

Understanding the Reasons for Low Representation of Ethnic Minority Students in STEM Fields

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Abstract— North Carolina is becoming a state known for STEM. Its expected job growth in STEM related industries ranks in the top third nationally with Charlotte and Raleigh consistently ranking in the top 100 metropolitan areas for STEM careers. The state's universities produced 21,191 STEM graduates in 2014, the 10th most in the United States according to the Department of Education. Between the 2012-2013 and 2013-2014 academic years, North Carolina universities produced the 10th most underrepresented minority graduates in STEM fields in the nation. My College Options and STEMconnector report 26.2% of North Carolina High School students are interested in STEM compared to 25.5% nationally for 2013. Statistically, North Carolina is a model for increasing diversity in STEM fields, but a large inclusion gap remains in STEM graduates. From 2009 through 2013, North Carolina universities produced four times more White engineering and computer science undergraduates than African American, Native Americans, and Hispanic engineering and computer science undergraduates combined. Considering the universities' overall production of STEM graduates, and the amount of high school students interested in STEM, an analysis of the effectiveness of North Carolina's K-12 public schools instruction on underrepresented minorities is required. Underrepresented minorities historically score lower than White and Asian American students on standardized math exams, a common metrics used to determine math aptitude. By utilizing literature reviews of previous research on the topic and analyzing the teacher population of North Carolina's K-12 public schools, standardized math exam scores of North Carolina's 3rd, 4th and 8th grade students, and the effects of economic conditions have on students' education, we hope to better understand and highlight the circumstances that are preventing an increase in STEM diversity in North Carolina. We propose increasing the number of ethnic minority educators, improve cultural training for educators by implementing cultural relational teaching methods into standard curriculum including more hands-on instruction, a redistribution of financial resources to state public educational institutions, including higher education, based on need instead of population. We believe these changes have the potential to increased interest and self-efficacy in math and science for underrepresented minority students of North Carolina.

I. Introduction

The US Department of Commerce reports employment in Science, Technology, Engineering, and Mathematics (STEM) careers is expected to grow 17% by 2018 compared to 10% for non-STEM careers. In North Carolina, 229,000 new STEM jobs are expected, which ranks 15th nationally according to US Bureau of Labor Statistics, 2011. Workers in STEM have higher wages and lower unemployment according to the US Bureau of Labor Statistics, with workers in computer, mathematical, architecture, and engineering occupations in North Carolina earning an annual mean salary between \$73,390 and \$80,550.

Despite recruiting and education efforts, underrepresented minorities, (African Americans, Native Americans, and Hispanics) continue to be underrepresented in STEM. In 2011 non-Hispanic Whites represented roughly 67% of the total workforce, but held 71% of STEM jobs. Asians held 15% of the STEM jobs compared with 6% of all jobs. African Americans held 6% of STEM-related jobs, Native American held 0.4% of STEM jobs, and those of "Some Other Race"

held 1% of STEM jobs, while representing 27% of all jobs”[1]. According to 2013 data from the Computer Research Association, 4.5% of all new computer science or computer engineering degree holders were African American, and 6.5% were Hispanic. Between 2009 and 2013, the number of ethnic minority engineering graduates increased by 12.3%, compared to increases of 22.75% and 19.72% for White and Asian graduates.

North Carolina has a number of nationally and internationally recognized universities producing STEM graduates, including the top producer of Native American biological, biomedical, and physical science graduates, and the top producer of African American engineering and natural resources conservation graduates according to *Diverse Issues In Higher Education* magazine. However, there remains a large gap between the overrepresented and the underrepresented entering and graduating with STEM related majors. Improving North Carolina’s K-12 educational system by implementing proven methods of relational teaching and immersion programs have the potential to improve the academic success and interest of underrepresented minorities while simultaneously increasing diversity in STEM industries within the state.

The lack of underrepresented minorities (URMs) within the sciences has been studied thoroughly since the White House and Department of Education have given added emphasis to STEM. Though there have been numerous studies on why STEM fields lack diversity, no studies have been conducted on North Carolina, a state which is a top producer of minority STEM graduates, but has a large gap between the underrepresented and overrepresented. This is evident by the combined 13% increase in URMs graduating with bachelors degrees in engineering or computer science compared to the 23% increase in White undergraduates and the 20% increase in Asian American undergraduates.

II. North Carolina Higher Education

North Carolina is home to four of the top 100 ranked US News and Reports national universities and six of the top ranked Historically Black Colleges and Universities (HBCU) [2]. Of these universities, North Carolina Agricultural and Technical State University (NCA&T) and North Carolina State University (NCSU), rank in the top 10 for producing URM minority engineers.

NCA&T graduates the largest number of African American engineering undergraduate, master and doctoral students in the US. NCA&T is the nation’s largest producer of minority agricultural graduates. NCA&T’s online Masters of Information Technology ranked 16th for Best Online Graduate Computer Information Technology Programs in the US by US News and Reports. NCSU made “*Diverse Issues in Higher Education*” Magazine’s Top 100 Degree Producers list in physical science, biological and biomedical sciences based on number of degrees awarded to African American, Hispanic, Asian American and Native American students in 2008-09. NCSU also ranked: No. 6: doctorates in math and statistics awarded to all minorities; No. 10: doctorates in engineering for African Americans; No. 11: doctorates in engineering for Hispanic; No. 12: master’s degrees in engineering for African Americans; No. 16: undergraduate degrees in engineering for African Americans [3].

University of North Carolina Pembroke (UNCP) originally began as a teacher college for Native Americans in 1887. In 1970, the university extended its STEM offerings to address the need for more Native American doctors, engineers, and scientists within the predominately Native American community of Pembroke, N.C. Over that time period, UNCP has produced more than fifty Native American doctors. *Diverse Issues in Higher Education Magazine* rated UNCP as the nation's top producer of Native American Biological, Biomedical, and Physical Science undergraduates.

III. Factors Affecting Underachievement

Academic success or failure is affected by multiple factors. This research will highlight factors in North Carolina including teacher bias, financial concerns, lack of preparation in K-12 education, and family and communal influence.

A. Historical Racial Biases and Low Academic Expectations

Expectations and attitudes of educators play an important role in the academic success of students. As of 2015, ethnic minorities represented 18% of North Carolina public schools teachers and 28% of school administrators. The low representation leaves URM students with few people in leadership roles that look like them resulting in minority students' reality being not acknowledged and low expectation of academic performance based on race by teachers [4].

Some White educators subconsciously have low academic expectations of ethnic minority students, based on stereotypes that view them as academically or intellectually inferior to White and Asian students. The low academic expectations perpetuate notions of school being only for Whites and Asians among URM high school students. The sustaining of this notion leads to lower confidence in academic ability and to these students deliberately sabotaging their academic performance [5]. When URM students achieve high academic success, teachers with low expectations attribute the success to extenuating factors rather than intellectual ability. This devaluation of achievement creates tension and distrust between the student and instructor which ultimately leads to the student behaving in tune with the teacher's expectation [4]. High achieving URM students can suffer from stereotype threat, a social-psychological predicament that can arise from widely known negative stereotypes about one's group [6], due to teacher low expectations for URM students. Empirical evidence has shown the pressure of not confirming or conforming to negative stereotypes can result in the student not performing to their highest potential [6].

Standardized testing is a common metric used to predict academic success. Previous research has proven that standardized testing is biased towards White students as these tests are standardized in predominately White schools, emphasizing White, middle-class culture while ignoring other cultures, role models, and alluding to negative perceptions of non-White people [4]. For example, according to the College Board, the 2011-2012 Computer Science AP exam writers were overwhelmingly White male, with women representing 19%, African-American 4.5%, Hispanic 8.4%, and Native American/Alaska Native 0.3% of exam writers.

B. Financial Concerns

When economic status is equal, previous research has shown no statistical difference in academic performance between the URM and White students. This can be attributed to equal access to resources. North Carolina had the 34th highest percentage of people living in poverty in the US for 2014 with the percentage of Whites nearly 2 times lower than URMs, according to the US Census Bureau. For 2013, The National Center for Children in Poverty statistics shows North Carolina had the highest percentage of Hispanics and the 20th highest percentage of African American children, 18 and under, living below the federal poverty line in the nation. Both of these statistics are higher than the national average.

Eighty of North Carolina's 100 counties are considered rural, which are more likely than urban counties to have high levels of poverty, as they are less populated with fewer industries. State funding for K-12 is based on formulas that utilize the number of students and other targeted factors resulting in more populous counties receiving more funding. It is important to note North Carolina Department of Public Instruction (NCDPI) reports the state's most financially distressed schools are predominantly comprised of low income URMs. The National Education Association ranks the state in the bottom five for per-pupil expenditures due to budget cuts.

Federal and state budget cuts to higher education have made attaining a college education more difficult for all people, but more so for URMs. Hurtado and others found that ethnic minorities are more likely to have concerns over paying for their education. Their research indicated that underrepresented minorities work more hours in high school and are more likely to work full time during college, making it more difficult to focus on academics [7]. Federal education funding has been cut over \$300 million including cuts to Title III, the Parent Plus Loan Program, Pell grants, and graduate subsidies in 2011 [8], which benefit low-income and working class students.

Adding to the burden of paying for college, the College Board reports the average college tuition has increased by 50% since 2000. February 2015, the UNC Board of Governors, agreed to an average 4.3% tuition increase for in-state undergraduates across all state universities followed by a 3.7% increase in 2016. This is after a 9.9% tuition increase in 2012-2013. With cuts to financing programs and other federal grants, the burden of paying for college may deter economically disadvantaged URMs from going to college or graduating from college.

The effects of the budget cuts and tuition increases can be seen in the decrease in enrollment at HBCUs. Of the eleven HBCUs in NC, only three saw enrollment percentage increases in full-time students, while seven saw double digit decreases from 2010-2013. Smaller colleges and universities such as HBCUs and UNCP, which are URM dominated, have smaller endowments and depend heavily on tuition dollars and government funding to continue operations.

C. Lack of Preparation in K-12

Participating in advanced math courses prepares students for more rigorous collegiate math courses, which typically are requirements for STEM related majors. The National Action Council for Minorities in engineering reports twice as many White American high school

students take calculus courses than URM students. Asian American high school students take calculus at a rate seven times higher than URM students [9]. With URMs historically scoring lower than White and Asian American students on standardized math exams, it is fair to say URMs are not prepared to take higher-level math courses such as calculus.

In 2015 more URM students enrolled in Advance Placement (AP) courses than previous years according to NCDPI, but it's important to note AP courses in North Carolina public schools have open enrollment, meaning any student, regardless of academic qualification may enroll in AP courses. School administrators advise students based on their academic record, but the final decision is left to the student and their parents. Some school systems do have requirements such as earning a "C" in pre-calculus before being allowed to enroll into AP calculus, but this is not the standard operation for all North Carolina public schools. As a result of open enrollment only 32.7% of URMs had scores of "qualified" or higher compared to 65% of Asian and 58% of Whites for the 2014-2015 academic year.

Not all of North Carolina's rural and impoverished school systems offer AP courses due to the lack of teachers qualified to teach AP courses in the district. The lack of this important resource results in rural students being ill prepared for college level math and science courses at a greater rate than metropolitan students. This lack of academic resources is reflective of the socioeconomic disparity between regions.

This is not surprising since URM primary and middle grade math scores are much lower than their White and Asian peers. North Carolina students' average National Assessment of Educational Progress (NAEP) math score for fourth graders was four points higher than the national average of 240 in 2015. URMs average score was 232, eight points lower than the national average and 21 points lower than White students. Eighth graders' scores for all North Carolina students was equal to the national average of 281 while URMs of North Carolina average score was 268, 13 points lower than national and state averages and 24 points lower than North Carolina's White students. This is indicative of the lack of early preparation of North Carolina's URMs in math, leading to less participating in upper level math courses in high school.

D. Family and Community Effects

Family and community have a great deal of influence on decisions, self-confidence, and perspectives on academics. A misconception of URM students is they fear of being labeled a "sellout" or "acting white". This is based on Dr. John Ogbu oppositional culture theory, which states that by conforming to school requirements (attaining good grades, speaking and writing "proper" English, and good behavior) is considered as "acting white" and giving up one's minority identity [10]. More recent research has proven this theory does not apply for all minorities as quantitative data shows that the oppositional culture theory's explanation for the academic gap is limited [11]. For example, a 2006 CBS News Poll on students opinions on school showed African-American students had higher perceived academic success as "cool" and took pride in high academic achievement at higher percentages than their White peers [12].

Parents have the greatest influence on academic performance. Encouragement and integration of academics into daily activities helps minorities not commit “academic suicide” according to Dr. James Moore [13]. Research has shown students with highly educated parents typically perform higher academically. In 2010, the US Census reported 10% of the population earned a graduate or professional degree (4.1% of Hispanics, 6.1% of African Americans, 4.4% of Native Americans, 10.8% of Whites, and 20.3% of Asians). Students with parents who hold professional or graduate degrees were nearly three times more likely to have interest in STEM than students with parents whose highest level of education is a high school diploma or lower.

Low-income families typically do not place great emphasis on education. The goal most low-income parents have for their children is to gain employment. A college education is not a goal or priority, so it is not discussed. Past research has shown that low income parents, who discussed post high school aspirations, assist with school work and expose their children to non-sports related, extracurricular activities such as art, music, and religious activities, saw their children achieve higher academic levels than those who did not [14]. By being involved in their children’s academics and providing access to non-stereotypical activities, parents can provide a support system necessary for URM students to build self-confidence, to overcome obstacles and have successful academic careers.

The levels of safety within students’ neighborhoods impact their academic success. High achieving African American students responded they always feel safe where they live, but generally African American students across all levels of academic achievement felt less safe than White students [12]. The National Crime Victimization Survey-School Crime Supplement reported in 2006, schools with gang activity and high levels of violence reported a cumulative 2.85 average GPA, whereas schools with no gang activity reported a 3.15 GPA [12].

IV. Problem Statement

The purpose of this research is to demonstrate the lack of URM students is not due to academic ability, but is due to correctable obstacles. With North Carolina being a southern state that was hit hard during the economic crisis of 2008, we believe racial bias, lack of financial resources, and the inability to relate science to their current situation plays a role in the underrepresentation.

The questions we asked are:

1. With URM students having higher percentages of living beneath the poverty line, is there a linear relationship between economically disadvantaged students and lower test scores?
2. Is North Carolina’s public school teacher population representative of North Carolina’s population and would more non-White teachers increase URM students’ academic performance?
3. Is there a linear relationship between a school district’s average score and the percentage of poverty within the Local Education Agency’s county?
4. Will North Carolina produce more minority graduates with degrees in STEM related fields by 2018?

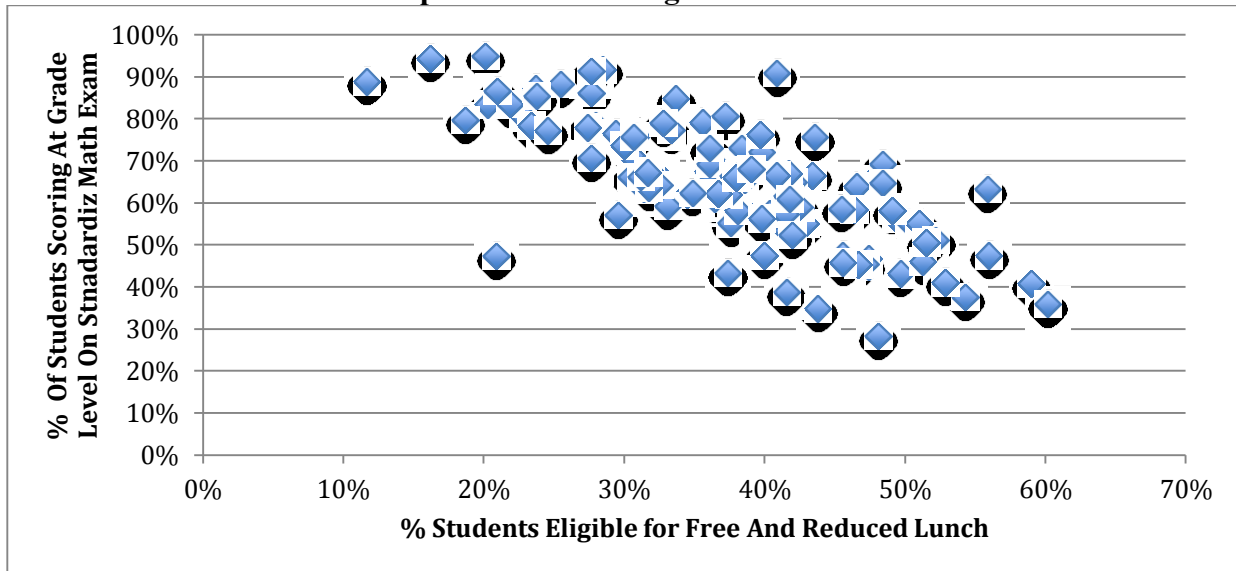
V. Experiments and Results

A. Relationship Between Economically Disadvantaged Students and Lower Test Scores

African American, Native American and Hispanic have the highest percentages of people living below the federal poverty level in North Carolina. Historically, these groups have lower average standardized test scores.

School systems use the percentage of students eligible for free and reduced lunch as a metric to measure a schools level of poverty. As the percentage of students on free or reduced lunch increases the percentage of students who score at grade level on standardized math exams decreases. Figure 1 shows the linear relationship between the free and reduced lunch and 3rd -8th grade standardized math test scores of North Carolina.

Figure 1. Percentage of All Students (3rd-8th grade) Scoring At Grade Level On Standardize Math Exams Compared to Percentage on Free and Reduced Lunch

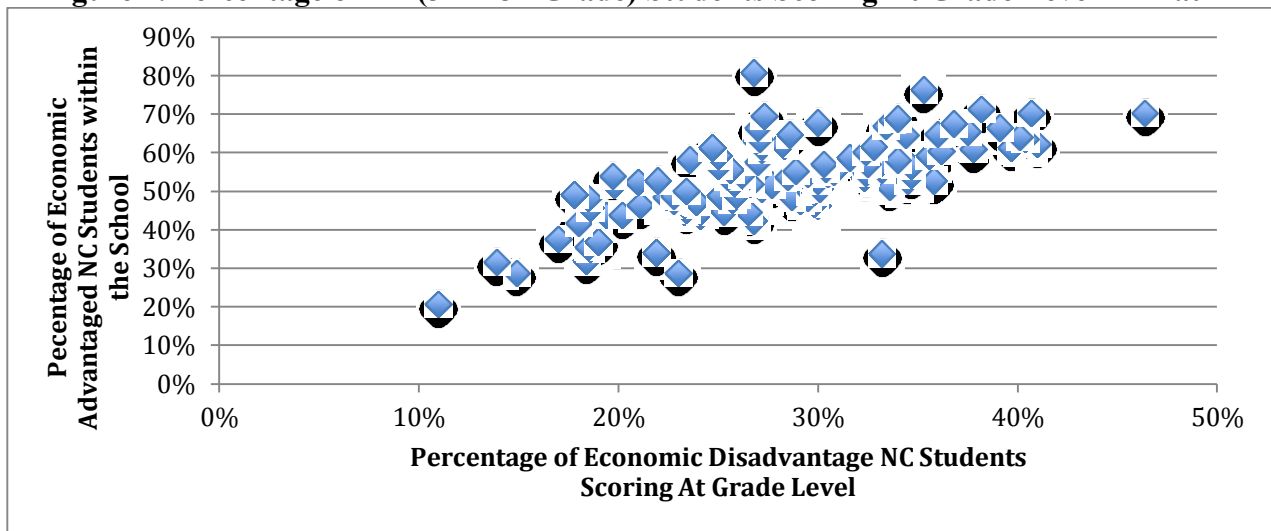


Source: North Carolina Department of Instruction

Using a simple regression model, it is determined that there is a 72% chance of a relationship between the test scores and number of economically disadvantaged students.

Using linear regression analysis, we see a strong relationship between the percentage levels of economically advantaged students and test scores of economically disadvantaged students. Figure 2 displays the linear relationship between economics and 3rd -8th test scores.

Figure 2. Percentage of All (3rd – 8th Grade) Students Scoring At Grade Level In Math



Source: North Carolina Department of Instruction

As a school’s percentage of economically advantaged students increased, the percentage of economically challenged students scoring proficient in math increased. Schools with a racially and economically diverse student population saw higher academic success among under privileged students.

B. Teacher Population And Effects On Academic Performance

Recruiting and retaining more non-White teachers has the potential to increase URM academic achievement. Though the majority of research states the integration of public schools benefited African American students, a negative consequence of the Brown vs. Board of Education Supreme Court decision was the reduction of African American teachers. Ten years after the ruling, 38,000 African American teachers and administrators had lost their position [15]. Research has indicated students have higher performance when their teacher is the same race. With more than 80% of North Carolina public school teachers being White, statically URMs have very little chance of having a teacher of their own race as opposed to their White peers. For the 2015-2016 academic year, North Carolina public school teachers were 81% White compared to only 49.5% of total students as shown in Table 1.

Table 1. Percentage of students and Teachers in North Carolina for the 2015-2016 Academic Year

Race	Student	Teacher
Native American	1.34%	N/A
Asian American	2.99%	N/A
Hispanic	16.55%	N/A
African American	25.71%	14.33%
White	49.47%	81.05

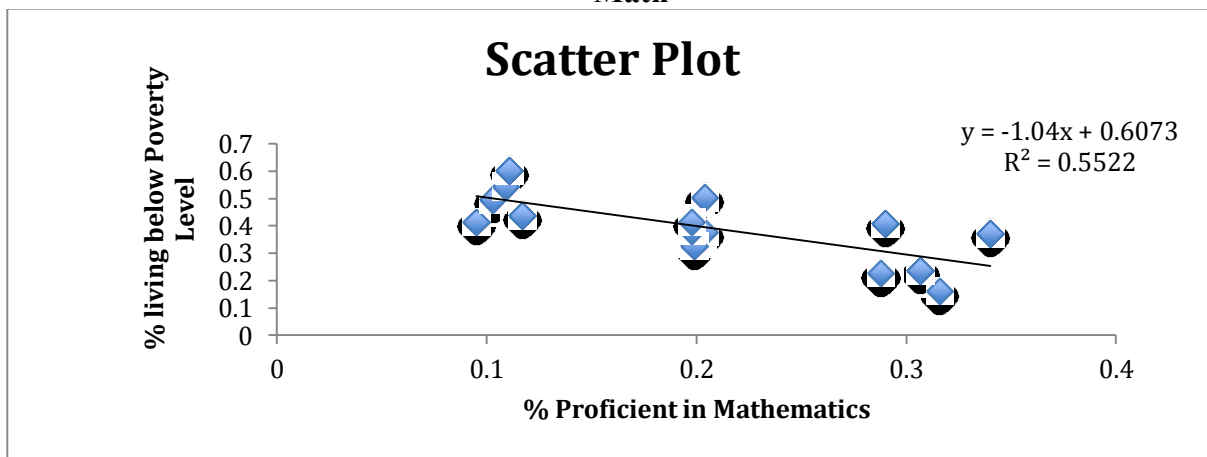
Source: North Carolina Department of Instruction

Past research has shown evidence that students benefit from having a same sex teacher. Stanford Professor, Thomas Dee followed students from 79 schools from state of Tennessee from kindergarten through third grade and saw African American math and reading scores increased by three to six percentile points when having an African American teacher for a year [16]. Minority students benefit from having same-race teachers because these teachers are role models, surrogate parents, disciplinarians, counselors and advocates[15]. In another study on the effects race has on education, researchers saw African American eighth grade students, receive more favorable evaluations on their effort and a slight, decrease in disruptive behavior from African American teachers than White teachers. The study also showed African American students were rated as having lower absentees, better work habits and less disruptive behavior than their White peers when they had African American teacher as opposed to having a White teacher [17].

C. Community/County Poverty Levels and Test Scores

The level of poverty within a community appears to have an effect on the number of students who score at the proficient level on standardized fourth and eighth grade math tests. By running a simple linear regression analysis on test scores from the top five North Carolina counties with the highest, lowest and median levels of poverty within North Carolina, we see there is a relationship between the level of poverty within a county and its schools test scores. Figure 3 shows as a county's level of poverty increases the percentage of students scoring at a proficient level decreases.

Figure 3. % of County Population below Poverty Level vs. County Schools % Proficient in Math



Source: North Carolina Department of Instruction and US Census (2011-2013)

D. Forecasting Ethnic Minorities Earning STEM Degrees

Between the 2005-2006 and 2013-2014 academic years North Carolina universities saw a total decrease of 15 Native American and 885 African American freshmen students continuing to study engineering or computer science at universities reporting to American Society for Engineering Education (ASEE). Hispanics saw an increase of 163 students, Asian Americans

+320 students, and White Americans +573 students. It is important to note that all ethnicities had decreases in the number of students enrolled in engineering and computer science.

Student data submitted to ASEE shows 67% of all engineering and computer science degrees went to White students from 2005 to 2013. Since 2010, 62% of full-time engineering and computer science students in North Carolina were also White. Table 4 shows the forecasted decline in the percentage of ethnicities earning degrees in STEM related majors.

In predicting the number of graduates in engineering and computer science, we used exponential smoothing forecasting methods, which gives recent observations more weight in forecasting than older observations. This statistical method was used because it detects significant changes by ignoring fluctuations that are irrelevant to the purpose [18]. This is vital as each race has fluctuations in the number of graduates since 2005.

We forecast a steady decline in ethnic minorities earning engineering and computer science degrees in North Carolina except for Hispanics. By 2020, African Americans have an expected loss of 14, and Native Americans have an expected loss of five undergraduates in engineering and computer science compared to gains of 53 Asian, 286 White, and 22 Hispanics engineering and computer science undergraduates in 2020.

Table 2. Forecasted Number of URM's earning Engineering or CS Undergraduate Degrees

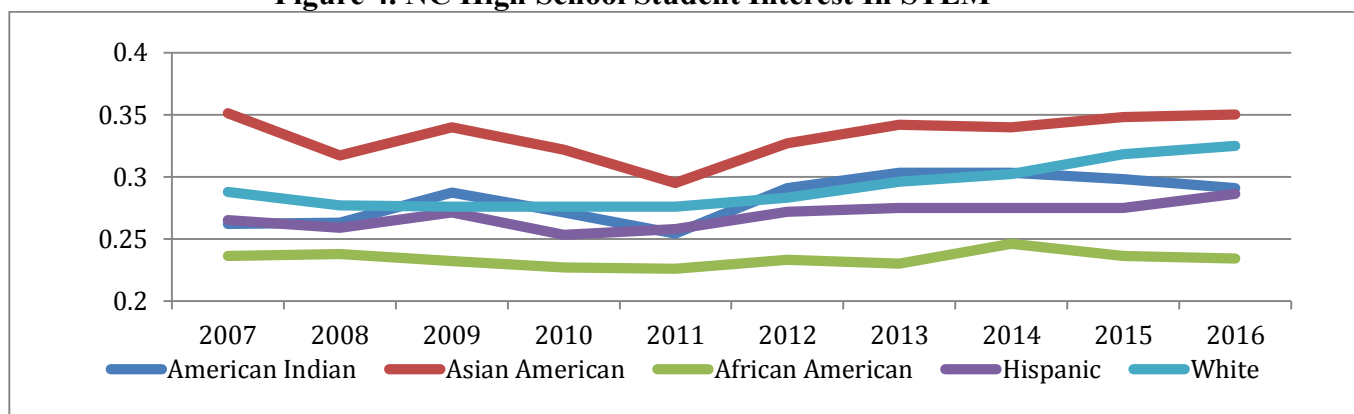
Year	Asian American	White	Hispanic	Native American	African American
2010	162	1199	46	10	256
2011	182	1358	53	7	235
2012	161	1310	61	7	237
2013	213	1358	80	11	257
2014 forecasted	209	1443	73	8	250
2015 forecasted	219	1317	78	8	249
2016 forecasted	228	1499	83	7	248
2017 forecasted	238	1544	88	7	246
2018 forecasted	247	1417	92	7	245
2019 forecasted	257	1599	97	6	244
2020 forecasted	266	1644	102	6	242

Source: American Society for Engineering Education

Studies looking into the reasons students complete or leave a major, indicated students who left STEM-related majors had negative learning experiences, whereas students with intentions to pursue a career in science persisted despite the negative experiences [19].

MyCollegeOptions.com, a popular free college-planning program, did a survey of high school students that showed increased interest in STEM. Since 2007, White, Hispanic and Native American interest has increased while African American has remained constant and Asian American interest has gone up and down. Figure 4 shows percentage of interested parties by graduating classes from 2007-2016. As interest in STEM increases, the hope is more URM's will continue to pursue their interest in STEM related fields.

Figure 4. NC High School Student Interest In STEM



VI. Discussion

There are a multitude of factors that have created the situation in which African Americans, Hispanics, and Native Americans are underrepresented in STEM fields. However, these factors such as poverty and family life, cannot be legislated or controlled by outside sources. What can be changed are the methodologies used by K-12 institutions. The research of this paper suggests implementing cultural relational teaching methods in K-12 instruction, creating programs that introduce hands on experience in STEM, recruit and retain more minority teachers, and implementation of programs to provide URMs seeking an advance degree research opportunities will help improve racial diversity in STEM fields.

Researchers have acknowledged the importance of cultural capital in education; the accumulated beliefs, knowledge, techniques, technologies, ways of doing, being, and the identities and ritual of a people [5]. Teachers trained to deal with classroom diversity have the ability to recognize and set aside their own biases, are aware, acknowledge, and become knowledgeable of the differences in how students learn and communicate. Not knowing students' learning and communication styles can lead to problems such as poor academic performance, negative views of education, and misconduct [20]. Dr. A. Wade Boykins, professor of psychology at Howard University, describes this as a "mismatch of teaching and cultural styles" [17]. This mismatch leads to misunderstandings between teacher and pupil, which view the students' behavior as disruptive when culturally it is accepted. The US Department of Education has reported ethnic minority students are disciplined at greater rates and with harsher penalties than White students [21].

To better relate instruction to URM students' reality, teachers should consider combining of student culture and standardize curriculum, which has proven to be effective. A study conducted on Alaskan Yupik tribe students, which integrated the tribe's culture with standardized curriculum. The results were Yupik students in the program learned math quicker, retained more information, and enjoyed math more than Yupik students who were not in the program [22]. Students saw greater academic success when their teachers exhibited a strong belief in the students learning ability, provided the curriculum in context to each student's lives, and established caring relationships with students.

At times it is best that students teach their teachers on how to best teach them. Chapel Hill-Carrboro schools implemented a successful program called Student Six to help train teachers on how to better work with minority students. The Student Six program is a direct conversation between students and teachers in which the students teach the teachers how to connect with them. It is based on six tips: (1) *Be Visible*: Ensure every student feels welcome and part of the class; (2) *Create A Safe Space*: Place yourself in close physical proximity to reduce the vulnerability students may feel; (3) *Connect To Students' Lives*: Connect the instructions to concepts and situations that are relevant to their lives; (4) *Connect To Student's Culture*: Connect the student's culture to assignments in a positive manner; (5) *Address race and racial dynamics in the classroom*: Ignoring this fundamental part of student identity can inadvertently damage the trust relationship between student and teacher; (6) *Connect to student's future selves*: Recognize that all students have dreams about their future and help them realize they can achieve their dreams. Most curriculums imply only White Americans have made important discoveries. Incorporate non-White Americans who made discoveries and had positive impacts [23].

To increase ethnic representation in STEM majors and fields, the underrepresented need to realize becoming a STEM professional is possible. The creation of programs that provides hands-on experience would help URMs realize their potential as STEM professionals. An example is the partnership between code.org and ten North Carolina school systems to teach K-12 students computer programming. Expanding or creating more partnerships with organization like code.org has the potential to increase computer science exposure among all students, but especially URMs, who are more less likely to have home computers or home Internet than their White and Asian peers. The increased exposure has the potential of leading to greater representation in computer science fields and help fill the 19,389 state's reported available computer jobs as of November 2015. The Bureau of Labor Statistics projects computer science to have the largest percentage of expected job openings from 2010 to 2020. Computer science is expected to add almost twice as many new jobs as engineering, which has the second highest number of expected job openings.

Data from The College Board, National Center for Education Statistics, and Bureau of Labor shows African American and Hispanic students, who try AP Computer Science in high school, are seven times more likely to major in it in college. However, only 1198 North Carolina high school students took AP Computer Science exams in 2015, including 50 Hispanics and 79 African Americans. The state has re-defined how it views computer science as evident by becoming one of 26 to allow computer science to count as a core math or science for high school graduation and college admission requirements.

Having more same-race teachers in minority dominated, impoverished and/or underperforming schools potentially will increase academic performance. Dee's research showed both African American and White students increased test scores when learning from a teacher of the same race. The increase for African American test scores may be in part due to minority teachers are more likely to have favorable assumptions about minority students' capabilities than White teachers [16].

Dee found that African American students, who benefited the most from having a same race teacher, were concentrated in schools with dominate minority populations. This is consistent with the hypothesis that predominately African American dominated schools tend to attract and retain high-quality African American teachers, but are only able to attract only low-quality White teachers [16]. In North Carolina, more than 80% of all public school teachers are White, but less than half of all public school students are White. The number of minority teachers leaving the profession or the state increased 28% between 1988 and 2009 compared to an increase of 8% for White teachers [24]. The lack of minority teachers leaves the minority-dominate, impoverished, and/or underperforming schools able to attract only inexperienced or low-quality White teachers as high-quality White teachers have more options, and typically avoid these school systems [16].

Due to the lack of high quality teachers in rural, impoverished, or underperforming schools, many states, including North Carolina have attempted to encourage high-quality teachers to work in these schools with financial incentives. From 2001 to 2004, North Carolina gave an annual bonus of \$1800 to teachers certified in math, science, or special education who taught in low performing and/or high poverty schools. North Carolina's bonus program failed primarily due to poor implementation, but it is also important to note that many principals and teachers, who knew about the program, felt the financial bonus was too low to make a difference.

There is evidence that supports increasing teacher salaries affects student achievement. According to the National Education Association rankings, North Carolina average teacher annual salary fell from 25th in 2009 to 47th in 2015 culminating in the worst percentage change in average salaries for public school teachers in the nation. However multiple studies on teacher motivation prove financial incentives alone does not attract and keep high-quality teachers in schools with negative reputations. Other studies have indicated the level of working conditions, including a strong leadership within the school, have greater influence than monetary gains when motivating teachers to work in underperforming, impoverished, rural, and minority dominated schools [25].

In higher education, "Bridging" programs provide greater access for research opportunities to minority graduates from smaller universities. Fisk and Vanderbilt universities partnered to create the first Bridge program with the goal of improving diversity in STEM. The program does not place heavy emphasis on traditional metrics such as GRE scores, but placed more attention on the applicant's determination on achieving their goals [26]. As of spring 2015, the program has produced 16 PhD graduates in Physics, Astronomy and Materials Science, including the first African American female to graduate from the Yale astronomy program and the first African American female astronomer to publish a first-author Nature article. The program is a success as it has an 80% retention rate for the PhD and 97% overall retention rate, including a 100% job placement rate for those who completed the PhD program [27].

Columbia University has created a successful Bridge program and The Ohio State University, University of South Florida, Massachusetts Institute of Technology, and University of Michigan have all received funding from the American Physical Society to begin similar programs [26]. With the number of high-level research institutions in North Carolina, creating Bridge programs that look at the entirety of the URM academic ledger instead of standardized

test scores would provide greater access to research opportunities and improve URM representation in STEM.

VII. CONCLUSION AND FUTURE WORK

UNCP, NCSU, NCA&T and a handful of other North Carolina HBCU's are among the nations top producers of ethnic minority STEM graduates, but the rate of URMs graduating with STEM degrees is not at a pace to impact the gap between the underrepresented and the overrepresented, further proving interest in STEM must become strong early in a student's education and fostered with care. The way the state educates ethnic minorities needs to change from the "assembly line" ideology of the current educational system, and begin implementing cultural-relational instruction in the classroom along with real-world simulations early in education. Research has proven that these methods have a positive effect on URMs academic success as well as their self-confidence.

A positive student-teacher relationship is vital to promoting academic success. Research has shown teacher support is second only to that of a parent when predicting students going to college for STEM. North Carolina teachers need to be better trained to deal with a multicultural classroom and parents need to be encouraged to be more active in their children's academics. By training teachers on how to effectively communicate with ethnic minority students, recognize, and put aside any bias. Since the state teacher population is not diverse, increasing the number in ethnic minority teachers could encourage minority students to excel academically. Research has proven that same race teachers relate better to same race students, creating a level of trust, and caring due to being members of the same culture. URM parents must be encouraged to engage in their child's education and provide support in the form of positive communication, assistance in homework, promoting success, and give praise for high achievement.

A more in-depth, comprehensive study is needed to effectively examine how implementing these programs would increase diversity in STEM-related industries in North Carolina. Factors such as home conditions for URMs, financial and educational support systems for impoverished schools by state government, communal and family support systems needs to be evaluated and considered before definitive resolutions can be discovered.

Bibliography

- [1] L. Landivar, "Disparities in STEM Employment by Sex, Race, and Hispanic Origin," United States Census Bureau, Washington DC, ACS-24, Sep. 2013.
- [2] "Historically Black Colleges and Universities Ranking | Rankings | US News Best Colleges." [Online]. Available: <http://colleges.usnews.rankingsandreviews.com/best-colleges/rankings/hbcu>. [Accessed: 16-Mar-2016].
- [3] "Rankings | NC State University." [Online]. Available: <https://www.ncsu.edu/about/rankings/>. [Accessed: 31-Mar-2015].
- [4] H. P. Mandel, *The Psychology Of Underachievement : Differential Diagnosis And Differential Treatment*. New York: Wiley, c1988.
- [5] E. W. Gordon, *Supplementary Education : The Hidden Curriculum Of High Academic Achievement*. Lanham: Rowman & Littlefield Publishers, c2005.
- [6] C. M. Steele and J. Aronson, "Stereotype threat and the Intellectual Test Performance of African Americans.pdf," *J. Pers. Soc. Psychol.*, vol. 69, no. 5, pp. 797-811, 1995.

- [7] S. Hurtado, C. B. Newman, M. C. Tran, and M. J. Chang, "Improving The Rate Of Success For Underrepresented Racial Minorities In STEM Fields: Insights From A National Project," *New Dir. Institutional Res.*, vol. 2010, no. 148, pp. 5–15, 2010.
- [8] B. A. Smikle Jr., "Solving Minority Underrepresentation In STEM Careers," *TheHill*, 06-Mar-2015. .
- [9] R. Boege, "North Carolina's 2015 STEM Report Card," The Alliance for Science & Technology Research in America, Washington DC, 2015.
- [10] J. U. Ogbu and H. D. Simons, "Voluntary and Involuntary Minorities: A Cultural-Ecological Theory of School Performance with Some Implications for Education," *Anthropol. Educ. Q.*, vol. 29, no. 2, pp. 155–188, 1998.
- [11] A. L. Harris, "I (don't) hate school: revisiting oppositional culture theory of blacks' resistance to schooling," *Soc. Forces*, vol. 85, no. 2, p. 797+, Dec. 2006.
- [12] I. A. Toldson and D. Owens, "Editor's Comment: 'Acting Black': What Black Kids Think About Being Smart and Other School-related Experiences," *J. Negro Educ.*, vol. 79, no. 2, pp. 91–96, 2010.
- [13] The Quality Education for Minorities (QEM) Network, "Spring 2010 Workshop on the Recruitment and Retention of African American Male Students in Science, Technology, Engineering and Mathematics (STEM)," The Quality Education for Minorities (QEM) Network, Washington DC, Sep. 2010.
- [14] L. M. Gutman and V. C. McLoyd, "Parents' Management of Their Children's Education Within the Home, at School, and in the Community: An Examination of African-American Families Living in Poverty," *Urban Rev.*, vol. 32, no. 1, 2000.
- [15] J. E. Lyons and J. Chesley, "Fifty Years After Brown: The Benefits and Tradeoffs for African American Educators and Students," *J. Negro Educ.*, vol. 73, no. 3, Summer 2004.
- [16] T. S. Dee, "The Race Connection: Are Teachers More Effective With Students Who Share Their Ethnicity?," *Educ. Next*, vol. 4, no. 2, p. 52+, 2004.
- [17] D. B. Downey and S. Pribesh, "When Race Matters: Teachers' Evaluations of Students' Classroom Behavior," *Sociol. Educ.*, vol. 77, no. 4, pp. 267–282, Oct. 2004.
- [18] "What is exponential smoothing? definition and meaning," *BusinessDictionary.com*. [Online]. Available: <http://www.businessdictionary.com/definition/exponential-smoothing.html>. [Accessed: 27-Mar-2016].
- [19] A. V. Maltese, C. S. Melki, and H. L. Wiebke, "The Nature of Experiences Responsible for the Generation and Maintenance of Interest in STEM," *Sci. Educ.*, vol. 98, no. 6, pp. 937–962, 2014.
- [20] H. Morgan, "Improving Schooling for Cultural Minorities: The Right Teaching Styles Can Make a Big Difference," *Educ. Horiz.*, vol. 88, no. 2, pp. 114–120, Dec. 2010.
- [21] T. Lewin, "Black Students Face More Harsh Discipline, Data Shows," *The New York Times*, 06-Mar-2012.
- [22] C. E. Sleeter, "Deepening Social Justice Teaching," *J. Lang. Lit. Educ. Online*, p. 5, Feb. 2014.
- [23] K. Schwartz, "Facing Race Issues In the Classroom: How To Connect With Students," *MindShift*. [Online]. Available: <http://ww2.kqed.org/mindshift/2014/04/04/how-can-teachers-address-race-issues-in-class-ask-students/>. [Accessed: 30-Nov-2015].
- [24] D. Harris, "Chapel Hill Students Navigate Minority Teacher Shortage," *Southern Neighbor*, vol. 14, no. 4, pp. 7–8, Apr-2015.
- [25] C. T. Clotfelter, E. J. Glennie, H. F. Ladd, and J. L. Vigdor, "Teacher Bonuses and Teacher Retention in Low-Performing Schools: Evidence from the North Carolina \$1,800 Teacher Bonus Program," *Public Finance Rev.*, vol. 36, no. 1, pp. 63–87, Jan. 2008.
- [26] S. Haruch, "A Graduate Program Works To Diversify The Science World," *A Graduate Program Works To Diversify The Science World*, 13-Jan-2014. .
- [27] "About the Bridge Program," *Fisk-Vanderbilt Bridge Program*. [Online]. Available: <http://fisk-vanderbilt-bridge.org/program/description/>. [Accessed: 01-Dec-2015].