Accessing STEM-Focused Education: Factors That Contribute to the Opportunity to Attend STEM High Schools Across the United States

M. Felicity Rogers-Chapman¹

Abstract
In recent years, policy makers, researchers, and educators have focused on the preparation of individuals in STEM (science, technology, engineering, and mathematics) fields. One popular policy lever is STEM-focused high schools. The purpose of this study is to identify which student populations have access to STEM secondary schools. By comparing STEM high schools to neighborhood schools and districts, this study finds access to STEM high schools to be unevenly distributed. Among the key findings is that STEM high schools tend to have fewer students from disadvantaged groups than their district averages. Furthermore, I find that African Americans are disproportionately represented in admissions-only STEM high schools. As funding for more STEM high schools is allocated and infused into the system, it is important to identify locations and groups that may benefit and currently lack access to STEM high schools. Decision makers would be wise to place future STEM high schools in areas with high percentages of Latino students who may benefit from these unique programs.

¹Claremont Graduate University, Claremont, CA

Corresponding Author:
M. Felicity Rogers-Chapman, Claremont Graduate University, 150 E. Tenth Street, Claremont, CA 91711, USA.
Email: felicity.chapman@cgu.edu
Recent policy reform has focused on preparing more students in STEM (science, technology, engineering, and mathematics) fields. Interest in increasing the number of individuals for STEM has developed out of a concern that there are not enough U.S. graduates to supply STEM jobs (Castellano, Stringfield, & Stone, 2003; President’s Council of Advisors on Science and Technology [PCAST], 2010). In the United States, the ratio of postsecondary STEM degrees to all degrees awarded has hovered around 17% for the past 20 years (Kuenzi, 2008). The United States falls well below other countries in participation in STEM fields. For example, in 2002 the number of students majoring in STEM fields as a percentage of college students was 26.2% in European countries, and 33.3% in Asian countries, with numbers as high as 50% in China and 64% in Japan (National Science Foundation [NSF], 2006). Increasing STEM majors is a concern for policy makers.

Increasing STEM majors can be accomplished by providing STEM preparation for underrepresented populations, in particular students from low-income backgrounds (Means, Confrey, House, & Bhanot, 2008; Oakes, 1990; PCAST, 2010). STEM high schools aim to do just that. These specialized secondary schools are designed to prepare students for STEM fields. Students who attended STEM-focused high schools pursued STEM-related majors at a rate of 50% higher than students who attended traditional high schools (Subotnik & Tai, 2011). However, with only an estimated 100 to 500 STEM high schools across the nation (Kuenzi, 2008; Means et al., 2008; PCAST, 2010), access is limited. Unfortunately, we know little about which students may have access to these schools. Limited access may hinder students from different backgrounds or areas of the country from the potential opportunity to learn at STEM high schools.

The purpose of this study is to understand which students across the United States have access to STEM high schools. Specifically, this study looks at access by student demographics and spatial access by region and urban locale. If, as suggested in a recent report to the president (PCAST, 2010), the nation will create 200 more STEM high schools, it is important to understand who has access to them and how access might be equalized by appropriate placement of new schools.
Theoretical Framework

School access is important in that it affects issues of equity. Theory related to spatial inequity has focused on uncovering the source of distributional patterns. Studies cite organizational rule (Lineberry, 1977; Rich, 1982), politics (Meier, Stewart, & England, 1991), and race (Cingranelli & Bolotin, 1983). Theory related to inequity in access to educational component has focused on counseling (Holmes, Dalton, Erdmann, Hayden, & Roberts, 1986; Lee & Ekstom, 1987), curriculum (Cogan, Schmidt, & Wiley, 2001; Oakes, 1990; Schmidt, Cogan, Houang, & McKnight, 2011), and tracking by student background (Gamoran & Berends, 1987; Rubin, 2003). Additionally, a large body of theory has developed around the concept of inequity in access resulting from stratification. Social stratification occurs when people are grouped into social classes.

Stratification among schools has been part of the education discussion for decades. The Truman Commission Report (1947) found stratification in educational attainment, especially as it pertained to African American students. The educational system denied equal opportunity for African Americans starting as early as the first grade. The Truman Commission Report (1947) called for the establishment of open admission community colleges, which would be free for all youth. The Coleman Report (1966) commissioned by the Johnson administration continued the inquiry into equity in education. The Coleman Report found that school differences not related to per pupil funding affected educational quality. The team of researchers led by Coleman further reported that socially disadvantaged African American students benefitted from racially mixed classrooms. More recent studies expand issues of inequity with findings that link differences in schools, and in particular teachers, to student outcomes (Darling-Hammond, 2004; Hanushek, 2003). Therefore, it is important to examine how access to schools is distributed.

Stratification theory (Kerbo, 2006) suggests that access to opportunity may be limited by the control of resources by the “haves.” With a policy goal of reducing stratification within STEM fields, this study hypothesizes that inclusive (open admission) STEM high schools will have higher proportions of low-SES, minority students than their corresponding district representation. Furthermore, it is expected that exclusive (selective) STEM high schools will have higher percentages of students who have traditionally participated in STEM fields, that is, high SES, White, and Asian students. Because exclusive schools have admission requirements, it is less likely that they will reach low-SES, minority students who are more likely to have been placed in
low-level math and science courses (Cogan et al., 2001) than their higher SES peers and are therefore less likely to have obtained the necessary requirements for admission to exclusive STEM high schools.

Background

The demand for students in science, mathematics, engineering, and technology (STEM) fields consistently outpaces the supply in the United States. An increasing number of jobs require STEM knowledge (Lacey & Wright, 2009). Yet students in the United States are largely underprepared to enter STEM fields. Seventy-five percent of United States eighth graders were not proficient in mathematics in 2009 as measured by the National Assessment for Educational Progress (Cogan et al., 2001).

A gap in preparation for STEM fields exists between underserved populations, such as African Americans and Hispanics, and the majority group in STEM fields, Whites, and Asian males. While the average White or high SES student may perform at the 50th percentile, the average low-SES, Black, or Hispanic student performs in the 20th percentile (National Research Center [NRC], 2011). Latinos, African Americans, and women are underrepresented in STEM fields relative to their proportion in the population at large. For example, Latinos represent just 5% of STEM workers but 20% of the U.S. population. In a study of participation in AP science and mathematics exams in California, researchers found both growing participation and achievement in AP exams but minority participation growing at a slower rate than Whites (Brown & Campbell, 2008). Education reform aims to increase the participation of students underrepresented in STEM fields.

To raise the number of undergraduate degrees in STEM fields, education policy needs to support the preparation of students who are underrepresented in STEM fields at the K12 level. One recent policy solution that is growing in popularity is the development of inclusive STEM secondary schools, defined as open admission schools focused on preparation for and engagement in STEM fields. States such as Texas and Ohio have launched several inclusive STEM secondary schools since 2005 (PCAST, 2010). Early research into STEM schools suggests that specialized STEM schools have high access to resources, motivated students, and, in some cases, freedom from state testing requirements (NRC, 2011). Additionally, inclusive STEM high schools recruit students from low-SES backgrounds. They provide additional support for students who might not otherwise be academically prepared such as tutoring and summer bridge programs (PCAST, 2010). STEM schools may have expert teachers, opportunities for apprenticeships
with scientists, access to sophisticated laboratory equipment, and advanced
curriculum (Subotnik et al., 2011). These additional resources provide oppor-
tunities for students in science and mathematics. Furthermore, these mea-
sures have been linked to increased interest and participation in STEM majors
(Subotnik et al., 2011). Early research into Texas’ inclusive STEM schools
shows that students perform slightly higher on mathematics and science
achievement, are absent less, and take more advanced courses than peers in
traditional schools with similar demographics (Young, House, Wang,
Singleton, & Klopfenstein, 2011). These findings are limited in that they do
not account for potential selection bias. It may be that students who choose to
attend STEM high schools are more motivated or prepared in comparison to
their traditional school peers and that their higher performance levels is not
related to the school itself but instead to individual student characteristics.
Furthermore, a study controlling for selection bias would allow for compari-
son of the STEM specialized high schools versus traditional high schools in
measuring student outcomes.

Research Question

The research question for this study is “Who has access to which types of
STEM secondary schools in the United States?” To answer this question, I
pose three subquestions:

1. What is the relationship between SES and access to each type of
   STEM secondary school in the United States?
2. What is the relationship between student race and access to each
type of STEM secondary school in the United States?
3. What is the relationship between geographic placement and urban
   locale of schools and access to STEM secondary schools?

The Gap in STEM Education

Inequity measured by race, gender, and location in STEM education has
occurred due to variations in teacher quality, school funding, courses offered,
resources, and facilities (Darling-Hammond, 2004; Gamoran & Berends,
1987; Schmidt et al., 2011). The opportunity to learn in high schools is likely
to be stratified (Gamoran & Berends, 1987) due to between-school differ-
ences and student backgrounds. Between-school stratification refers to the
different opportunities to learn offered from school to school. One concept
of opportunity is the availability of courses at any individual school. A wide
variation in both availability of courses and the quality of the courses offered exists across the United States (Gamoran, 1987; Kahle & Lakes, 1983; Schmidt et al., 2011; Welch, Anderson, & Harris, 1982). Using TIMSS-R data, researchers found significant differences in content coverage in mathematics classes both between schools and within schools. The study suggests that a gap in content coverage across the United States presents different opportunities for students to gain the skills and knowledge to progress on the academic pipeline (Schmidt et al., 2011). In an earlier study of TIMSS data, a mismatch in textbook and course title on mathematics existed for nearly 30% of U.S. eighth-grade students (Cogan et al., 2001). Students may be taking Algebra but may not be gaining the skills necessary to advance to the next course because they are using textbooks below the content level suggested by the course title. Differentiation not only in content but manner in which content is delivered has been shown to affect learning outcomes. Further study through qualitative means would add to understanding possible stratification among schools.

Each student brings his or her own background to school, which influences the way in which they approach learning opportunities. Student background includes such factors as gender, race, SES, and parents’ education level. Student background affects how a student and their family interact with a school environment. Student background is connected to student achievement (Lareau, 2002). In a multiyear study, Lareau found that parents from low- and middle-SES backgrounds interact both with their children and with schools differently. She found that parents from higher SES backgrounds are more likely to encourage their children to ask questions of authority figures than lower SES families. This affects the way children interact with teachers and may stratify learning opportunities. Additionally, high-SES parents are more likely to understand and navigate the school culture as an advocate for their child (Lareau, 2002).

A low-SES background may also influence a student’s choices. Children living in poverty with less access to resources (as measured by parental education, parents’ occupational status, and family income) are more likely to drop out of high school (Rumberger & Lim, 2009). Research indicates that family background, including SES, maternal education, and family expectations, is the strongest determinant of a student’s educational attainment (Belfield & Levin, 2009). The way in which students interact with the school culture shapes their opportunities. White and Asian students are likely to exhibit early interest in mathematics and science and thus be placed in high-ability programs than African Americans and Hispanics, who were more likely to be placed in remedial or low-ability groups (Dossey, Mullis,
Lindquist, & Chambers, 1988; Persell, 1977; Rosenbaum, 1980). Placement into lower ability groups negatively impacts student opportunity. For example, low-level mathematics courses tend to stress basic computational skills, while upper level courses emphasize math concepts and critical thinking. Students who are not in top classes learn less because of their academic placement (Slavin, 1985). Students categorized as low-achieving often are also low income. Low-income students are typically tracked into low-level classes in high school. The impact of this may be less opportunity to participate in STEM fields because of lack of preparation in the academic pipeline.

Stratification of schools affects social equity and potential opportunities to learn. High-SES, low-minority schools tend to have better access to resources. Deficiencies in schools, combined with student background, provide disparate opportunities to learn. Therefore, the composition and location of STEM high schools has the potential to increase access to science and mathematics education for underrepresented populations in STEM fields. This study specifically addresses the composition and location of STEM high schools for the purpose of identifying which student populations are currently served by STEM high schools and inform the discussion as to which students may not currently have access.

**Method**

**Data**

The data for this study come from the Common Core Data set available from the National Center for Education Statistics (2007). Researchers have debated the definition of STEM secondary schools (Means et al., 2008; PCAST, 2010). STEM schools have a science, technology, engineering, and/or mathematics focus and may or may not include vocational schools depending on the definition adopted by the researcher. To account for the ambiguity in definition, this study compares results from three lists of schools.

The first list is generated from the National Consortium for Specialized Secondary Schools of Mathematics, Science, and Technology (NCSSSMST) and was used in the PCAST report to the president in identifying STEM secondary schools in the nation (PCAST, 2010). The NCSSSMST list of 88 schools consists of schools that are paid members of NCSSSMST. An earlier study conducted by SRI International (Means et al., 2008) adds to the NCSSSMST list by including schools based on their mission. This yielded a
list of 204 schools. Five schools that duplicated other observations in the same list were eliminated from this population. For this study, I identified STEM schools as those that contain STEM fields, as defined by the National Science Foundation, in its name (see Appendix A). I further narrowed the list to secondary schools (i.e., with students in Grades 9-12). Schools that are virtual (online), technical centers that were not schools, and those that were closed as of 2009 were removed from the data set, yielding a list of 459 schools. Examining school websites and district information, I classified schools by the three types of STEM schools identified in the 2010 report to the president (PCAST, 2010): exclusive, inclusive, and vocational. Because the intent of the development of STEM high schools is to increase the preparation of students for STEM degrees, I further eliminated all vocational schools. The final list includes 273 STEM secondary schools, 52 exclusive (selective), and 221 inclusive (open admission) schools.

Some lists include virtual schools while others do not. The SRI and NCSSSMST lists included alternative and virtual high schools, both of which were eliminated from the Name Search list used in this study. Schools within schools can also be found on the SRI and NCSSSMST list. The Common Core Data set does not have data specific to schools within schools and therefore could not be included in the Name Search list. Additionally, governor’s schools, residential academies that are run by states, are counted on the SRI and NCSSSMST list but not the Name Search list. Data for these schools do not appear in the Common Core Data set because they are not contained within the nation’s school districts.

Study Variables

For each school, I examined access to type of STEM school (exclusive or inclusive) in terms of the following independent variables: student eligibility (free/reduced-price lunch, no free/reduced-price lunch), race of students as defined by NCES, and urbanicity. Socioeconomic status of both schools and districts were determined by the percentage of students eligible for free or reduced-price lunch. Eligibility for free or reduced-price lunch is calculated using the Federal Poverty level for each year. For example in 2009, a family of four could make no more than US$28,665 annually to be eligible for free lunch and US$40,793 annually to be eligible for reduced-price lunch status. Free and reduced-price lunch eligibility as a measure of SES is limited in that it does not account for differences of cost of living that can further affect students’ socioeconomic background.
**Statistical Analysis**

The independent variables were first analyzed in terms of access to types of STEM schools. Because STEM schools make up less than 2% of secondary schools in the United States, access from a broad population to STEM schools is already limited. The analysis for this study focused on the students in STEM schools and the relationship between variables within schools and districts. Further for California schools, API (Academic Performance Index) scores for STEM high schools and a matched neighborhood schools, defined as within one mile of a STEM high school, were compared for school performance. API is the measure of academic performance for each school in California. Data for California API scores from 2005 to 2010 were included. For each list (NCSSSMST 2011, SRI 2009, and STEM Names), a Pearson chi-square test was conducted to determine independence of variables in relation to type of STEM schools. Furthermore, a difference of means test was conducted for each variable. Finally, logistic regression provided information regarding the relationship between SES and race and access to each type of STEM high school. The results of the analyses of multiple lists were extensive, so only the STEM Name Search list findings will be presented here.

**Results**

The data show a disparity in access to types of STEM schools by SES, race, and geographic location. Additionally, the California data suggest that STEM high schools perform better than their corresponding neighborhood schools.

**STEM Versus Non-STEM API Scores**

On average, California STEM high schools perform better on the API. For the period from 2005 to 2010, STEM high schools had an average API score of 746 while corresponding neighborhood schools averaged 663. The range of scores for STEM high schools was 599 to 943. Neighborhood schools’ API scores ranged from 453 to 941. By matching individual STEM schools to their neighborhood schools, I find STEM schools perform better on the API in the majority of cases. Outliers in which neighborhood schools perform better than STEM high schools do exist. This suggests a need for further research regarding STEM versus non-STEM high schools in terms of academic performance and preparation of students for STEM fields.
Results by STEM School Type

Inclusive STEM high schools enroll more than three times as many students as exclusive STEM schools. Less than 50% of students in STEM high schools are eligible for free or reduced-price lunch. If students were eligible for either, they were more likely to be eligible for free lunch (i.e., closer to the poverty level). In exclusive STEM high schools, almost 40% (39.74) of students were eligible for free lunch. Thirty-three percent of students in inclusive STEM high schools were eligible for free lunch. The two types of schools have a similar proportion of students eligible for reduced-price lunch with 6.19% and 6.89% at exclusive and inclusive schools respectively.

Inclusive (open admission) STEM high schools are more evenly distributed among White, Black, and Hispanic students than exclusive STEM high schools. More than 41% of students in exclusive STEM high schools are Black, with 24.46% of students in these schools being White. Asians, American Indians, and students identifying as coming from two or more races are not highly represented in STEM schools of either type. Asians constitute 10% of inclusive STEM high schools and just 4% of students in exclusive STEM high schools. In both schools, American Indians/Alaska Natives and students of two or more races make up less than 1% of the student population.

Wide variance in school composition exists for STEM high schools. The standard deviations show that for both inclusive ($SD = 26.47$) and exclusive ($SD = 31.59$) STEM high schools very low- and very high–SES schools exist. STEM schools have a wide distribution of students by race. Statistical significance between the means of exclusive and inclusive schools exists for both Blacks and Hispanics. Exclusive (selective) STEM high schools have a statistically significant higher percentage of Black students on average compared to other races. Blacks constitute on average 45% of exclusive STEM school students. This is significant for two reasons: first Black students are much more highly represented in exclusive schools than they are in inclusive (open admission) schools and second, they are overrepresented in STEM schools than in the secondary school population of which they only make up 9%. The first point is of particular interest in that the literature suggests that minorities, and in particular Blacks, drop out of the academic pipeline for STEM before they reach high school (Oakes, 1990; Wenner, 2003). If this is true, then the question becomes how do students who are not prepared for the rigorous curriculum of STEM as measured by test scores and previous academic achievement gain admission into exclusive STEM high schools at a rate disproportionately high for their representation in high schools at large? Additionally, the
overrepresentation of Blacks in STEM exclusive high schools suggests that Blacks have better access to STEM schools than students from other races. Hispanics represent 20% of students in exclusive schools, a percentage similar to their national representation of secondary students (22%). In inclusive STEM schools, Hispanics constitute 29% of the population, suggesting that the goal of the policy to increase participation in STEM high schools of Hispanic students is succeeding.

While inclusive STEM high schools have fewer students eligible for free and reduced-price lunch as a percentage of total enrollment, exclusive STEM high schools have a lower percentage of schools with low-SES students. Of the exclusive STEM high schools, 29 of the 52 have fewer than 50% of students eligible for free or reduced-price lunch. Inclusive STEM high schools are more likely to be high poverty schools than exclusive STEM high schools. Ninety-nine of the 221, or 45% of the inclusive STEM high schools, have more than 70% of students eligible for free or reduced-price lunch.

Using a simple logistic regression (Table 1) shows that SES has a statistically significant role in access to STEM high schools by type. The odds that a STEM secondary school is inclusive is 3% greater for each 1% increase in the number of students who are eligible for free or reduced-price lunch. Exclusive schools are more likely to have fewer students from disadvantaged backgrounds. Furthermore, the odds of a school being inclusive are 10% lower for each increase by 1% of Black students. This finding is supported by the disproportionately higher percentage of Black students in exclusive STEM high schools. Furthermore, it reinforces the need for further research into the representation of Black students in exclusive STEM high schools.

Furthermore, the data show that STEM schools are not evenly distributed across the United States nor are they distributed evenly between urban and suburban locations. Where a student lives matters as to whether or not he or she may be able to access a STEM high school. Using the NCES codes for urban locale (for a full description of codes see Appendix B), I identified the frequency of each type of STEM high school to be located in the different locales.

Inclusive (open admission) STEM high schools are concentrated in cities, and more specifically large cities. Of the 221 inclusive STEM high schools, 111 (50%) are situated in large cities. Exclusive (selective) STEM high schools are also more likely to be in city areas than noncity areas. Thirty-seven (71%) of the exclusive STEM high schools identified in this study are located in urban areas. Students living in large cities are more likely to have access to STEM high schools of either type than those not living in cities.
Figure 1 shows the specific placement of STEM high schools in the continental United States. The inclusive STEM high schools are more widely distributed than the exclusive STEM schools. States that are less densely populated, such as Montana, North Dakota, and Wyoming, do not contain any STEM high schools. These states may have other STEM initiatives in place that do not include STEM-focused high schools. Students on the West Coast have very limited access to exclusive STEM high schools, with only 2 exclusive high schools available, one in Northern and one in Southern California. The lack of even distribution of types of STEM schools throughout the United States stratifies access to these schools for students of different ethnicities and socioeconomic backgrounds.

As Figure 1 above illustrates, more STEM schools are located on the East Coast and the South Atlantic regions than in the Midwest or Western States. Furthermore, exclusive schools are concentrated in the East and South Atlantic with only 2 in each the Mountain, Pacific, and West North Central

<table>
<thead>
<tr>
<th>Table 1. Logistic Regression and Odds Ratio by STEM Type (Exclusive = 0, Inclusive = 1): SES, Ethnicity (N = 234).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logistic regression and odds ratio</td>
</tr>
<tr>
<td>Number of observations = 234</td>
</tr>
<tr>
<td>LR chi² (5) = 38.27</td>
</tr>
<tr>
<td>Prob &gt; chi² = 0.0000</td>
</tr>
<tr>
<td>Pseudo R² = 0.1560</td>
</tr>
<tr>
<td>Log likelihood = −103.55173</td>
</tr>
<tr>
<td>STEM type</td>
</tr>
<tr>
<td>Coefficient</td>
</tr>
<tr>
<td>SES—Percentage of students eligible for free or reduced-price lunch</td>
</tr>
<tr>
<td>Ethnicity</td>
</tr>
<tr>
<td>White</td>
</tr>
<tr>
<td>Black</td>
</tr>
<tr>
<td>Hispanic</td>
</tr>
<tr>
<td>Asian</td>
</tr>
<tr>
<td>Constant</td>
</tr>
<tr>
<td>9.24554</td>
</tr>
<tr>
<td>6.51174</td>
</tr>
<tr>
<td>1.42</td>
</tr>
<tr>
<td>0.156</td>
</tr>
</tbody>
</table>
Figure 1. Geographic distribution of STEM high schools across the United States.
divisions. The large concentration of STEM schools in the Middle Atlantic area (New York, Pennsylvania, and New Jersey) is likely to be due to the large districts in these areas. The New York City School District and Philadelphia School District are the largest and 10th largest in the nation, respectively (U.S. Department of Education, 2009). Given district size, though, we might expect to find a larger number in Los Angeles Unified School District, the second largest school district in the nation by enrollment, or in Florida, which has the fourth and eighth largest school districts.

### Results by STEM School Type and District

The variance between distribution of race and SES in the two types of STEM schools is better understood in a comparison of school demographics to the demographics of their districts and neighborhood schools. In other words, are the STEM high schools representative of the distribution of students in the area in which they are located? For the purpose of this study, neighborhood schools are defined as those within a 1-mile radius of the STEM high school. This limits the findings in that rural STEM high schools may not be matched with a traditional high school. For the discussion of districts, this study includes districts that have at least one STEM-focused secondary school.
A statistically significant difference between school SES and district SES exists (Table 2). The school SES mean (52%) is lower than the mean of neighborhood schools (62%) and school districts (59%). These findings suggest that STEM secondary schools are not as accessible to students from a low-SES background as those from a high-SES background within each district.

While students in STEM schools are substantively representative of their districts, they are not representative of their neighborhood schools. No statistically significant difference exists between district and school representation of Hispanics and Asians. From a statistical standpoint, Black students are slightly overrepresented and White students are slightly underrepresented in STEM high schools as compared to their district average. Depending on the size of schools and districts, these differences may be less significant from a practical standpoint. For example, a STEM high school of 400 students might have a statistically significant higher proportion of Black students than the district just by adding 2 Black students to its population. Thus the data show that STEM schools are representative of their districts in terms of race but tend to have a smaller proportion of students eligible for free or reduced-price lunch than their district means. White students are overrepresented in STEM high schools (29%) compared to neighborhood schools (19%), while Black and Hispanic students are underrepresented in comparison to their neighborhood schools. Black students constitute 38% of their neighborhood school enrollment but just 33% of STEM high school enrollment. Hispanic students are similarly underrepresented, making up 35% of enrollment in neighborhood schools and 28% of enrollment in STEM high schools. The disparity between representation in neighborhood and STEM high schools for poor, minority students suggests that despite the placement of schools in urban locales, STEM high schools on average may not be reaching the target population of the policy.

**Discussion**

With a limited number of STEM-focused high schools nationwide, limited access for all students remains. This study reveals several important findings related to access to STEM schools. First, the analysis of SES students and schools shows wide variations across STEM high schools. Exclusive schools tend to constitute a higher percentage of high-SES schools, those with less than 30% of students eligible for free or reduced-price lunch than inclusive STEM schools. In contrast, inclusive STEM high schools include a higher percentage of schools classified as high poverty (nearly 40%), with more
than 70% of students eligible for free or reduced-price lunch. Furthermore, neighborhood schools have higher poverty on average than STEM schools, suggesting that access to STEM high schools is not evenly distributed for poorer students. This has potentially significant implications. The enrollment in inclusive STEM high schools is more than three times that of exclusive STEM high schools, meaning many more students in practical numbers are being placed in high-poverty schools. Research demonstrates the importance of students from low-SES backgrounds attending high-SES schools. Students from low-SES backgrounds perform better academically when in schools with less than 50% of students come from low-SES backgrounds (Rumberger & Palardy, 2005). Additionally, curriculum variations may exist between the two types of schools (Means et al., 2008). While knowledge of the differences between STEM school curricula is limited, the literature suggests high-poverty schools are limited in resources. In a SRI report, researchers found that on average exclusive STEM high schools are more academically rigorous than nonexclusive schools (Means et al., 2008). Research suggests that less challenging coursework can reduce a student’s opportunity to prepare for STEM fields (Cogan et al., 2001; Oakes, 1990).

In addition to SES affecting placement in exclusive or inclusive schools, SES in STEM schools is not representative of districts. STEM schools tend to have a higher SES than the district mean. The low-SES students within a given district may have less access to STEM schools due to geographic placement in the district and knowledge of their existence. Even inclusive schools with an open enrollment policy traditionally require an application. The source of the disparity of SES between STEM schools and districts requires further study.

Race, in particular being Black, has an effect on access to STEM schools. Compared to national representation in the secondary population, Black students are overrepresented in STEM schools. They are also more highly represented in STEM schools than in their district. This suggests that Black students have better access to STEM high schools and, in particular, better access to exclusive STEM high schools. Given the goal of the policy to reach underrepresented populations, the high percentage of Blacks as compared to Whites and Asians suggests that the policy is achieving its goal.

Of concern, though, is the underrepresentation of Latino students in the STEM high schools. As the fastest growing minority population, the increase in participation of Latino students in STEM fields has both practical and social implications. Exclusive STEM high schools have relatively low enrollment by Latino students. Latino students are more equally represented to other ethnicities in inclusive STEM high schools. Participation in STEM-focused high schools by Latinos mirrors their district percentages. Therefore the data
suggest that the underrepresentation of Latino students overall in STEM schools may be due to placement of STEM schools in districts that have less than 30% of its student population of a Latino background. Texas, a state with a large Latino population, has launched a STEM initiative that includes the creation of more STEM schools in the state. I would expect that in future years Latino participation in STEM schools may increase. Based on the type of STEM schools being added in recent years, I predict that the participation will be in low-SES, minority inclusive STEM schools.

From a research perspective, this study finds that in addition to demonstrating who has access to STEM high schools, it is necessary to come to a consensus among researchers on the definition of a STEM high school. If the intent of the STEM high school policy is to prepare students for STEM majors, then the definition of STEM high schools should be limited to those who do just that. A discussion as to the merit of including vocational schools, which offer fewer upper level science and mathematics courses, is merited. Practical considerations related to the definition of STEM schools include school practices as well as funding for STEM schools. As more STEM-focused secondary schools are built, researchers and policy makers need to come together to clearly define what constitutes a STEM school.

**Limitations**

This study provides evidence of stratification in STEM high schools but is limited in its ability to assess the impact of such stratification. Further research that examines both immediate and long-term outcomes is necessary. A detailed study of STEM high school outcomes such as student achievement and graduation rates in comparison with schools of similar demographics is warranted. Furthermore, if as is suggested by policy that STEM-focused schools better prepare and engage students for STEM majors than traditional schools, postsecondary outcomes for students who graduate from STEM schools need to be determined. Geographic factors may contribute to access as well as explain some of this disparity and are worthy of further study. The uneven distribution of Blacks in STEM high schools may be explained by the placement of schools in areas with higher percentages of Black students than the overall secondary student population. Research is required to understand how and why Black students are overrepresented in STEM high schools. At this time, little is known about where STEM high schools are located. In theory, these schools provide an opportunity to prepare and engage additional students for STEM fields, which are in high demand in the United States. Spatial stratification would reduce opportunities for some
students. Furthermore, with so little known about STEM high schools in general, a finely grained study of what occurs within the different STEM school types will better inform the discussion of the value of these schools as an educational model for increasing STEM majors, particularly for underrepresented populations.

Policy Implications

The variation in SES and ethnic composition of STEM high schools as well as the significant difference between STEM schools and districts suggests that stratification of access to STEM high schools exist. As new schools are created, it is important to specifically target Latino students from low-SES backgrounds who continue to be underrepresented. Additionally, the value of STEM high schools over traditional high schools in preparing students for STEM fields needs to be examined in great detail. A long-term investment in research into the merit of STEM high schools needs to be included as part of the STEM education policy agenda. It is of little importance to build more STEM high schools until researchers and policy makers can both define them and assess their ability to change the participation of students in STEM fields.

Appendix A

STEM Fields According to the National Science Foundation

Mathematics
Statistics
Forestry
Engineering (electrical, chemical, mechanical, civil, or other engineering)
Computer science
Natural resources
Physics
Biophysics
Geography
Environmental studies
Physical sciences
Chemistry
Biological science
Interdisciplinary studies including biopsychology
Technology
Appendix B

11 = City, Large: Territory inside an urbanized area and inside a principal city with population of 250,000 or more.
12 = City, Midsize: Territory inside an urbanized area and inside a principal city with a population less than 250,000 and greater than or equal to 100,000.
13 = City, Small: Territory inside an urbanized area and inside a principal city with a population less than 100,000.
21 = Suburb, Large: Territory outside a principal city and inside an urbanized area with population of 250,000 or more.
22 = Suburb, Midsize: Territory outside a principal city and inside an urbanized area with a population less than 250,000 and greater than or equal to 100,000.
23 = Suburb, Small: Territory outside a principal city and inside an urbanized area with a population less than 100,000.
31 = Town, Fringe: Territory inside an urban cluster that is less than or equal to 10 miles from an urbanized area.
32 = Town, Distant: Territory inside an urban cluster that is more than 10 miles and less than or equal to 35 miles from an urbanized area.
33 = Town, Remote: Territory inside an urban cluster that is more than 35 miles from an urbanized area.
41 = Rural, Fringe: Census-defined rural territory that is less than or equal to 5 miles from an urbanized area as well as rural territory that is less than or equal to 2.5 miles from an urban cluster.
42 = Rural, Distant: Census-defined rural territory that is more than 5 miles but less than or equal to 25 miles from an urbanized area as well as rural territory that is more than 2.5 miles but less than or equal to 10 miles from an urban cluster.
43 = Rural, Remote: Census-defined rural territory that is more than 25 miles from an urbanized area and is also more than 10 miles from an urban cluster.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author received no financial support for the research, authorship, and/or publication of this article.
References


President’s Council of Advisors on Science and Technology. (2010). *Prepare and inspire: K-12 education in science, technology, engineering and mathematics (STEM) for America’s Future*. Washington, DC: Author.


**Author Biography**

**M. felicity Rogers-Chapman** is a doctoral candidate in educational policy, reform, and evaluation at Claremont Graduate University. She is a Bowen Policy fellow in higher education, a Marianne Balasco fellow and a Richard Riordan Policy fellow. Her research interests include education policy, urban studies, stratification, educational change, and policy implementation.