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Student Participation in a STEM Preparation Program and Academic Performance at a Historically Black College and University

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Abstract

There has been a question whether or not the United States (US) is behind in global competitiveness in regard to providing an adequate supply of Science, Technology, Engineering, and Mathematics (STEM) workers. As the diversity of the United States population increases and is compounded by an underrepresentation of minority students pursuing a STEM-related degree, there is an increased need for minority students to pursue careers in STEM-related fields in the United States (US). This study examined if Black students' participation in the Research Initiative for Scientific Enhancement (RISE) program was related to their academic performance and preparedness for STEM-related fields and other classes. The study employed the science identity conceptual framework, which argues that minority students need to have science identities, competence, performance, and recognition as "science persons." This study utilized GPAs data of RISE program participants, controlled for their races, gender, previous educational achievements, and parental education levels, and compared them with non-program participants. Using the Average Treatment Effect on the Treated it was found that RISE program participants had significantly higher STEM GPAs and cumulative GPAs versus non-RISE students. The results may inform the federal government, policy makers, and educational leaders of the advantages of funding and establishing the RISE program in schools.

Key Words: Academic Performance, Higher Education, Science Technology and Math

Introduction

This study examined the relationship between minority students' participation in the Research Initiative for Scientific Enhancement [RISE] (NIH, 2017) a STEM enrichment program and their STEM-related academic performance and preparedness for math, science, and all other courses. It has been argued that there exists a heightened need for minority students to pursue careers in STEM fields in the US (Bright, 2013; Casey, 2012). There is underrepresentation of minorities in STEM, and as the percentage of minority Americans increases, certis paribus, the disparity will increase. Racial and ethnic minorities are expected to consist of more than one-half of the national population by 2050 (Jackson, 2013; Museus, Palmer, Davis, & Maramba, 2011). Minority students constituted 10% of the College of Engineering Program's undergraduate enrollment at North Carolina State University (NC State Engineering, 2014). Similarly, the *Hispanic Outlook in Higher Education* reported that there were less significant proportions of African-American, Native American, and Hispanic women in STEM majors; these minority groups were underrepresented amongst all STEM majors (McGlynn, 2009). Additionally, a National Science Foundation study on science and engineering performance indicators showed that the percentage of African American undergraduate students who were awarded degrees in STEM slowly rose from 7.7% in 1997 to 8.3% in 2006. From 2002 to 2006, this percentages remain between 8.3 and 8.4% yearly, indicating the strong need for greater enrollment and retention programs (Kendricks, Nedunuri, & Arment, 2013). More recently Bidwell (February 24, 2015) stated that according to recent reports since 2000, the number of black and latino students interested in STEM has declined. With respect to social justice and economic earnings, due to significant earnings benefits, STEM fields are one way to elevate the social classification of low-income minorities, removing them from chronic poverty (Adolino & Blake, 2011). Historically on average, those in STEM positions have garnered 26% more in earnings compared to their counterparts in other fields (Bright, 2013).

STEM enrichment programs have been established for the purpose of recruiting minority students into STEM fields (Flowers, 2009; Hansen & Gonzalez, 2014; Kendricks et al., 2013; Miller, Chang, Wang, Beier, & Klisch, 2011; Slovacek et al., 2011; Wyss, Heulskamp, & Siebert, 2012). Some of the enrichment programs were established in middle schools and high schools as well as in higher education. It is argued that minority STEM enrichment programs such as the RISE program should start enrolling their participants from the third grade and exposing them to an additional 15 minutes of independent practice with math and science programs lessons each day (Martella, Nelson, Morgan, & Marchand-Martella, 2013). This is a similar principle as Olympic participants who start preparing as early as before the age of seven, nine or an older (DeJarnette, 2012; Sundgot-Borgen & Garthe, 2011).

Background

The government initiated American colleges and universities in the 1640s, for the purpose of educating upper class White men to serve in positions of power in the New World (Thelin, 2004). Women won the right to attend colleges in the late 1770s and the government opened Salem College in North Carolina as the first American women's college in 1772. Similarly, according to Thelin (2004), the government did not recognize Blacks in the US as citizens and so they did not admit them into an exclusive institution such as the university; as an aside, Cheney University in Pennsylvania became the first Black university, in 1837. Black land-grant colleges were formed via federal grants for educating the newly freed Blacks shortly after the end of slavery in the 1890s. Several Blacks and non-Blacks became students in these colleges and universities over the years. However, little by little, minority students were also admitted to predominantly white universities (Thelin, 2004).

Although minority students were accepted into predominantly White universities, the U.S. Census Bureau (2012a), in 2009 reported, minority students 25 years and over who earned bachelor's degree or more in the US were only 17.6% Black and 12.6% Hispanic. Out of the 56 million people aged 25 and over who earned a bachelor's degree, approximately 20 million of them earned a degree in science and engineering fields (Siebens & Ryan, 2012). In addition, the U.S. Census Bureau (2012b) states, earnings in dollars of a bachelor's degree holder in STEM-related fields were $72,415.00 annually compared to Non-STEM workers in business, education, and arts, humanities, and others with annual earnings in dollars $64,553.00, $49,152.00, and $52,691.00, respectively (U.S. Census Bureau, 2012b). Finally, in 2011, out of approximately 117 million civilians aged 25 to 64 employed, about seven million were STEM occupants. Out of the seven million people employed in STEM occupations, minorities in STEM were only 6.4% Black and 6.5% Hispanic compared to 70.8% White and 14.5% Asian (U.S. Census Bureau, 2013).

The need for STEM workers has increased in the current global economy, in the nation, and in the nearest locality, especially among the minorities (Casey, 2012; DeJarnette, 2012). Many studies have shown that STEM innovation has been a main driver of US economic growth. The late 20th century led to huge progress in computer and information, and biomedical technologies. Subsequently, to capture the economic benefits of the prevailing and unsubstantiated technologies in their entirety will need a pipeline of Americans equipped with STEM knowledge, skills, and abilities. In addition, the needs for STEM workers have increased even in other fields due to the dispersion of technology (Casey, 2012).

Literature indicated different minority STEM-related programs established in schools in order to equip students with respect to STEM majors (Flowers, 2009; Hansen & Gonzalez, 2014; Kendricks et al., 2013; Miller et al., 2011; Slovacek et al., 2011; Wyss et al., 2012). Kendricks et al. (2013) argued on minority student perception of the impact of mentoring on STEM disciplines, that students perceived mentoring as a contributor to their academic success in STEM areas. Kendricks et al., focused on the impact of mentoring on academic performance, but they did not report if the program or activity influenced them to major and graduate in STEM-related careers. Similarly, most researchers who studied STEM-related programs such as RISE, evaluated either the effectiveness of their various programs, activities in the programs, or the impact of the enrichment programs on program participants' retention, academic performance, major, and graduation (Almarode et al., 2014; Carter, Mandell, & Maton, 2009; Eagan et al., 2013; Fifolt, Engler, & Abbott, 2014; Jones, Barlow, & Villarejo, 2010; Kendricks et al., 2013; Kier, 2013; Maton, Sto Domingo, Stolle-McAllister, Zimmerman, & Hrabowski, 2009; Miyake et al., 2010; Slovacek et al., 2011; Soldner, Rowan-Kenyon, Inkelas, Garvey, & Robbins, 2012). Yet, the aforementioned studies did not examine the relationship between minority students' participation in the RISE program and their STEM-related academic performance and preparedness for math, science, and all other courses. Therefore, it is argued that there is a gap in the knowledge regarding the relationship between minority students' participation in the RISE program and their STEM-related academic performance and preparedness for math, science, and other courses.

Conceptual Framework

The science identity conceptual framework (Eagan et al., 2013) was used to understand how minority students' participation in the RISE, a STEM enrichment program, was related to STEM-related academic performance and preparedness for math, science, and other courses (compared to non-participants or non-treated group).

Connection of key elements of the framework with STEM programs. The key elements of science identity framework, (a) viewing identity from the science education scholars' way (i.e., social theory, the process of learning which is socialization of students into scientific norms and scientific terminology, and the pursuit for more equitable science education) and (b) from the science identity model (competence, performance, and recognition) (Carlone & Johnson, 2007), all depict that constructing social relationships is significant in increasing one's science identity. Next, each of the key elements of the framework is discussed and connected with STEM enrichment programs.

It has been argued that minority students were marginalized by science teaching and learning practices, engineering, and related careers (Aikenhead, 2011; Johnson, 2011; Lee, Quinn, & Valdes, 2013; Meyer & Crawford, 2011). Rahm (2014) argues that the cultural research of science education is still marginalized and dominated by the cultural difference model; science education fails often to consider the socio-historical and political positioning of students and institutions and programs. In addition, only a few minority students possess the relevant science norms and discourse practices of science; most of them lack the skills, especially the Hispanics (Eagan et al., 2013; Lee et al., 2013). Furthermore, there is still lack of equity in science education, and the traditional school science practices still persist (Johri & Olds, 2011; Penuel & Fishman, 2012). Additionally, minority students often lack the competence, performance, and the recognition as seen in the science identity model that is required in scientific fields. Literature shows that students of color are more likely to have more difficulty succeeding in undergraduate science than their white counterparts as they face interrelated and multilayered challenges (Beasley & Fischer, 2012; Carlone & Johnson, 2007; Espinosa, 2011; Hurtado et al., 2011; Johnson & Bozeman, 2012).

As a result, to help minority students in the aforementioned situations, RISE programs were established at institutions serving minorities. STEM enrichment programs, including RISE, have structured activities that provide students with essential supports and information that assist them, helping them navigate through STEM-related pathways. It is where minority students socialize to demonstrate science discourse and practice (Eagan et al., 2013), along with having competence, performance and recognition to be identified as scientists; it is an avenue that will break the bridge between the mainstreaming and marginalization and make science education more equitable than the traditional practices. Therefore, as minority students participate in STEM enrichment programs, they socialize by connecting with faculty and advanced peers who give them access to professional networks. In addition, they have access to relevant information, resources from different institutions, workshops, presentations, and competitions to build their competence. More specifically, this is true for a study that used the RISE program to provide activities, including undergraduate research and professional development, to minority students. This allows them to be recognized as "science persons" by both their peers and the faculty; these allow them more science identities (Carlone & Johnson, 2007) than students who do not participate in the RISE program. In a related study conducted by Johnson and Bozeman (2012) on adopting an asset bundles model to support and improve minority students' careers in academic medicine and the scientific pipeline, the results indicated that undergraduate research consisted of the specific sets of skills and resources individuals had to build on, that assisted them to succeed in academics and professional tasks.

What is a STEM Enrichment Program?

A STEM enrichment program is any program or treatment that is designed to inspire participants and reinforce in these participants the perception that they can pursue STEM-related careers (Supalo, Hill, & Larrick, 2014). STEM programs utilize various structures to accomplish the aforementioned goals. These include (a) using a friendship group that has a climate supportive of STEM where students socialize with academic goals (Robnett & Leaper, 2013), (b) a support group established to provide adequate social and academic support for the purpose of exposing students to STEM (Soares et al., 2013); and (c) an initiative established for improving STEM enrollment, retention, and graduation (Chang, Kwon, Stevens, & Buonora, 2016; Godin et al., 2015; Merolla & Serpe, 2013; Salto, Riggs, Delgado De Leon, Casiano, & De Leon, 2014; Wilson et al., 2012a).

The STEM enrichment program investigated in this study is Research Initiative for Scientific Enhancement (RISE). There are numerous STEM enrichment programs. However, only few of them will be mentioned here. They are the Benjamin Banneker Scholars Program, Minority Opportunities in Research, McNair Program, Scholar Program, Meyerhoff Scholarship Program, Talent Search Program, remediation class, intervention class, supplemental class, some developmental classes, academic interaction, and some additional classes (Almarode et al., 2014; Carter et al., 2009; Eagan et al., 2013; Fifolt et al., 2014; Jones et al., 2010; Kendricks et al., 2013; Kier, 2013; Maton et al., 2009; Miyake et al., 2010; Slovacek et al., 2011; Soldner et al., 2012).

The Effectiveness of STEM Enrichment Program Activities

Mentoring. Mentoring, according to Slovacek et al. (2011), is when students are supported and advised by the faculty. Kendricks et al. (2013) examined the effectiveness of the Benjamin Banneker Scholars Program (BBSP). Results showed that mentoring was consistently rated as having the largest impact on their academic performance (Kendricks et al., 2013; Soldner et al., 2012). Some research studies (Jackson, 2013; Kendricks & Arment, 2011; Slovacek et al., 2011) found other activities more effective than mentoring in impacting students' performance or decisions; although they still reported the effectiveness of mentoring. In the programs, many activities were employed to enhance students' academic performance, which led to their graduation, and guided their entrance into PhD programs, along with their completing the PhD program in biomedical fields. Among the mentoring variables, the most significant predictors were having a mentor, receiving aid from that mentor in applying for graduate school, and having a faculty member who assisted in dealing with university issues. Similarly, the most significant research activity was taking part in communicating research to others (Slovacek et al., 2011). McGee, Saran, and Krulwich (2012) equally supported mentoring that impacts diversity by increasing scientific talents, particularly in underrepresented minorities.

Undergraduate Research. STEM support undergraduate research is done on campus in faculty-run labs. Jones et al. (2010) determined there was a relationship between timing and duration of undergraduate research involvement and college retention and academic performance in biological science.

Jones et al. found that, in spite of differences among these students in previous accomplishments and demographic characteristics, undergraduate research is positively associated with odds of earning a bachelor's degree, persevering in biology, and performing well in biology. Kendricks and Arment (2011) investigated the Scholar Program (SP) and found that among all the activities in this enrichment program, students ranked undergraduate research as having the greatest influence on professional preparedness for a STEM career and/or graduate study. Furthermore, undergraduate research participants were inclined to have enhanced academic performance, interest in a STEM PhD, interest in a STEM major, developed skills, and learning experience (Carter et al., 2009; Johnson & Bozeman, 2012; Maton et al., 2009; McGee et al., 2012; Shaw & Barbuti, 2010; Singer, 2013; Tyler-Wood et al., 2011).

Living-learning community. The effectiveness of the living-learning community was confirmed by Wawrzynski and Jessup-Anger (2010). They conducted a quantitative study and the results indicated that a student in a collaborative living-learning community is more likely to expect greater peer academic interactions as well as an enhanced academic environment. Findings indicated that students in living-learning environments experienced college differently as well. The students in collaborative living-learning communities were more likely to connect with their peers regarding academics and had more positive opinions about the benefit of their residence hall. Additionally, there were differences among the collaborative living-learning and combined living-learning community students, although they were hard to contrast directly (Wawrzynski & Jessup-Anger, 2010).

Whalen and Shelley (2010) found similar positive results about the living-learning community analysis revealed that the number of years students lived on-campus was significantly related with greater success, hence they were more likely to graduate or be retained by year six, which showed stronger academic capability of the STEM majors and students who participated in the learning community (which was available for STEM majors). Finally, Alkhasawneh and Hargraves (2014) concurred with the above studies about the effectiveness of the living-learning community in students' decisions to major in STEM fields. Results from the analyses of data showed the themes: The first themes that surfaced from the students' responses included the important role of family members, mostly parents, who played a part in impacting their decision to consider majoring in STEM (i.e., students' primary environment). Some students viewed their parents as role models and would try to follow their path and pursue a career in STEM fields. Relatives and acquaintances were another source of motivation as well. The second theme that surfaced was high skill in science and mathematics. The students expressed an understanding that STEM disciplines were appropriate with their career targets and abilities. To a smaller degree, students recognized the influence of high school teachers (Alkhasawneh & Hargraves, 2014). The overall results indicated that modeling retention for underrepresented minority students in STEM majors and analyzing main factors that influence student accomplishment, as well as understanding students' first year academic experience, could effectively build a learning environment and strategies that would lead students to the right path to success (Alkhasawneh & Hargraves, 2014).

STEM Programs Prepare Students For Math, Science, and Other Classes

When students participate in STEM enrichment programs, these programs prepared them for math and science classes and other subsequent classes (Rabitoy, Hoffman, & Person, 2012; Raines, 2012; Salto et al., 2014; Tran & Nathan, 2010; Wilson, Iyengar, Pang, Warner, & Luces, 2012).

Raines (2012) revealed that student participation in the FirstSTEP Summer Bridge Program positively influenced their academic performance and persistence rates at the same rate as the non-participants. The students' preparedness for their subsequent classes as a result of enrichment programs was revealed in a mixed-method study conducted by Salto et al. (2014) that examined and contrasted the effect of the Loma Linda University (LLU) Summer Health Disparities Research Program on high school (HS) and undergraduate (UG) student participants. The results of the study suggested that the program (SRE) impacted terminal degree intent and enhanced participant willingness and preparedness to incorporate research into future careers for both groups. In addition, it was revealed by the quantitative data that both the HS and the UG participants reported large, statistically significant advances in self-assessed research skills and research self-efficacy when compared to their prior conditions.

Rabitoy et al. (2012) supported the finding that enrichment programs prepare students for future academics. Their study found that students participating in SI received significantly higher final grades than non-participants in chemistry, physics, biology, and mathematics.

Furthermore, the small statistically significant enhancement in final cumulative GPA related with this study suggests that taking part in SI sessions results in academic performance benefits beyond the courses offering SI, and goes into enhancing academic performances in further course work (Rabitoy et al., 2012). Chyung, Moll, Marx, Frary, and Callahan (2010) concurred with the above studies about how students were prepared for future classes due to enrichment programs, in their investigation on the effectiveness of an introduction to material science and engineering course for preparing students to learn in the in-class lecture. In additional work (Moses et al., 2015; Palmer, Davis, & Thompson, 2010; Wai, Lubinski, Benbow, & Steiger, 2010) reported that STEM enrichment programs would not only prepare students for their future classes, but would strengthen their skills in those classes and subsequent STEM attainments. This is consistent with a study by Palmer et al. (2010) whose report includes how HBCU initiatives promote academic success among African-Americans in STEM and help students strengthen their skills in math and critical thinking, advanced math, mandatory tutorial support, and research/training.

Methodology

The treatment group, included students who were in STEM and non-STEM fields and were RISE program participants sometime within the past 14 years (from 2002 to 2016), while the control group were students in STEM and non-STEM fields, who did not participate in the RISE program. The participants were from equivalent cohorts of an HBCU in the south east. There were 114 students in the treatment group and 280 students in the control group. This number of students in the control group were used in order to find a good match for each student in the treatment group. Thus, there was a total of 394 students from different classifications such as sophomore, junior, senior, and graduate students from minority races – African American, Indian American, and Hispanics. The participants' age range was from 18 years and above. They were male and female students.

Procedures for recruitment and participation. Participants were recruited from the RISE program known as Research Initiative for Scientific Enhancement (RISE, 2016). Most participants were recruited in the program during that time, based on their STEM interest and willingness to participate in research, although a few non-STEM majors were also recruited. Participation in the RISE program is by self-selection/voluntary. Several criteria were used to recruit participants: (a) student must complete an application and provide three letters of recommendation, official transcript(s), personal statement, and state application; (b) student must be a full-time student; (c) they must be a sophomore as of fall semester; (d) they must apply with a minimum GPA of 2.8; (e) they must have declared their major in biology, chemistry, or psychology; (f) they must be a US citizen, US national or permanent resident; and (g) they must be African American, Hispanic, Indian American (FSU-RISE, 2012). In this study, students who have graduated were included as participants to ensure an adequate sample size to obtain a reliable regression model and to assume that coefficients of the predictors were from a normally distributed sampling distribution due to the central limit theorem. This led to realizing a valid confidence interval and significance test (Field, 2013).

Data Analysis

Research questions. These two research questions guided this study:

1. Is there a relationship between students' STEM-related academic performances and their participation in the RISE program as compared to non-program participants?
2. Is there a relationship between students' preparedness for math, science, and other courses and their participation in the RISE program compared to non-program participants?

The Average Treatment Effect on the Treated (ATET), a particular form of linear regression, was computed using the teffects command in order to compute the average treatment effect (of participating in the RISE program) on the participants in their academic performance and their preparedness for math, science, and other courses compared to non-program participants. ATET utilizes propensity score matching in an attempt to reduce sample bias when observational data are being analyzed. The variables used in the study are displayed below in tables 1 and 2. Table 1 shows the dependent variables while table 2, the variables used in the matching process.

Variables. Both dependent and covariates are represented in tables 1 and 2 below.

Table 1

Dependent Variables

Research Question	Dependent Variable	Measurement
Students' STEM-related academic performance	A GPA in STEM majors	Continuous scale, GPA score 0.0 to 4.0
Students' preparedness for math, science, other courses	A cumulative GPA	Continuous scale, GPA score 0.0 to 4.0

Table 2

Covariates for Propensity Score Matching

Covariate	Measurement
Gender	Binary, 1 = male, 0 = female
Social Economics Status	An EFC below $785, less than 25th percentile,= 1, else = 0
Parental education level	0 = college degree, 1 = first generation
Previous Educational Achievement	0 = Prior college, 1 = first college
Race	0 = for all other students, 1 = Black, Hispanic or Native American

The matching reduced the bias in the samples as such that the bias was smaller in all cases with variances ratios being near 1 – meaning that the variance in both treatment and control are the same.

RESULTS

Descriptive Statistics

The participants in the study were 394 STEM and non-STEM students comprised of 114 RISE program scholars, the treatment or treated group, and 280 in the control group. The males were 147 in number, while the females were 259. Tables 3a, 3b and 3c are the summary of the descriptive statistics for the variables utilized in this study: STEM GPA (for STEM-related academic performance), Cumulative GPA (for preparedness for math, science, and other courses), STEM major and graduate/non-STEM major and graduate (combined), race, prior college (for previous educational achievement), parental education, and treated (RISE program participants)/non treated (non-RISE program participants). The Black participants were greater in number than other races, followed by the Hispanics, and lastly, the Indian Americans (See Table 3a, 3b, and 3c). Indian Americans had the highest cumulative GPA among the races in male participants (M = 3.59; SD = 0.325), followed by the Hispanics, with both male and female participants having the same cumulative GPA (M = 3.02, SD = 0.821) and (M = 3.02; SD = 0.783), respectively. The female students had higher STEM GPA than the male students (M = 3.23; SD = 0.478) and (M = 3.02; SD = 0.804), respectively.

Table 3a

Descriptive Statistics on Variables of Black Race by Gender

Group / Race	Gender	N	M	SD
Black				
STEM majors or gradates/non-STEM majors or graduates	M	119	088	0.323
	F	225	0.85	0.354
STEM GPA (for STEM-related Academic performance)	M	178	2.64	0.712
	F	94	2.66	0.722
Cumulative GPA (for Preparedness for all classes)	M	119	2.70	0.698
	F	224	2.75	0.678
Prior College	M	108	0.77	0.424
	F	208	0.72	0.450
Parental Education	M	119	0.37	0.485
	F	225	0.43	0.496
Treated (RISE program participants)/ non-Treated (non-RISE)	M	119	0.29	0.458
	F	225	.025	0.436
Expected Family Contribution (EFC)	M	119	0.504	0.502
	F	225	0.476	0.501

Note. Due to missing data the numbers above vary across research question; parental education is 0 = college education, 1 = first generation; previous educational achievement is 0 = prior college and 1 = first college; STEM majors or graduates = 1 and non-STEM majors or graduates = 0; RISE program participants =1 and non-RISE program participants = 0; and for EFC see Table 2.

Table 3b

Descriptive Statistics on Variables of Hispanic Race by Gender

Group Race	Gender	N	M	SD
Hispanic				
STEM majors or gradates = 1/non-STEM majors or graduates = 0	M	14	1.00	0.000
	F	25	0.88	0.332
STEM GPA (for STEM-related Academic performance)	M	13	3.02	0.804
	F	18	3.23	0.478
Cumulative GPA (for Preparedness for all classes)	M	14	3.02	0.821
	F	25	3.02	0.783
Prior College	M	13	0.54	0.519
	F	23	0.48	0.511
Parental Education	M	14	0.36	0.497
	F	25	0.32	0.476
Treated (RISE program participants)/non-Treated (non-RISE)	M	14	0.07	0.267
	F	25	0.28	0.458
Expected Family Contribution (EFC)	M	14	0.500	0.519
	F	25	0.600	0.500

*Note***.** Due to missing data the numbers above vary across research question. For the definitions of the above variables, see Table 3a.

Table 3c

Descriptive Statistics on Variables of Native American Race by Gender

Group Race	Gender	N	M	SD
Indian American				
STEM majors or gradates = 1/non-STEM majors or graduates = 0	M	2	1.00	0.000
	F	9	0.89	0.333
STEM GPA (for STEM-related Academic performance)	M	0	0.00	0.000
	F	9	3.23	0.478
Cumulative GPA (for Preparedness for all classes)	M	2	3.59	0.325
	F	9	2.43	0.574
Prior College	M	2	0.50	0.707
	F	9	0.67	0.500
Parental Education	M	2	0.50	0.497
	F	9	0.56	0.527
Treated (RISE program participants)/non-Treated (non-RISE)	M	2	0.00	0.000
	F	9	0.22	0.441
Expected Family Contribution (EFC)	M	2	0.500	0.707
	F	9	0.222	0.441

Note. Due to missing data the numbers above vary across research question. For the definitions of the above variables, see Table 3a.

Table 4 below is the summary of the descriptive statistics for RISE program participants' and non-RISE program participants' STEM majors, STEM graduates, STEM GPA (for STEM-related academic performance), and cumulative GPA (for preparedness for math, science, and all other courses) variables. In Table 4, the gap that RISE created in graduation, majoring, STEM GPA and cumulative GPA was made plain. This table depicts means in these variables, which showed the magnitude of the benefit of RISE. For the "STEM majors" variable, non-RISE students major about 85% in STEM disciplines, while RISE students major about 92%; the 7% difference is important to produce more STEM students. For the "STEM graduates" variable, also, non-RISE students graduate about 79% in STEM disciplines, while RISE students graduate about 91%; the 12% difference is also important to produce more STEM graduates.

Furthermore, Table 4 shows the difference in STEM GPA and cumulative GPA of RISE program participants and that of non-RISE program participants. RISE program students had higher STEM GPA than non-RISE students (M = 3.10, SD = 0.494) and (M = 2.54, SD = 0.766), respectively. This supported the interpretation given in Chapter Five, that RISE students could graduate more in STEM. Since better STEM GPA is a means to an end, STEM graduates could lead them to be part of STEM fields in graduate schools, and then, STEM careers. Similarly, Table 4 depicts the outcome that RISE program students had higher cumulative GPA than non-RISE students (M = 3.15; SD = 0.492) and (M = 2.64; SD = 0.741), respectively. A "3.15" GPA indicates about a "B" average, and a "2.64" GPA indicates about a "C" average. This means that RISE program students performed better, not only in STEM courses as stated earlier, but also in all classes (i.e., they become all rounded students).

Table 4

Descriptive Statistics on Dependent Variables

Group	N	M	SD
Non-Treated or Non-RISE program participants			
Variables			
STEM Majors	312	0.85	0.349
STEM Graduates	199	0.79	0.409
STEM GPA	234	2.54	0.766
Cumulative GPA	312	2.64	0.741
Treated or RISE program participants			
Variables			
STEM Majors	106	0.92	0.265
STEM Graduates	80	0.91	0.284
STEM GPA	101	3.10	0.494
Cumulative GPA	105	3.15	0.492

Note. Due to missing data the numbers above vary across research question. STEM majors = 1; non-STEM majors = 0; STEM graduates = 1; and non-STEM graduates = 0;

Question one. This question was formulated to ascertain if there was a relationship between students' STEM-related academic performances and their participation in the RISE program as compared to non-program participants. To respond to this research question, students' STEM GPA data were analyzed using Stata for an Average Treatment Effect on the Treated (ATET) Linear regression model following the teffects command (Stata, 2015), where propensity score was matched on gender, EFC, prior college, race, and parental education. A one-to-one matching process was employed. Students who participated in the RISE program were matched one-to-one with the non-RISE program participants.

Table 5

The relationship between STEM-related academic performances (STEM GPA) and *participation in RISE program versus non-program participants*

STEM GPA					95% Confidence Interval	
	Coefficient	AI Robust Std Err	z	P>|z|	Upper CI	Lower CI
RISE participants	0.626	0.084	7.50	<0.001	0.462	0.790

Table 5 indicates the RISE program participants have significantly higher STEM GPA than non-RISE program participants (coefficient [ATET] = 0.63 and P > |z| = < 0.001), which means they perform better academically in STEM courses than their counterparts (non-RISE program participants).

Question two. Finally, to ascertain the response for research question two (i.e., if there is a relationship between students' preparedness for math, science, and other courses and their participation in the RISE program compared to non-program participants), students' cumulative GPA were analyzed utilizing Stata. As mentioned above, an Average Treatment Effect on the Treated (ATET) Linear regression model was calculated following the teffects command (Stata, 2015) where propensity score was also matched on gender, EFC, prior college, race, and parental education. A one-to-one matching process was used. Students who participated in the RISE program were matched one-to-one with the non-RISE program participants.

Table 6

The relationship between preparedness for math, science, and other courses (Cumulative GPA) and participation in RISE program versus non-program participants

Cumulative GPA					95% Confidence Interval	
	Coefficient	AI Robust Std Err	z	P>|z|	Upper CI	Lower CI
RISE participants	0.514	0.072	7.07	<0.001	0.371	0.656

From Table 6, it is revealed that students in the RISE program had significantly higher cumulative GPA than non-RISE program participants (coefficient [ATET] = 0.51 and P > |z| = < 0.001), which means they were more prepared for math, science, and all other courses than their counterparts (non-RISE program participants).

DISCUSSION

Summary

The study revealed that for both questions, participating in the RISE program was associated with improved academic performance.

Question One. The results from the analysis of data demonstrated that RISE program participants have significantly higher STEM GPAs than non-RISE program participants. On the average, RISE participants were predicted to have a STEM GPA of 0.63 points higher than non-RISE participants. This 0.63 difference in GPA is very remarkable and should not be overlooked; it is about 16% of 4.0, the greatest GPA possible a student can obtain. Consequently, these results indicate that RISE program participants performed better academically in STEM courses than non-RISE program participants.

Question Two. The results revealed that students in the RISE program have significantly higher cumulative GPA than non-RISE program participants. On average, RISE participants were predicted to have a cumulative GPA of 0.51 points higher than non-RISE participants—with a confidence interval ranging from 0.37 to 0.66. As also shown in Table 4, 0.51 is the average difference in the cumulative GPA between RISE students and non-RISE students and is about 13% of 4.0, the greatest GPA possible a student can obtain. This difference in GPA is reasonable and highly significant and should not be ignored. This means RISE students are typically more prepared for math, science, and all other courses than non-RISE program participants.

Interpretation

First, this study intended to verify if participation in the Research Initiative for Scientific Enhancement (RISE) program was related to participants' STEM-related academic performance, which was posed in research question one. The result for research question one was positive. In other words, there was a relationship between students' STEM-related academic performance and their participation in the RISE program. Additionally, research question one utilized STEM GPA to determine students' STEM-related academic performance. The researcher found that RISE participants had higher STEM GPAs than non-RISE program participants.

There are three indications from this result: First, there seems to be a benefit to participating in RISE such that students' academic performance is enhanced. This may lead to program participants being able to attend graduate school, as they are more competitive candidates. Second, if the high STEM GPAs are indicative of superior understanding of STEM concepts, then RISE students may have the potential to perform better either in future academic or employment opportunities. Third, this result is consistent with that of research question in the other paper that is being published simultaneously with this paper (The result in the paper indicated, on the average, RISE program students graduate about 12% more often from STEM-related disciplines than non-RISE program students); that is, higher STEM GPAs may have led to higher graduation rates - from the enhanced success that the RISE students are predicted to have. Furthermore, since RISE shares many components that have been shown to be supportive of student performance, combining them in one model seems to have the potential to be a successful approach.

Furthermore, the second research question was used to confirm if the RISE program actually strengthened participants to be prepared for all classes, including math and science courses. The results depict that students' participation in the RISE program improved their preparedness for all courses. RISE program participants could be more versatile than non-program participants, and this was shown in their cumulative GPA data, which were utilized to determine preparedness for all classes. Many studies found that when students participate in STEM-related programs, these programs prepare them for math, science, and other future classes (Rabitoy et al., 2012; Raines, 2012; Salto et al., 2014; Tran & Nathan, 2010; Wilson et al., 2012b). As mentioned earlier, RISE program participants performed different activities which contributed to the desired outcomes found in this study. As stated earlier in this study, the RISE program has structured educational pipeline activities leading participants to graduate schools, such as hands-on biotechniques or biopsychology workshops, enrichment seminars, faculty-mentored intramural and extramural research, scientific communications and interdisciplinary research courses, local and national research symposia and conferences, and complete Graduate Record Examination (GRE) preparatory workshops.

The results from this study and others support the notion that STEM programs demonstrate a positive effect on students. Again, these are programs created in schools and organizations for recruiting, retention, educating, and graduating students; students perform different activities, including mentoring, living-learning community, STEM video, project-based/hands-on activities, tutoring, supplementary instruction, professional workshop and graduate school visit, and GRE workshop (Almarode et al., 2014; Jackson, 2013; Kendricks et al., 2013; Kier, 2013; Maton et al., 2009; Miyake et al., 2010; Slovacek et al., 2011; Soldner et al., 2012).

Implications

The U.S. Census Bureau projected that racial and ethnic minorities are expected to be more than one-half of the national population by 2050. As yet, relatively low rates of success among minority students in STEM education persist. Therefore, understanding how to maximize success among racial and ethnic minorities in STEM education is very important. This study has the potential to support the continued efforts to improve society at large, organizations, schools, families, and individuals, given the importance of technology in the current global economy, technology is a main driver of US economic growth, and minority students are underrepresented in STEM-related disciplines, hence, in STEM jobs. The results of this study are consistent with previous research on STEM programs, that participation in RISE appears to be related to improved academic outcomes.

Programs such as the RISE program that combine these activities (i.e., mentoring, undergraduate research, etc.,) appear to have the potential to support student success. This implies that a) if a school is implementing STEM goals, it is suggested that programs similar to the RISE program be considered as part of the STEM program, b) programs such as RISE that combine several activities, should be studied to determine what aspects of the program were beneficial and how, from a participant's perspective, and c) since the STEM program is such an important initiative, the RISE program and other similar programs are worthy of continued financial and academic support, as this study shows. They have the potential to produce positive outcomes.

That is, programs that influence the participants' STEM-related academic performance and preparedness for all courses should be established. While shown as positive, social injustice issues remain and according to Funk and Parker (January 9, 2018) many blacks are concerned about racial discrimination in STEM fields. This information will motivate educational leaders to write more grants and encourage students to connect with the RISE program.

This will transform the students, families, schools, and the society, however, to fully realize the potential of such programs, the perceptions and realities of blacks and other minorities in STEM areas needs to be fully addressed in unison with these academic initiatives.

Conclusion

Administrators exploring ways to support STEM academic success of students should consider programs such as RISE or other similar programs, as these have demonstrated the potential to improve certain outcomes. Participating in the RISE program could be helpful to minority students as it has been shown that many students of color have more difficulty thriving in undergraduate science than their white counterparts (Beasley & Fischer, 2012; Carlone & Johnson, 2007; Espinosa, 2011; Hurtado et al., 2011; Johnson & Bozeman, 2012). Consequently, to benefit minority students in STEM, it is suggested that programs like RISE may effectively support black student participation in STEM related fields.

Based on the results from this study, and if the results from an additional study are found to be positive, it could support the conclusion that RISE programs, especially the one utilized in this study, are effective in influencing participants' STEM-related academic performance and preparing them for all courses. Furthermore, this could increase the enrollment, retention, and graduation of minorities in STEM fields, thereby increasing the number of minorities in STEM jobs. Then, it is recommended that more RISE programs should be established in schools to ensure more minorities' STEM-related academic performance is enhanced and they are prepared for all courses, which could lead them to major and graduate in STEM-related fields.

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