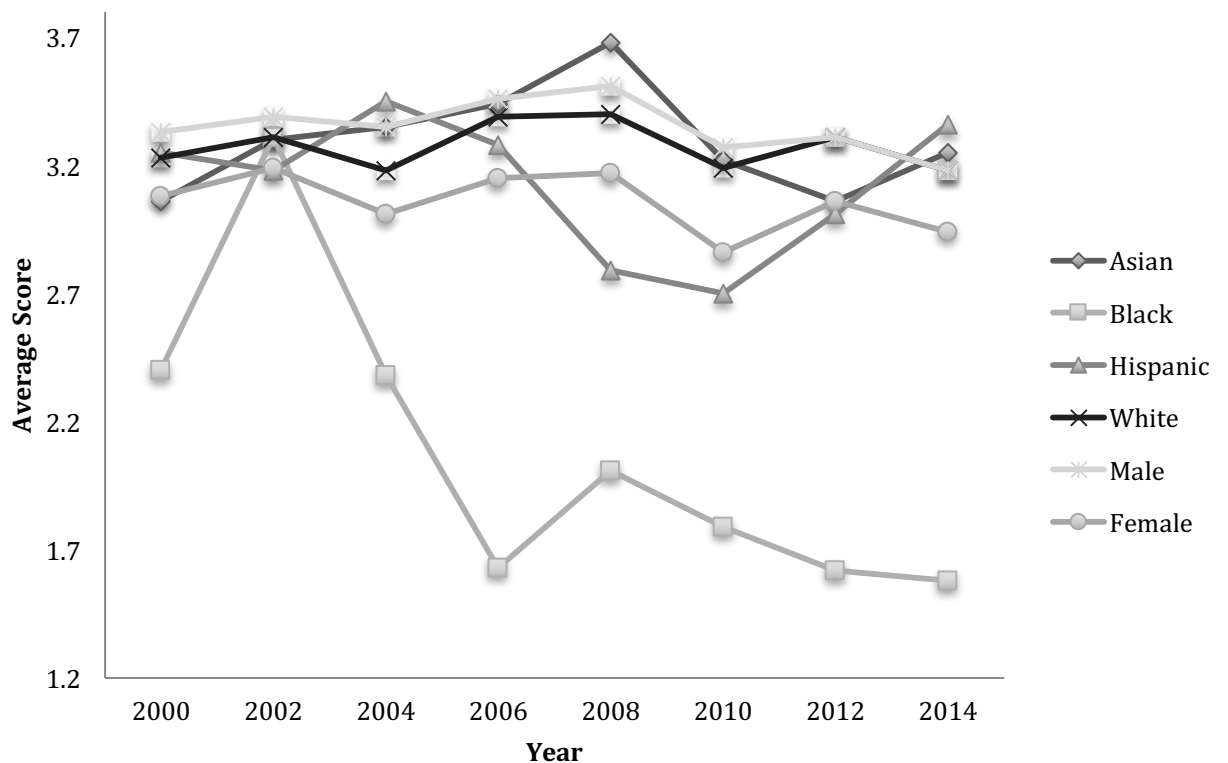


Figure 4.10. National and state trends in student participation rate on AP calculus exams by gender (2000 – 2014).



Students' average scores received on AP Calculus Exam showed mixed results. Nationally, the scores went down from 3.03 in 2000 to 2.92 in 2014 and from 3.21 to 3.07 locally. Only Asian students showed increase on a national level. In Missouri, Asian and Hispanic students demonstrated an increase in average scores, while Black and White students' scores decreased. Black students experienced the largest decrease from 2.4 in 2000 to 1.58 in 2014. As shown in Figure 4.11 male students in Missouri received higher scores than female students between 2000 and 2014. The same is true on a national level.

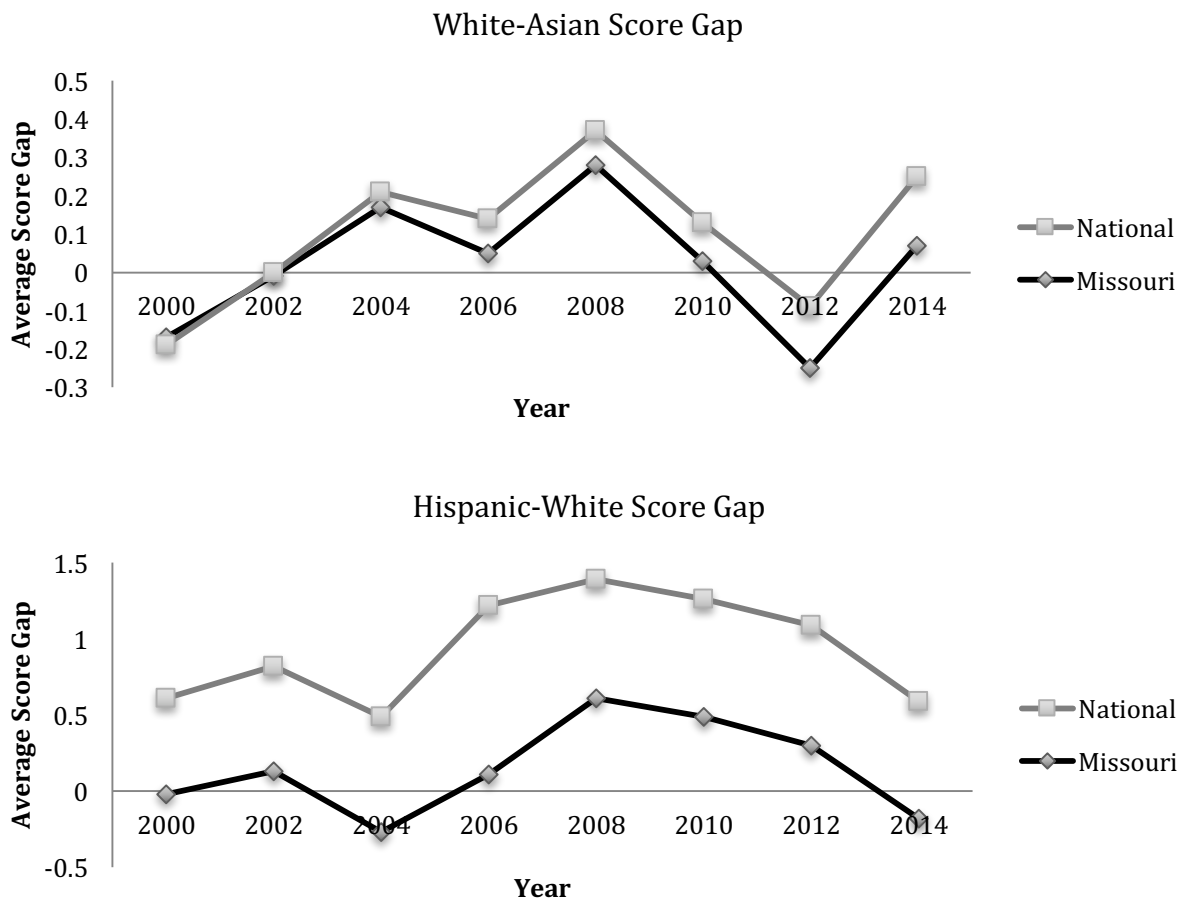
Figure 4.11. Average AP calculus scores received by Missouri students by race and gender (2000 – 2014).



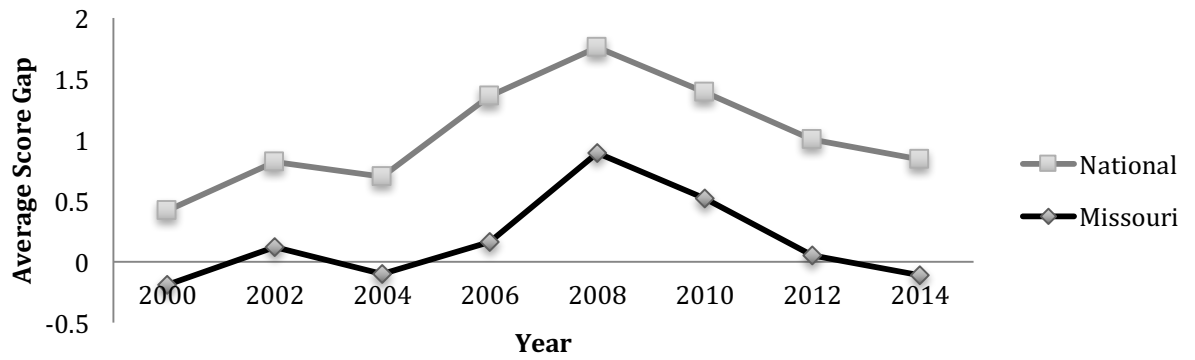
The racial achievement gap between average AP scores persisted for the time period studied. The trends in Missouri achievement gap largely mirrored national

patterns except for the Black-Hispanic and Black-Asian gap. As shown in Figure 4.12 the difference between average scores received by Hispanic and Black students increased from 0.85 in 2000 to 1.78 in 2014. Asian-Black average score gap rose from 0.66 to 1.67, and White-Black from 0.83 to 1.6. White students increased the gap in scores with Hispanics from 0.02 to 0.18 and reversed the trend with Asians from underperforming by 0.17 in 2000 to outperforming by 0.07 in 2014.

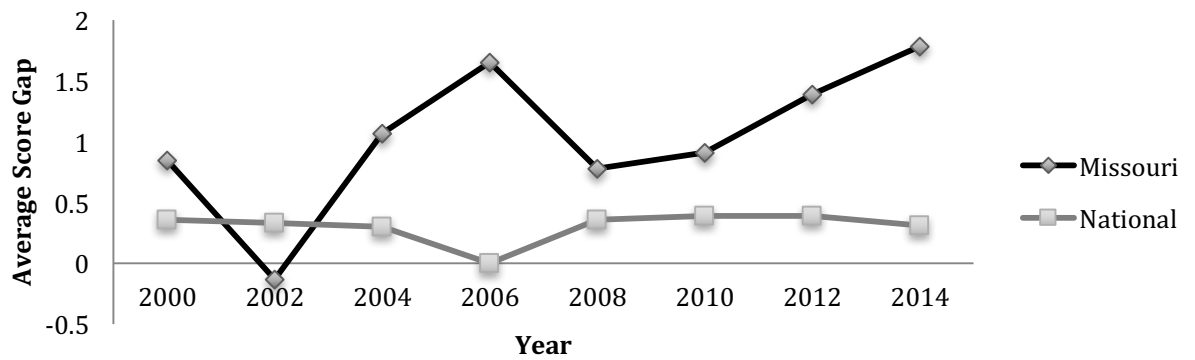
Figure 4.12. Missouri trends in achievement gap on AP calculus exam between racial groups and between genders (2000 – 2014).



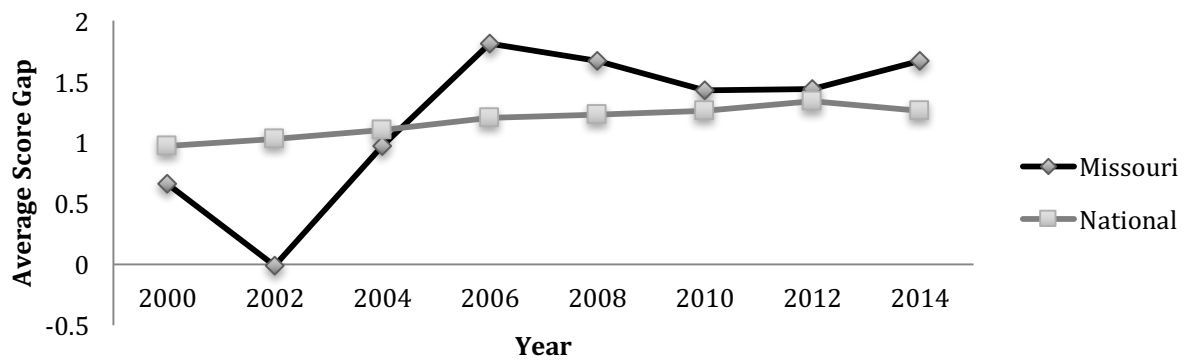
Hispanic-Asian Score Gap

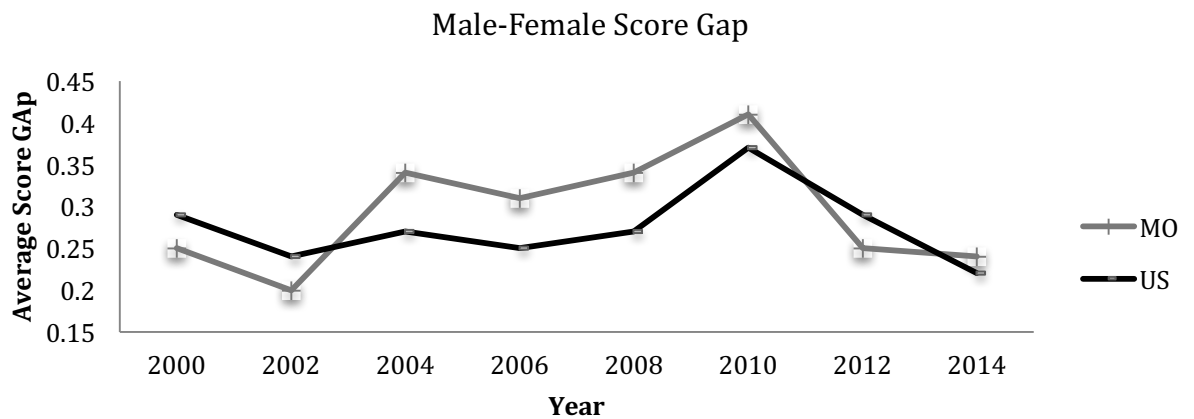
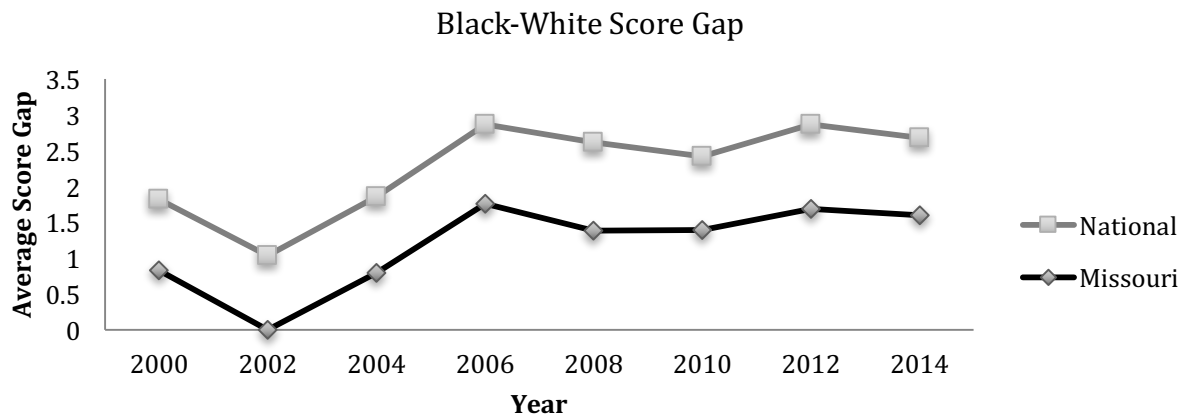


Black-Hispanic Score Gap



Black-Asian Score Gap





Any student who receives a score of 3 on an AP exam is considered to be ready for the college-level coursework. Therefore, a score of 3 is widely considered by college admission officers and educators alike to be a proficiency benchmark for AP exams. The final trend analysis examined the percentage of students who received scores of 3 or above on the AP Calculus exam. As the Figure 4.14 shows, college readiness rates for each of the racial group studied went down from 2000 to 2014. Unsurprisingly, White and Asian students remained the most prepared for college. The percent of Asian students scoring 3 or above on AP exams stayed practically unchanged (66% in 2000 and 67% in 2014). Seventy percent of White

students received a qualifying score in 2000 and 66% in 2014. The results for Black students were disappointing. The portion of Black student scoring 3 or above went from being low (45% in 2000) to an even lower number (21% in 2014). The results for Hispanic students were devastating. Hispanic students' results declined from 60% to 25% of them scoring proficient on the AP calculus exams.

Figure 4.13. Percent of Missouri students receiving qualifying scores on AP calculus exam by race (2000 – 2014).

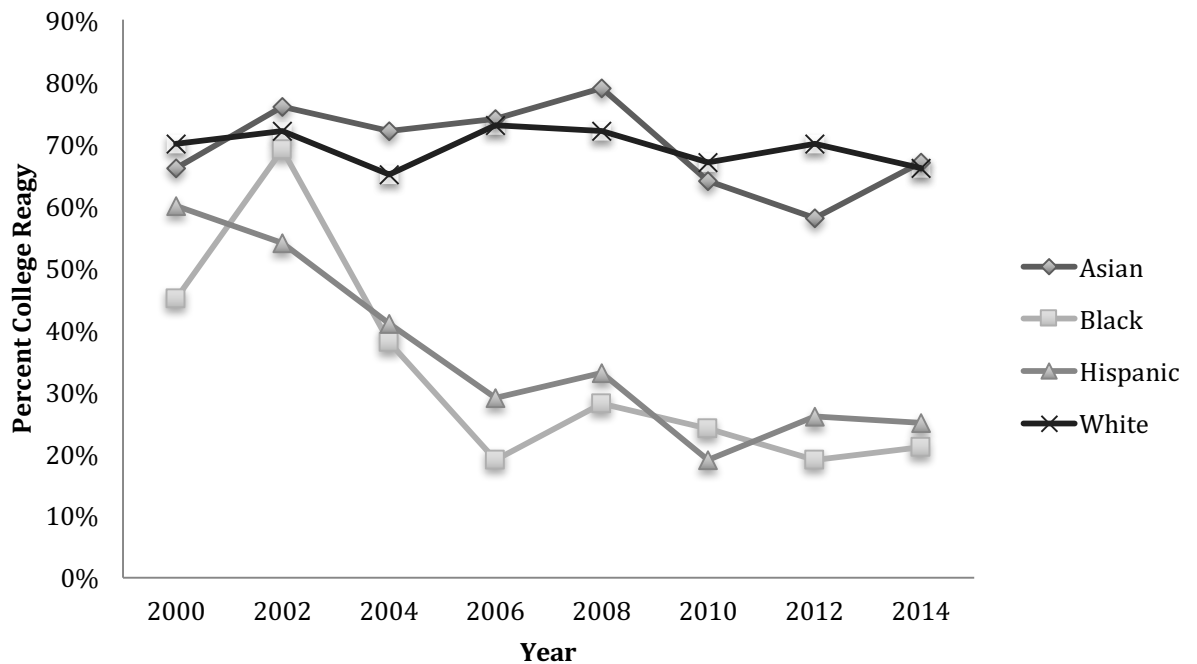
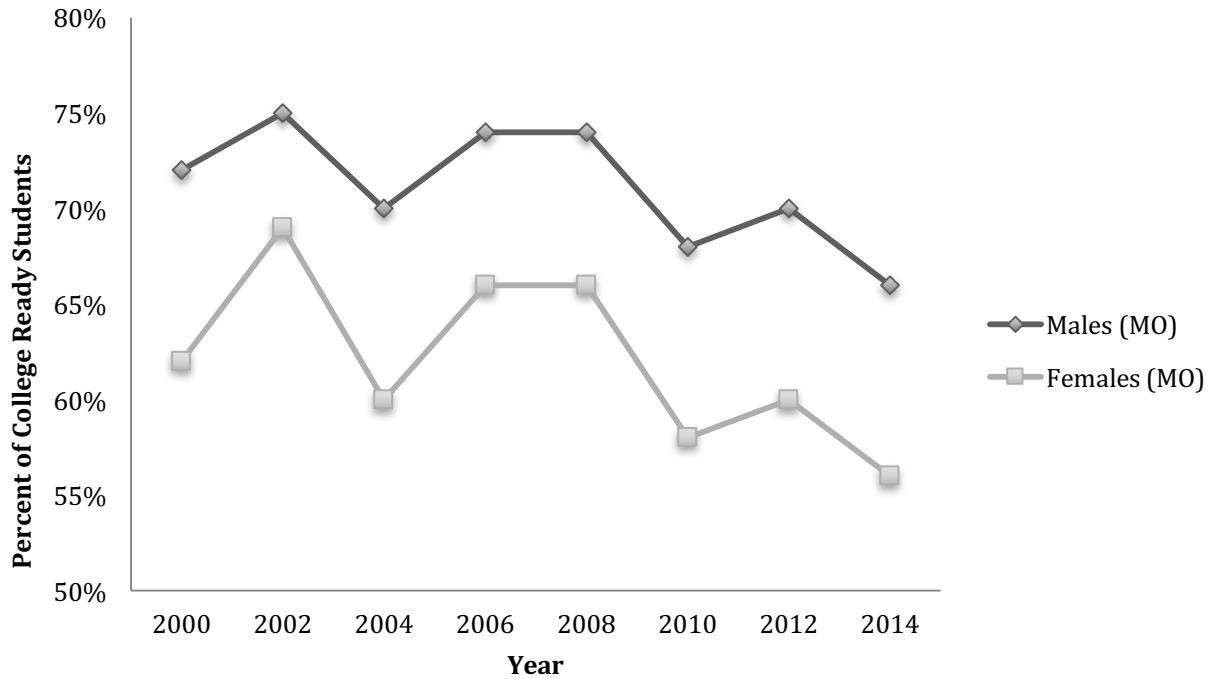


Figure 4.14. Percent of students in Missouri receiving scores of 3 and above on AP exams by gender (2000 – 2014).



ACT

More Missouri students took ACT in 2014 than in 2002. Hispanic students experienced the biggest growth, their numbers rose by 250%, Black test-takers increased by 63% and Asian by 48%. White students' participation remained stable with a modest growth of 5%. The racial breakdown of all Missouri ACT-takers was consistently close to the racial composition of the state population for the data available. In 2014, both datasets matched.

Figure 4.15. Student demographics of Missouri ACT takers (2002 – 2014).

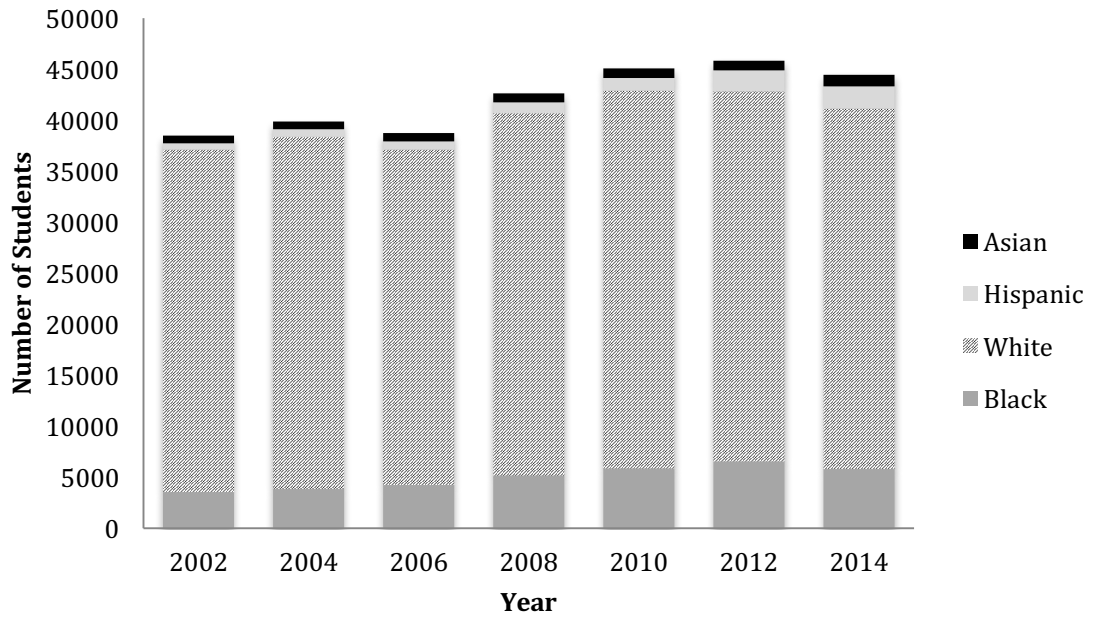
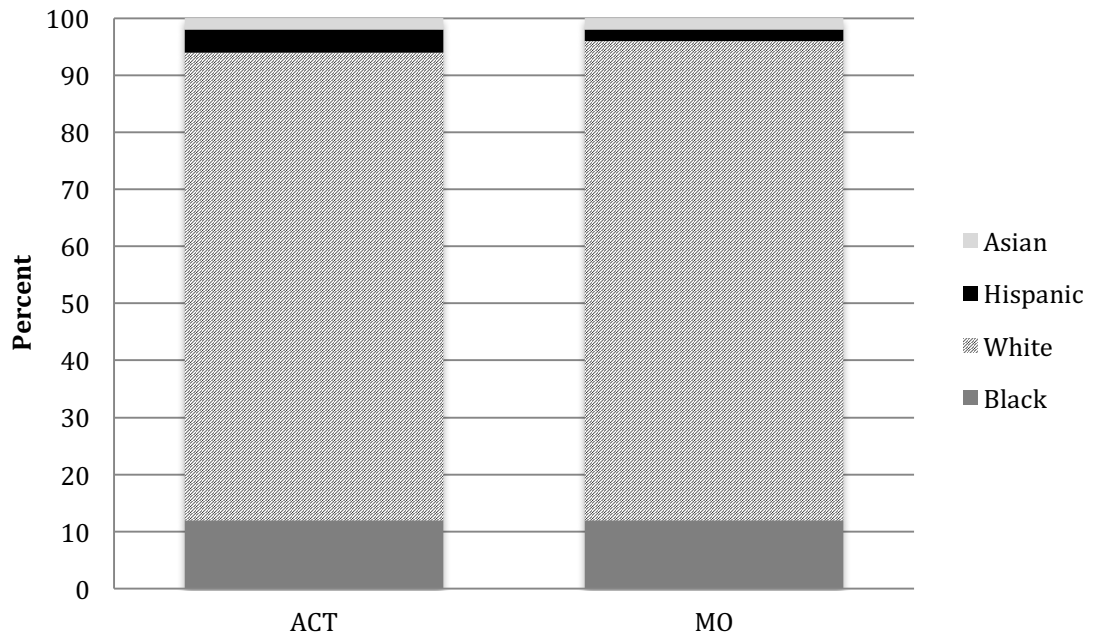
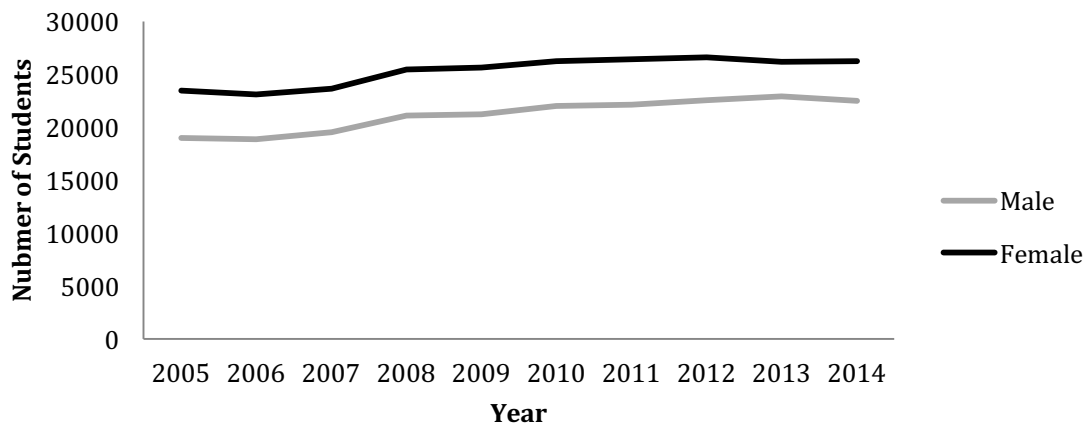


Figure 4.16. National and state comparison of students' demographics on ACT test, 2014.



Female students surpassed males in the number of test-takers, with both gender groups demonstrating increase in the number of students tanking the test. Between 2005 and 2014, the number of female students who took ACT test rose by 12% and the number of male students increased by 18%. Gender gap in ACT participation showed a moderate reduction, from 4,480 in 2005 to 3,700 in 2014.

Figure 4.17. Number of students taking ACT test in Missouri by gender (2005 – 2014).



National average composite ACT scores showed very little change between 2002 and 2014, hovering around 21. Black students consistently scored lower than any other racial group with a composite score of just below 17. The next group of students, Hispanics, averaged at 19. White and Asian students kept their scores very close at the 22 – 23 range. In Missouri, the state trends largely resembled national patterns, with Black students averaging at 17, Hispanics at 20, White at 21 and Asian at 22. Figures 4.18 and 4.19 show these patterns in almost flat lines.

Figure 4.18. Average national ACT scores by race (2001 – 2013).

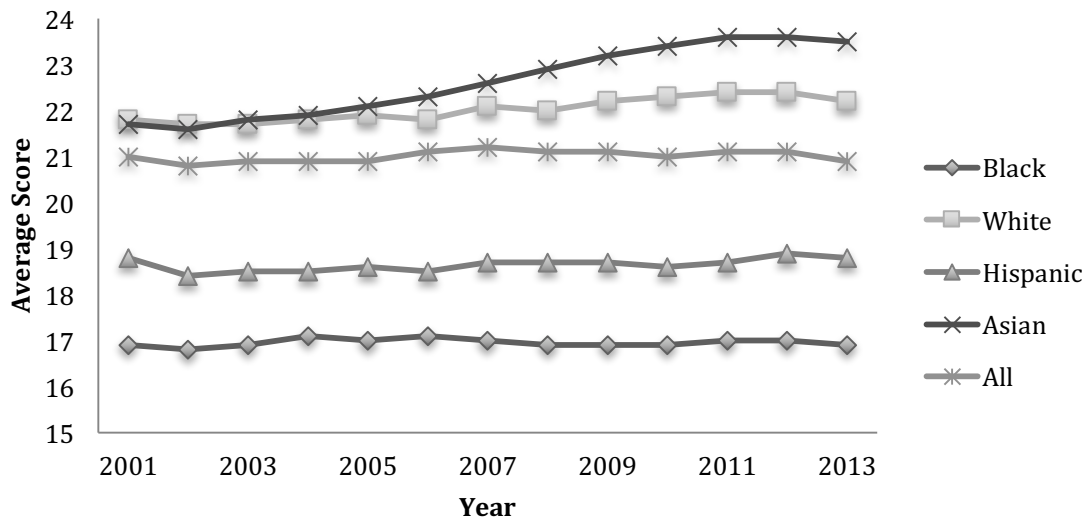
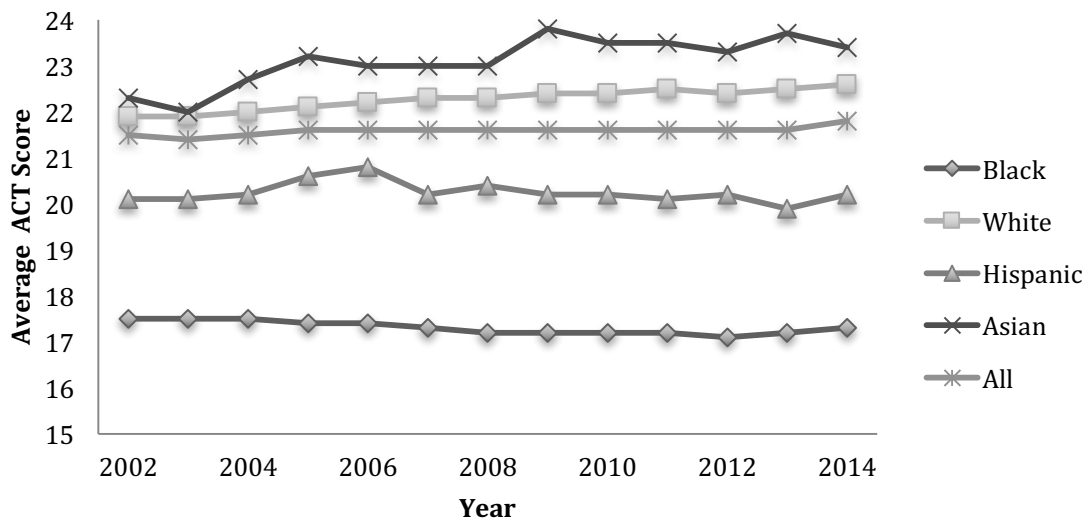


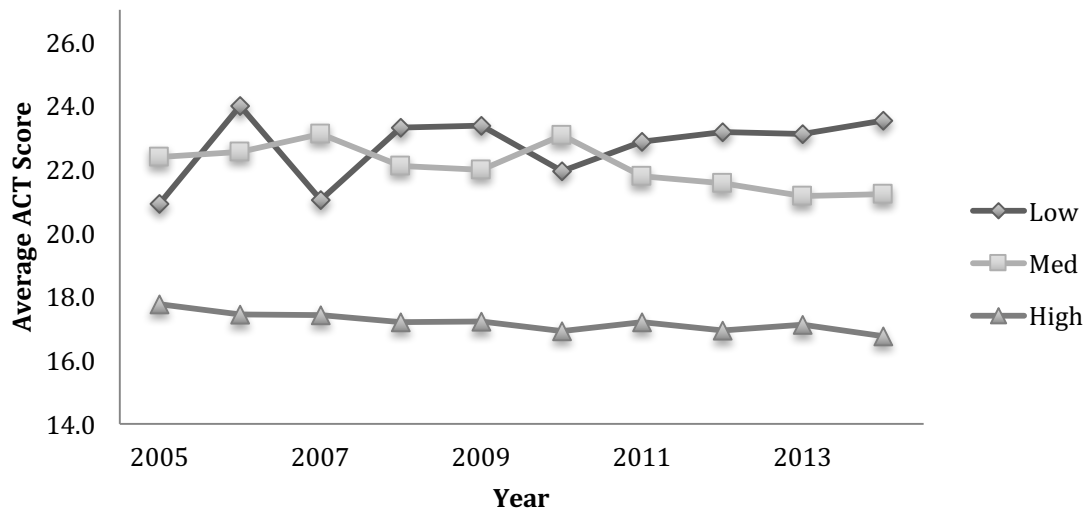
Figure 4.19. Average Missouri ACT scores by race (2002 – 2014).



Average ACT composite score was the only score reported for each high school included in the study. The trend analysis as shown in Figure 4.20 included data disaggregated by the type of school, from “Low Minority” (less than 25% of non-white students enrolled) to “High Minority” (over 51% of non-white students enrolled). Schools with less than 25% non-white students enrolled had the highest

average ACT scores and increased from 21 in 2005 to 23 in 2014. “Medium” and “High Minority” schools both showed a downward trend. Scores in “Medium Minority” schools decreased from 23 in 2005 to 21 in 2014, with a temporary spike in 2010. Scores in “High Minority” schools decreased in an even, steady pattern and dropped from 18 in 2005 to 17 in 2014.

Figure 4.20. Average ACT scores received by students in St. Louis area by demographic composition of school (2005 – 2013).

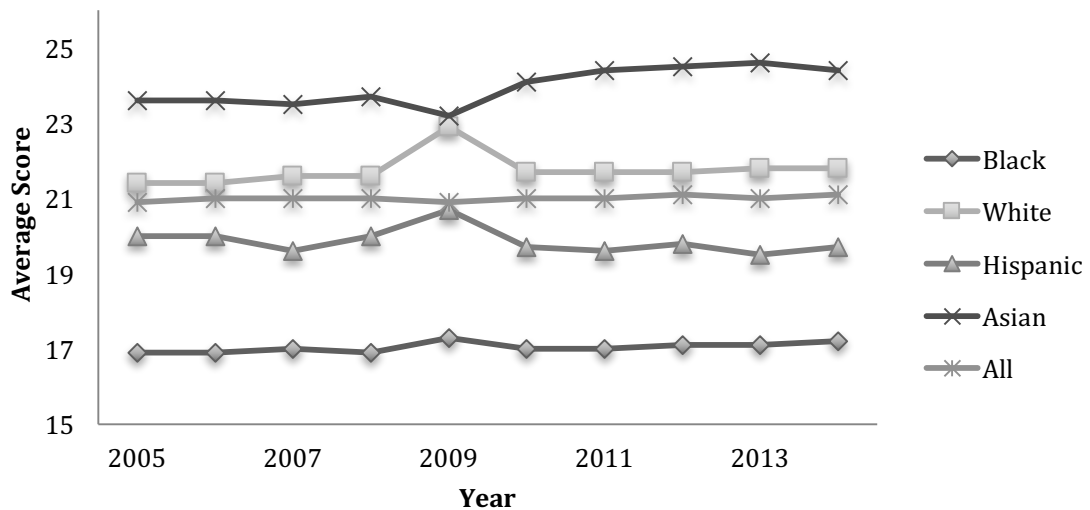


The picture held the same for the gender scores, which showed no progress between 2002 and 2014. Female and male scores were around 21 with minor variations.

The ACT first reported subject sub-scores disaggregated by gender on state reports in 2005. Examination of data revealed similar trends as with composite scores. Nationally, mathematics sub-scores showed 0.2 – 1.3 increase. Asian students increased math sub-scores by 5%, the rest of the racial groups rose by 1%.

Gender mathematics sub-scores did not change with 21.5 for males and 20.3 for females. As shown in Figure 4.21, Missouri Black and White students increased mathematics sub-scores by 2% each, Asians by 3% and Hispanic students' scores dropped by 2%. Math sub-scores disaggregated by gender remained almost unchanged.

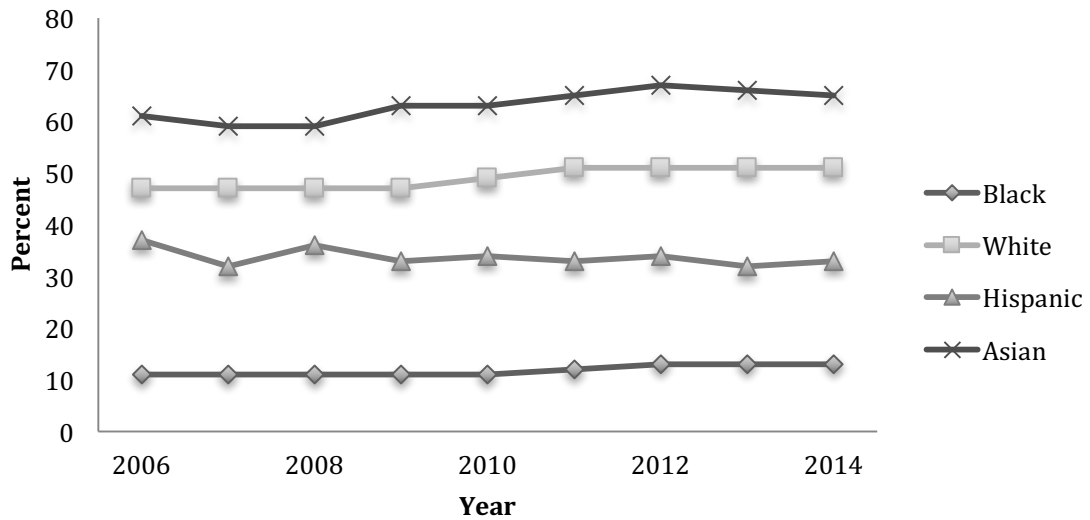
Figure 4.21. Average ACT scores received by Missouri students on mathematics tests by race (2005 – 2013).



Similar to College Board, ACT measures students' test results against College Readiness Benchmarks and reports them as percent of students meeting the benchmarks. Nationally, each racial group showed trends of increasing college readiness. The percent of students classified as college-ready increased in each racial group studied. The following growth was recorded: Asian students from 60% in 2006 to 69% in 2014, Black students increased from 11% to 14%, Hispanics, from 25% to 29%, and Whites, from 48% to 52%. In Missouri, Asian, Black and White students showed an increase in percent of meeting college readiness benchmarks.

Hispanic students showed a negative trend. In both situations, nationally and locally, Black students had the lowest percent of college readiness and Asian students had the highest.

Figure 4.22. Percent of Missouri students passing college-ready benchmark on ACT test by race (2006 – 2014).



Gender trends were available for state reports only. In Missouri, female and male students showed a modest increase in college readiness, from 49% to 50% for males, and from 38% to 41% for females.

NAEP and Missouri State Assessments.

For the last set of trends, the percent of students scoring at or above the proficient level on the NAEP and Missouri Algebra EOC were examined. NAEP and Missouri proficiency levels were used instead of scale scores. The trend analysis focused on the percentage of students meeting NAEP and Missouri proficiency standards, that is, students performing at or above the “Proficient” level. The percent of 17-year olds scoring proficient on the NAEP mathematics assessment rose

modestly from 23% in 2005 to 26% in 2013. Between 2005 and 2013 Asian students increased proficiency rates from 36% to 49%, White students, from 29% to 33%, Hispanic students, from 8% to 12% and Black students, from 6% to 7%. Male students had higher proficiency rates than females in 2005 and kept the gap steady in 2013. The percent of male students scoring proficient rose from 25% in 2005 to 28% in 2013. For female students, the numbers increased from 21% to 24%.

Figure 4.23. Percent of students meeting proficiency standards on NAEP mathematics assessment, reported nationally and by race (2005 – 2013).

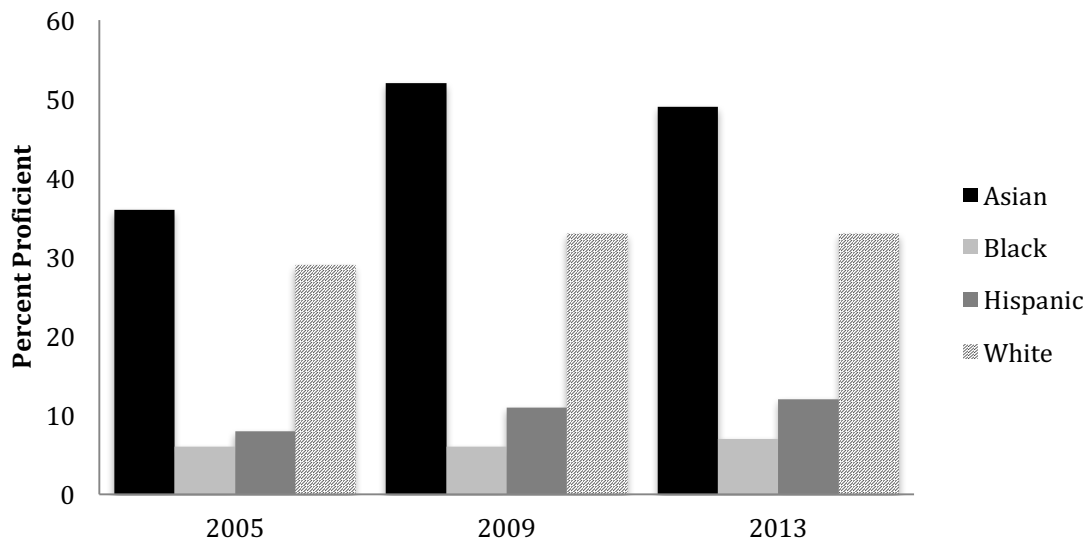
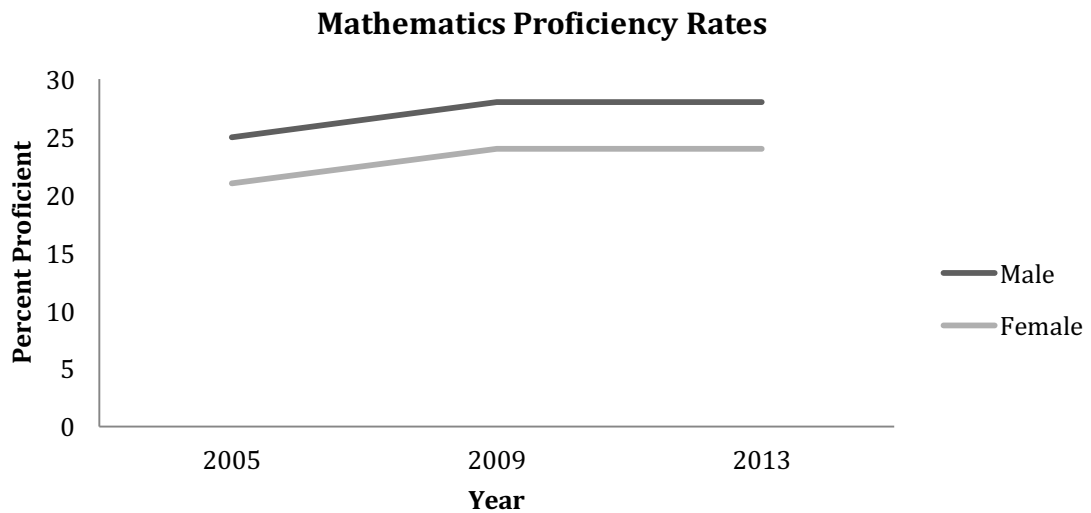
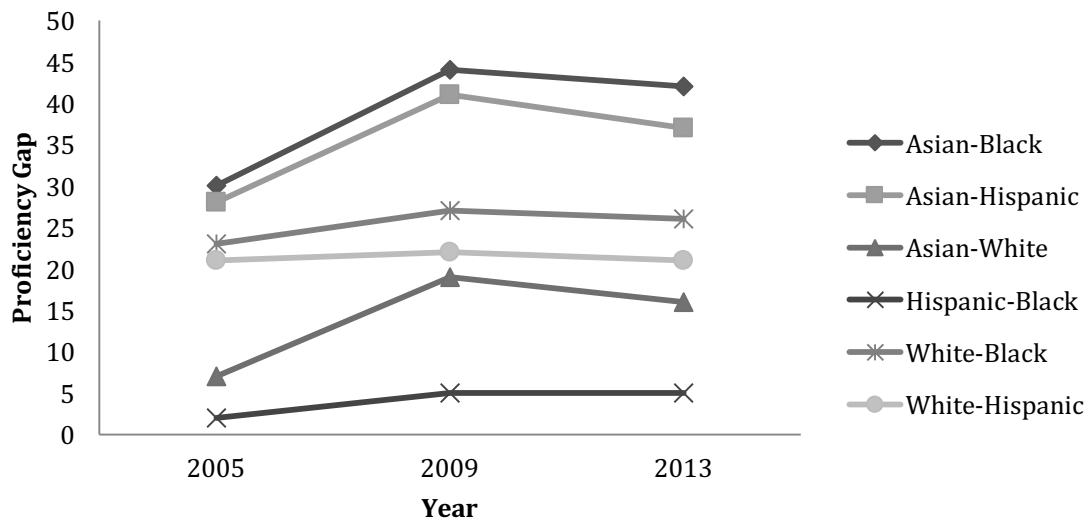


Figure 4.24. Percent of students meeting proficiency standards on NAEP mathematics assessments, reported nationally, by gender (2005 - 2013).



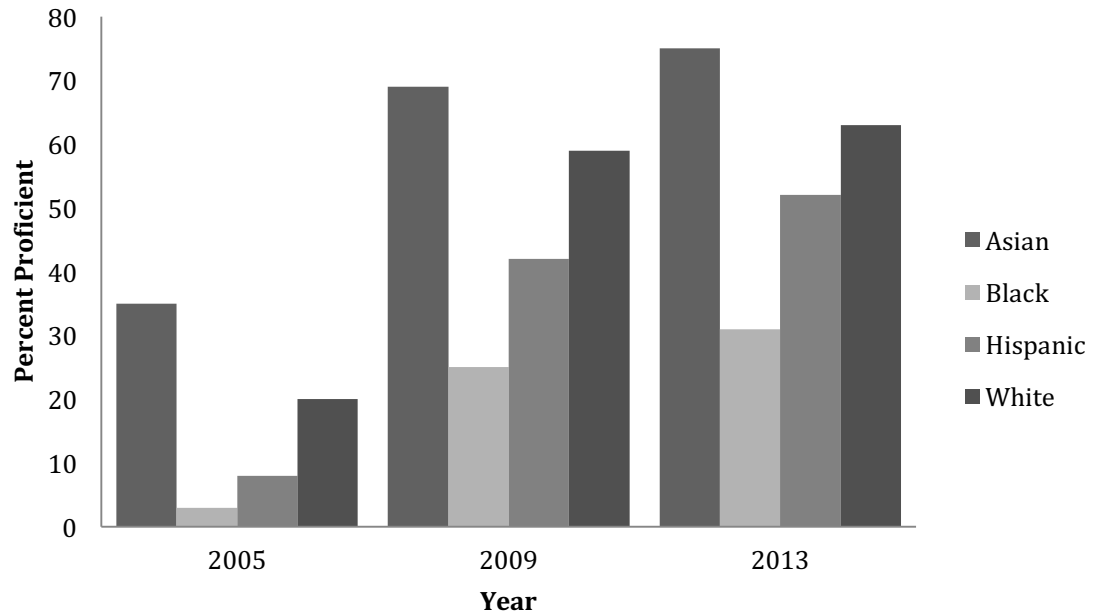
Trends in proficiency gaps on NAEP are shown in Figure 4.25. For each pairing (Asian-Black, Asian-White, Asian-Hispanic, etc.) the overall trend observed is slanted upward, which means that the proficiency gap is increasing among racial groups. The only exception is White-Hispanic proficiency gap that stayed at a steady 21 points difference in average scores. The greatest gap in proficiency rates is between Asian and Black students, it increased from 30 points in 2005 to 42 points in 2013. The smallest gap is between Hispanic and Black students at 5 points, even though it increased from only 2 points in 2005. The gap between Asian and White students is the most unstable; it spiked in 2009 at 19 points and then decreased to 15 points in 2013. Overall, Asian students were outperforming all other racial groups, and the Black students are lagging behind.

Figure 4.25. National trends in student achievement gap on NAEP in mathematics by race (2005 – 2013).



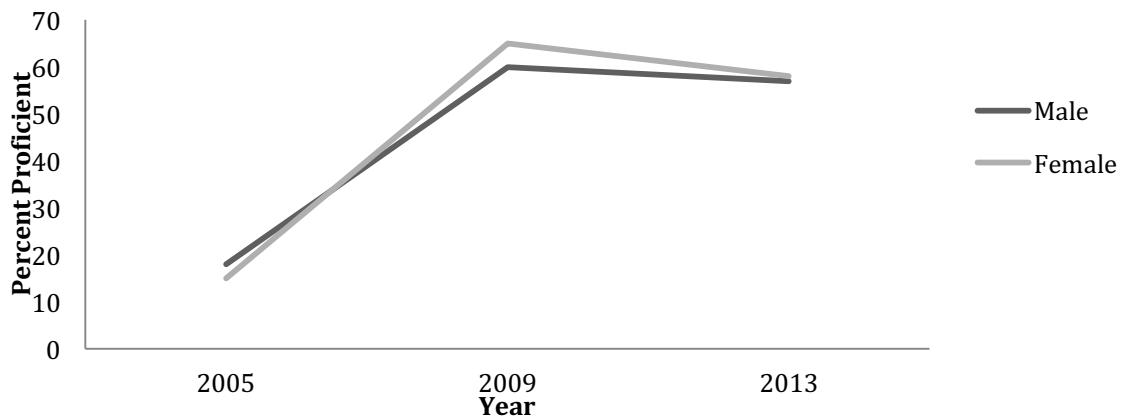
Missouri Assessment Program (MAP) is the state equivalent to NAEP. As it was discussed in Chapter 3, the proficiency levels were deemed comparable between the two assessments, making it possible to compare the achievement trends. Overall, there was a universal increase in proficiency rates based on race and gender. Black and Hispanic students demonstrated the biggest growth in proficiency rates increasing them ten- and seven-fold. Although impressive, the proficiency rates for Black and Hispanic students remain the lowest for the racial groups studied. For example, only 3% of Black students and 8% of Hispanic students scored proficient on Algebra EOC in 2005. In 2013 those numbers rose to 31% and 52% respectively. Asian students outperformed all other racial groups and more than doubled their proficiency rates from 35% to 75%.

Figure 4.26. Percent of Missouri students meeting proficiency standards in mathematics on NAEP, reported by race (2005 – 2013).



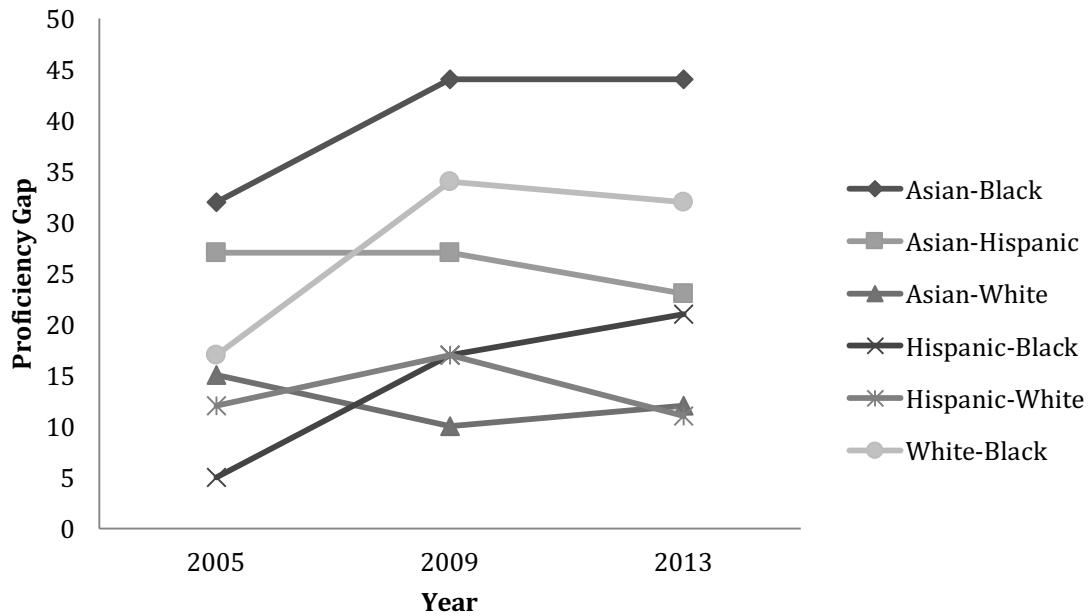
Comparison between gender proficiency rates produced mixed results. Male and female students had very similar proficiency rates in 2005 and 2013, with females outscoring males in 2009. The proficiency rates were the highest in 2009, and dropped in 2013.

Figure 4.27. Percent of Missouri students meeting proficiency standards in mathematics on NAEP, by gender (2005 – 2013).



Analysis of the trends in proficiency gaps revealed a familiar picture as shown in Figure 4.28. The largest gap was between Asian and Black students. The smallest gaps were between Asian and White and Hispanic and White. Half the trends showed an increase in proficiency gaps between racial groups, one held steady (White-Hispanic) and two gaps decreased (Asian-Hispanic and Asian-White).

Figure 4.28. Trends in achievement gap on Missouri Algebra End of Course Test reported by race (2005 – 2013).



Algebra EOC achievement trends by type of school.

Finally, students' proficiency trends on Algebra EOC included in the sample, showed very similar patterns as were seen on ACT and Advanced Placement. In each group of schools ("Low", "Medium" and "High Minority"), the proficiency rates increased, albeit at different paces. Asian students performed better than the rest and Black students lagged behind all other racial groups. However, unlike the stagnant average ACT scores and decreasing AP scores, Algebra EOC proficiency rates increased for Black students regardless of the type of school. Responding to the requirement of the NCLB, Missouri started requiring that every high school student takes Algebra EOC before graduation. Therefore, Algebra is the one mathematics course that every student is guaranteed to take during four years of high school. Conversely, school administrators and educators have four years to prepare students for successful completion of Algebra often at the expense of other math courses. As

it was evident in the enrollment trends analysis, Black students are the most likely to experience negative effects of such practice.

Figure 4.29. Percent of students scoring at or above proficiency level on Algebra EOC in “Low Minority” schools by race (2002 – 2012).

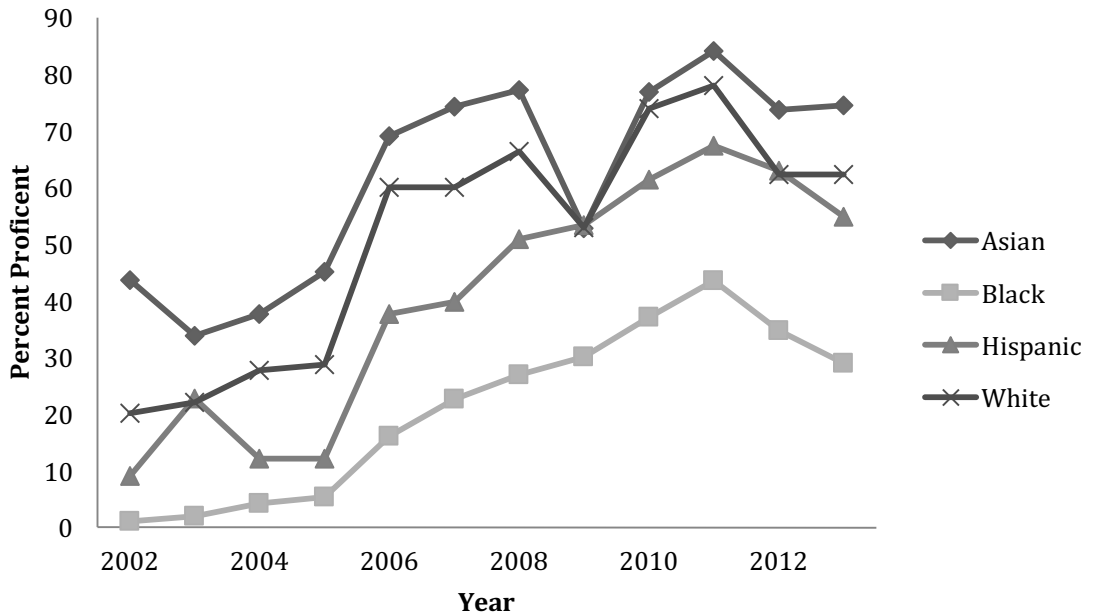


Figure 4.30. Percent of students scoring at or above proficiency level on Algebra EOC in “Medium Minority” schools reported by race (2002 – 2012).

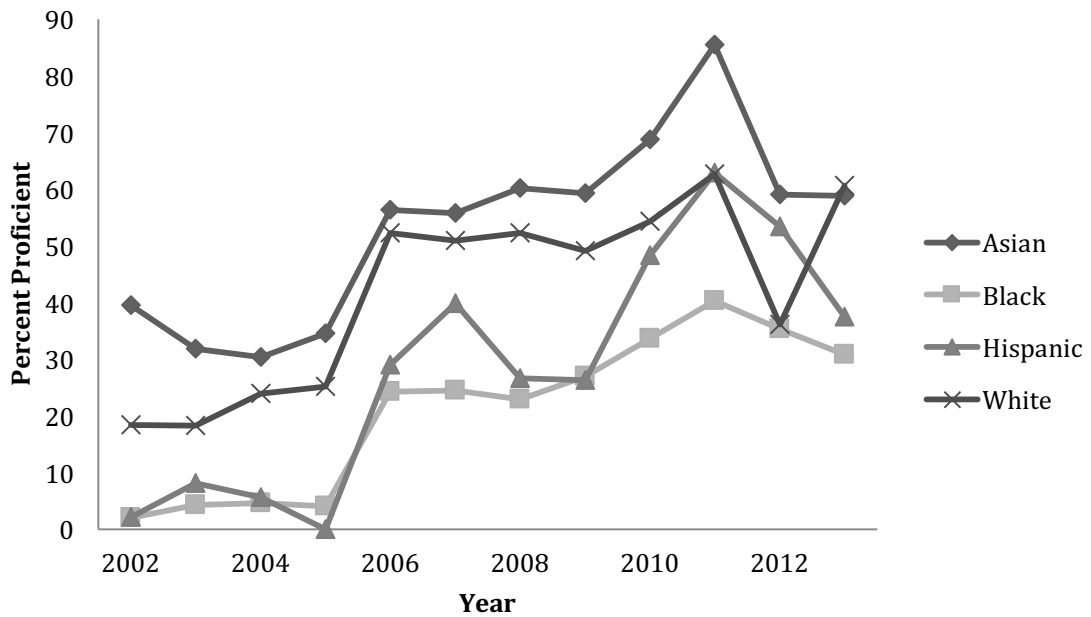
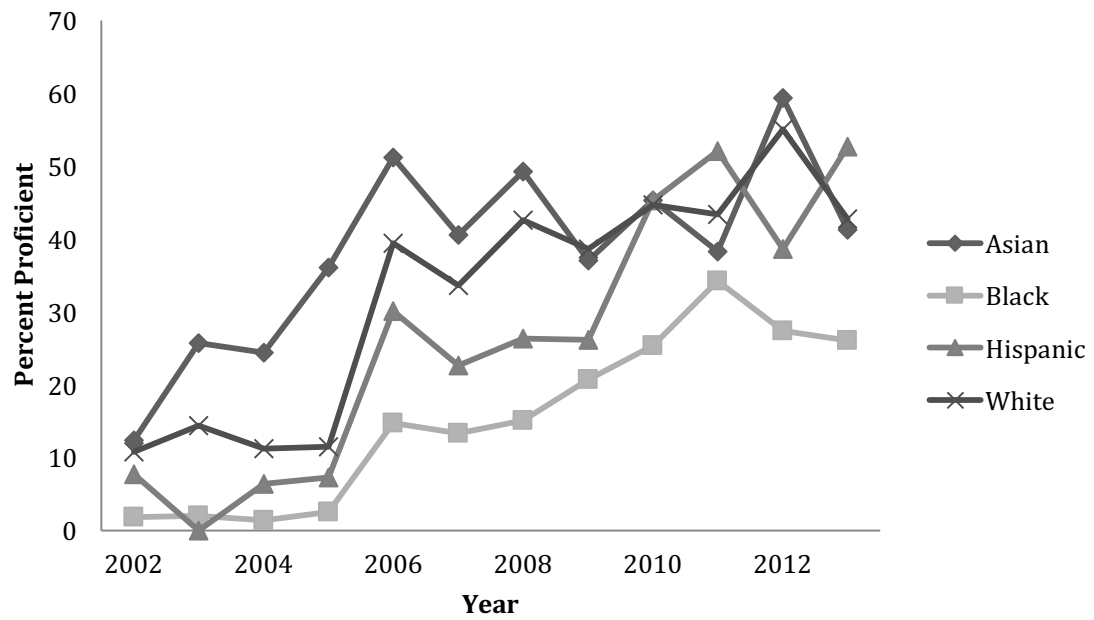


Figure 4.31. Percent of students scoring at or above proficiency level on Algebra EOC in “High Minority” schools by race (2002 – 2012).



CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter presents a summary of the study and important conclusions drawn from the data presented in the previous chapter. It also provides a discussion of the implications for action and recommendations for further research.

Summary of the Study

Students of color have dreamed and struggled for equity in education long before the “No Child Left Behind” Act, ESEA of 1965 or *Brown vs. Board of Education*. Those legal milestones opened new doors for Black students, balanced the scales in favor of children from poverty and focused public attention on students’ achievement. Despite numerous flaws and limitations, the NCLB’s long-lasting legacy was that it focused public attention on the racial achievement gap. For over a decade, researchers, educators, politicians and social activists have dissected, discussed and debated the reasons for the achievement gap. Solutions to the problem varied from changing instructional methods to dismantling existing system of education. On December 10, 2015 President Obama signed “Every Student Succeeds Act” a much-anticipated and long-awaited reauthorization of the ESEA. The era of NCLB is over. And the question is, what happened to the achievement gap?

Many studies have addressed the questions of the impact of the NCLB on the achievement gap. Regrettably, the vast majority of them used White-Non-White comparison framework. Aside from ignoring changing trends in the U.S. demographics, this type of comparison reinforces the stereotype of white as a

standard for all other races. There is a void in research literature in addressing the question of how achievement of different racial groups changed in comparison with each other.

The purpose of the present study was to examine achievement trends in mathematics of high school students in St. Louis city and county in 2000 – 2014. Specifically, the study was designed to compare achievement trends among four major racial groups (Asian, Black, Hispanic and White) and between males and females through enrollment in advanced level of mathematics, and scores received on state and national examinations using publicly available data. Local trends were to be disaggregated based on schools' demographic composition. Enrollment, participation and achievement gaps between students of different races were compared to national trends whenever available.

Two research questions guided achievement trend analysis.

1. How did the enrollment in high school advanced level mathematics classes changed for students of color?
2. What are the changes in the achievement among four racial groups (Asian, Black, Hispanic and White) and between males and females as evidenced by the scores on NAEP, AP Exams and ACT tests?

In order to examine students' achievement trends over a period of time, this research used descriptive longitudinal trend analysis with the starting year of 2000 (two years before NCLB implementation) and ending year of 2014 or sooner based on data availability. Data types collected included average scores, proficiency rates and enrollment numbers. Sources included results from Advanced Placement Exams

in Calculus, ACT, NAEP and Missouri End-of-Course Algebra exam. Data was accessed and downloaded from the U.S. Department of Education Office of Civil Rights, NCES, College Board, DESE and ACT. Some sources provided yearly reports (College Board and ACT), or digests (NCES), and others had online query (Office of Civil Rights, DESE). After each download, data was organized in tables, charts and graphs.

The longitudinal trend analysis, though appropriate for the comparison across the time with no cohort of students available, had a potential to omit the influence of unpredicted factors, not included in the list of variables. Therefore, the analysis of the achievement trends could present an incomplete picture.

Purposeful sampling revealed that St. Louis area public schools remained highly stratified by race and socio-economic status of the students, with an alarming pattern of being poor equated with being non-white.

By and large, the results of advanced mathematics enrollment trend analysis demonstrated increased participation from students of all races in either AP or advanced mathematics courses. Each racial group also demonstrated increased participation in AP and ACT tests.

Asian students were consistently over-represented in advanced mathematics classes and among ACT and AP test-takers. They had the highest average scores on AP Calculus Exams, ACT and Algebra EOC. They also had the highest percent performing proficient on exams and/or meeting college readiness benchmarks.

Black students experienced growth in enrollment in advanced mathematics, AP and ACT. Despite increased participation rate, access to advanced mathematics

courses remains elusive for this group. Regardless of their overall school enrollment, only 2 percent of Black students took AP Calculus and 12% took courses beyond Advanced Algebra. They also remained the lowest scoring of racial groups studied in all of the assessments, consistently under-represented in program participation, and the least college-ready. The most alarming trend was that the achievement gap between Black students and the rest of the racial groups increased no matter who they were compared to. The only positive trend in the study was observed on Algebra state assessments, where Black students demonstrated increase in proficiency rates. This trend can be explained by the fact that Missouri requires all students to take Algebra EOC before graduating high school. Therefore, Algebra is the course that all students take, some of them repeatedly until they are ready to take the EOC and at the expense of other math courses.

Hispanic students demonstrated an increase in participation in AP, ACT and advanced mathematics courses. Similar to Black students, they experienced a drop in average AP scores and college-readiness.

White students' achievement trends were mostly positive with increased average scores on AP and ACT. White students kept their majority in enrollment in AP, ACT and advanced mathematics and increased proficiency on state tests.

More female students participated in AP and advanced mathematics, although still not as many as males. Female student overtook males in the number of ACT test-takers yet scored lower on average.

Local enrollment and achievement trends by and large resembled national trends. Because high schools in the study were grouped according to student body

demographics, an alarming yet predictable pattern presented itself. The higher the percent of the minority students in a school, the lower the achievement. Program participation rates were not affected by the demographics of the school and often showed an inverse relationship, such as that only two percent of Black students attending any school were enrolled in AP courses regardless of the type of school.

Examination of NAEP assessments trends revealed increasing proficiency gaps for each racial pairing, except two. The achievement gap between Asian and White students is shrinking, and the gap between Hispanic and Black students is unchanged.

All racial groups demonstrated an increase in proficiency rates on Algebra EOC. The achievement gap increased except White-Hispanic, Asian-Hispanic and Asian-White.

Findings Related to the Literature

Similar to Borman et al. (2004), Hanushek et al. (2002), Ofrield & Lee (2004) and Strebinsky et al. (2006) the present study compared trends in achievement gap based on racial segregation and concentration of poverty. Unlike the previous studies, there was no need to separate the two factors. Racial segregation in St. Louis metropolitan area went along with poverty, as it was demonstrated by sorting schools in the sample based on race and SES. Groups that formed by the sorting were almost identical as they fell into “low/medium/high – minority/poverty” categories. The results of the present study confirmed what other researchers discovered: achievement is increasing sporadically, unevenly among racial groups and at a slow pace.

In addition to previous trend studies that investigated achievement gap among students in 4th and 8th grade (Bank, 2011; J. Lee, 2002; Lee, 2006), the present

research filled in the void created by the absence of a contemporary study in high school achievement trends. The field for a national, large-scale research on high school achievement gap remains mostly unexplored and awaits much needed development.

Achievement data trends confirmed the findings of Clotfelter (2009), Dee (2010), Ladd (2010) and Reback (2008) who found an increase in students' achievement after the NCLB. Students' scores and percent of students meeting proficiency benchmarks showed positive trends in every assessment included in the study. At the same time, achievement gaps between Black and Asian, Black and White and even Black and Hispanic students increased over the past decade. Asian students made the most gains in access and outcomes of education. White students took a small setback, yet managed to keep their dominance. Hispanic students experienced the greatest success in increased scores on the ACT, and only Black students trailed behind. The changes in achievement gaps seem to replicate racial society at large (Martin, 2009) and enforce effectively maintained inequality in access to quality education (Lucas, 2001).

Critical Race Theory researchers have long contended White – Black achievement gap comparisons, pointing to the unfair representation of White as a standard of achievement, speaking against labeling Black students as deficient, and advocating against reliance on tests (Ladson-Billings, 1998; Ladson-Billings & Tate, 1995; Martin, 2009; Martin, Gholson & Leonard, 2010). The trends in achievement gap confirmed what the CRT theorists have been saying all along: achievement gap should be measured against the highest achieving group of students, not the whitest.

Advanced mathematics enrollment trends that showed double-digit increase for every racial group seemed to confirm the findings of Adelman (1999, 2006), Lee (2002), Oakes (1985, 2005) and Perkins (2004) that link college readiness and the type of courses students take in high school. However, the disproportionately low growth in achievement as compared to growth in enrolment, specifically for Black and Hispanic students, may validate assertions by Clune (1992), Hoffer (1997) and Tietelbaum (2003) that mandating access does not guarantee achievement.

Advanced mathematics enrollment trends also seemed to confirm arguments of Braddock (1990), Kelly (2009), Lucas & Berends (2007) and Oakes (1994a, 1994b) that as school's diversity increases, so is the tracking, that the White students are more likely to be enrolled in AP and honors classes, and that tracking still exists in schools in a form of class placement. The present study uncovered the pattern of highest under-representation of Black students in AP classes in schools with the lowest level of diversity.

Finally, the findings in the present study seem to agree with Danny Martin (2003), who said that for Black students "equity in mathematics education remains elusive after almost three decades of the standards reforms". Despite increases in enrollment and programs participation, the achievement results are either stagnant or improved slightly.

Conclusions

Examination of achievement trends in high school mathematics in St. Louis metropolitan area showed that Asian students outpaced other racial groups in participation rates and enrollment in advanced mathematics courses, outperformed in

achievement results, and widened the achievement gap with the rest. Therefore, using the old language of White-Black, or White-Hispanic achievement gap seemed outdated when the highest performing group is no longer the same.

Equity in education was not only elusive for Black students, it was also getting harder to achieve. As this study showed, it was not enough to grant access to advanced mathematics classes or tests when the increase in corresponding achievement on said test did not follow. As numerous data sets and trends in this study showed, the breakdown of performance by racial groups did not matter by the test (Federal, state, non-profit or commercial). The outcomes were eerie similar: Asian students perform the highest, White students trailed close behind, Hispanic and Black students were on the bottom of the chart. Sometimes Hispanic students managed to separate from the Black, but not quite reached the level of White. Therefore, to make progress toward achieving equity in education, a new system of measures that reflect equity in outcomes, not just access, is necessary.

Another approach to measuring and ultimately closing the achievement gap may focus each racial group performance relative to a desired mastery of a standard. Using mastery on standards will allow each racial group to be evaluated on its own merit. Passing a designated benchmark of performance will be treated as narrowing the gap regardless of how other racial groups are progressing.

Recommendations for Further Research

The present study was limited to one metropolitan area. The trend results may not be the same when applied to other cities or states. Enrollment data for advanced mathematics courses was not available prior to 2009 and the reports for 2013 are

expected early next year. These reports may change the findings, as educational agencies get better at reporting the data. Further research is needed into students' achievement on mathematics tests. The majority of data available from NAEP describes the achievement of students in 4th and 8th grade. NAEP started testing 12th graders in 2005, yet it hasn't included high school achievement gap analysis on its yearly reports. The inconsistency of increased enrollment in advanced mathematics and the lack of progress in achievement should be further investigated. Advanced Placement classes are governed by the College Board which grants approval for its' curriculum. Further research into rigor and the quality of instruction in AP classes is needed, especially in schools with diverse student demographics.

Concluding Remarks

Even though access to advanced level of mathematics in high school has increased by double-digits for every racial group, the achievement gap among racial groups remains largely unchanged. In numerical terms, more Black and Hispanic students took calculus, trigonometry or statistics in 2011 than in 2000. A Black student in Missouri is guaranteed to take Algebra in high school. That same Black student has at most two percent chance of being enrolled in a Calculus class, regardless whether he is the only Black student in a school or represents the majority of school demographics. Asian and White students remain the beneficiaries of the national focus on the achievement gaps regardless of the type of school they are in. After more than a decade of educational policy that called for "high quality of education for all students", the students who needed it most are being left out.

Therefore, the dream of achieving equity in education for Black students is just as distant as it was before the NCLB.

Very recently, the U.S. Senate just passed long-awaited reauthorization of the ESEA, “Every Child Achieves Act of 2015”. Overall, the law promises less focus on assessments and more flexibility to states in determining what achievement looks like and how to measure it. It also promises to track achievement by subgroups based on race, socio-economic status, language proficiency and learning disabilities. And so I question how the achievement will be measured, who or what will set the standards, and who will benefit from this new law. As the last 15 years showed, for Black students the road to educational equity is still a very long journey.

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APPENDIX

Table A1 Rate of Enrollment in St. Louis Metropolitan Area High School Advanced Placement Mathematics Courses by Race and School Demographics, 2000 – 2011.

	Enrollment (%)					
	2000		2011		Change (%)	
All Schools						
Asian	65	5%	267	7%	202	310%
Black	45	4%	301	8%	256	568%
Hispanic	0		50	1%	50	
White	1,130	91%	3,334	84%	2,204	195%
Total	1,240		3,952			
“Low Minority”^a Schools						
Asian	0		112	10%	112	
Black	0		35	3%	35	
Hispanic	0		20	2%	20	
White	810	100%	929	85%	119	18%
Total	810		1,096			
“Medium Minority”^b Schools						
Asian	20	7%	115	15%	95	475%
Black	15	5%	31	4%	16	106%
Hispanic	0		16	2%	16	
White	270	88%	626	80%	356	132%
Total	305		788			
“High Minority”^c Schools						
Asian	45	36%	40	8%	- 5	- 11%
Black	30	24%	235	45%	205	683%
Hispanic	0		14	3%	14	
White	50	40%	232	45%	182	364%
Total	125		521			

^a “Low Minority” refers to schools with less than 25% of non-white students.

^b “Medium Minority” schools had 25% – 50% of non-white students enrolled.

^c “High Minority” Schools had 51% or greater on non-white students enrollment.

SOURCE: U.S. Department of Education, Office of Civil Rights, Civil Rights Data Collection, 2000, 2011 (<http://ocrdata.ed.gov>).

Table A2 *Rate of Enrollment in St. Louis Metropolitan Area High School Advanced Mathematics Courses by Race and School Demographics, 2009 – 2011.*

	Enrollment (%)					
	2009		2011		Change (%)	
All Schools						
Asian	417	6%	523	6%	106	25%
Black	1,274	19%	2,075	25%	801	63%
Hispanic	185	3%	185	2%	0	0%
White	4,752	72%	5,377	66%	625	12%
Total	6,628		8,160			
“Low Minority”^a Schools						
Asian	102	4%	229	6%	127	124%
Black	65	3%	239	6%	174	267%
Hispanic	40	2%	74	2%	34	85%
White	2,087	91%	3,257	86%	1,170	56%
Total	2,294		3,799			
“Medium Minority”^b Schools						
Asian	295	9%	247	9%	- 48	- 16%
Black	415	13%	481	18%	66	14%
Hispanic	65	2%	65	2%	0	
White	2,355	75%	1,852	70%	- 503	- 27%
Total	3,130		2,645			
“High Minority”^c Schools						
Asian	20	2%	47	3%	27	135%
Black	794	65%	1,355	79%	561	71%
Hispanic	80	7%	46	3%	- 34	- 43%
White	330	27%	268	16%	- 62	- 19%
Total	1,224		1,716			

Note: Advanced mathematics courses include trigonometry, elementary analysis, analytic geometry, statistics and precalculus as described in U.S. Department of Education, Office of Civil Rights Data Collection.

^a “Low Minority” refers to schools with less than 25% of non-white students.

^b “Medium Minority” schools had 25% – 50% percent of non-white students enrolled.

^c “High Minority” Schools had 51% or greater on non-white students enrollment.

SOURCE: U.S. Department of Education, Office of Civil Rights, Civil Rights Data Collection, 2009, 2011 (<http://ocrdata.ed.gov>).

Table A3 *Access rate to Advanced Placement Mathematics Courses in St. Louis Metropolitan Area by Race and School Demographics (2000 – 2011).*

	Enrollment (%)			
	2000		2011	
	Percent of total school enrollment	AP enrollment (percent)	Percent of total school enrollment	AP enrollment (percent)
All Schools				
Asian	3%	3%	4%	9%
Black	45%	< 1%	53%	1%
Hispanic	1%	0%	3%	2%
White	50%	3%	40%	5%
“Low Minority”^a Schools				
Asian	3%	7%	6%	12%
Black	16%	< 1%	12%	1%
Hispanic	1%	0%	2%	5%
White	80%	4%	78%	5%
“Medium Minority”^b Schools				
Asian	3%	0%	5%	18%
Black	27%	< 1%	33%	2%
Hispanic	< 1%	0%	3%	3%
White	70%	4%	57%	9%
“High Minority”^c Schools				
Asian	1%	0%	2%	3%
Black	77%	< 1%	86%	1%
Hispanic	1%	0%	2%	1%
White	21%	2%	9%	4%

^a “Low Minority” refers to schools with less than 25% of non-white students.

^b “Medium Minority” schools had 25% – 50% percent of non-white students enrolled.

^c “High Minority” Schools had 51% or greater on non-white students’ enrollment.

SOURCE: U.S. Department of Education, Office of Civil Rights, Civil Rights Data Collection, 2000, 2011 (<http://ocrdata.ed.gov>).

Table A4 *Access rate to Advanced Mathematics Courses in St. Louis Metropolitan Area by Race and School Demographics (2009 – 2011).*

	Enrollment (%)			
	2009		2011	
	Percent of total school enrollment	Adv. Math enrollment (percent)	Percent of total school enrollment	Adv. Math enrollment (percent)
All Schools				
Asian	3%	15%	4%	31%
Black	46%	7%	42%	12%
Hispanic	2%	8%	3%	15%
White	47%	13%	49%	15%
“Low Minority” ^a Schools				
Asian	6%	23%	5%	31%
Black	13%	9%	11%	17%
Hispanic	2%	16%	2%	19%
White	78%	21%	82%	29%
“Medium Minority” ^b Schools				
Asian	4%	19%	5%	43%
Black	27%	8%	32%	12%
Hispanic	3%	6%	3%	16%
White	67%	11%	60%	20%
“High Minority” ^c Schools				
Asian	1%	4%	2%	25%
Black	84%	6%	81%	8%
Hispanic	2%	2%	3%	13%
White	13%	6%	14%	10%

Note: Advanced mathematics courses include trigonometry, elementary analysis, analytic geometry, statistics and precalculus as described in U.S. Department of Education, Office of Civil Rights Data Collection.

^a “Low Minority” refers to schools with less than 25% of non-white students.

^b “Medium Minority” schools had 25% – 50% of non-white students enrolled.

^c “High Minority” Schools had 51% or greater on non-white students enrollment.

SOURCE: U.S. Department of Education, Office of Civil Rights, Civil Rights Data Collection, 2000, 2011 (<http://ocrdata.ed.gov>).

Table A5 *Demographic and Socio-Economic Characteristic of St. Louis City and County Public High Schools*

School Name	Student Characteristics	
	Free and Reduced Lunch (%)	Minority Students (%)
Afton High	35.0	10.9
Bayless Sr. High	50.6	10.8
Beaumont High	83.0	99.7
Carnahan School of the Future	89.4	89.3
Central High	17.1	18.7
Central Visual/Performing Arts High School	78.2	75.2
Clayton High	12.9	27.1
Cleveland NJROTC Academy	88.3	77.3
Eureka Sr. High	12.6	9.7
Fern Ridge High	36.0	34.8
Gateway High	84.2	65.7
Hancock Sr. High	68.7	21.8
Hazelwood Central High	48.6	87.9
Hazelwood East High	72.1	96.6
Hazelwood West High	46.3	43.5
Jennings High	85.7	96.4
Kirkwood Sr. High	16.0	21.1
Ladue Horton Watkins High	12.3	21.4
Lafayette Sr. High	9.6	11.4
Lindbergh Sr. High	14.3	9.2
Maplewood-Richmond Heights High	55.4	45.0
Marquette Sr. High	14.4	13.0
McCluer High	84.8	89.0
McCluer North High	52.4	69.8
McCluer South-Berkley High	79.4	94.5
McKinley Classical Leadership Academy	44.0	50.7
Mehlville High	31.9	11.8
Metro High	42.5	49
Miller Career Academy	81.4	95.3
Normandy High	83.2	98.6
North High	24.7	31.4
Oakville Sr. High	15.1	9.0
Pattonville Sr. High	35.4	33.8
Ritenour St. High	67.6	54.4
Riverview Gardens Sr. high	85	98.4
Rockwood Summit Sr. high	16.6	11.7
Roosevelt High	79.9	81.4
Soldan International Studies High	87.8	84.5
South High	18.5	17.0
Sumner High	87.9	100
Transportation and Law High	92.8	98.6
University city Sr. high	61.7	89.4
Vashon high	88.1	98.4
Webster Groves High	21.3	28.0
West High	13.5	11.5

SOURCE: Missouri Department of Elementary and Secondary Education, 2015