# K–12 DREAMS to Teach Program at Morehouse College: Challenges and Opportunities Creating the Next Generation of African American Male STEM Teachers

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*This study explores the pathways to K–12 Science, Technology, Engineering and Mathematics instruction among Black/African American males in the Discovery Research Education for African American Men in STEM to Teach (DREAMS to Teach) program at Morehouse College, a Historically Black College and University located in Southwest Atlanta, Georgia. Many studies articulate the importance of cultural alignment between students and their instructors' influence on STEM participation and persistence. This study investigates the pathways of Black males who successfully overcome barriers and subsequently choose to persist (or not) in STEM and STEM K–12 instruction in particular. Findings suggest that although DRK–12 Dreams to Teach participants arrive at Morehouse less prepared to pursue STEM degrees than other Morehouse STEM students, they catch up and are retained in STEM and are on track to graduate at the same rate. This study improves our understanding of STEM persistence and K–12 instruction in the context of a federally funded, STEM-focused intervention targeting African American males.*

Over the past 30 years (1987–2016), the number of teachers from underrepresented (UR) populations more than doubled (Taie & Goldring, 2017). (In alignment with Census Bureau classifications of race/ethnicity, in this paper we use the term "overrepresented" to refer to those individuals who self-identify as White, nonHispanic, while the term "underrepresented" refers to individuals of Black/African American, native Hawaiian/Pacific/Islander or Asian, Native American/Indian/Alaska Native, or Hispanic/LatinX descent or ethnicity, and those of multiple races.) As of 2015–2016, about 80% of all public school teachers were nonHispanic White, 77% percent of whom were female. Accounting for the bulk of this growth are Latinx teachers (2.9% in 1987 to 8.8% in 2015) and nonHispanic Asian teachers (0.9% in 1987 to 2.3% in 2015). Meanwhile, the proportion of Black and Native American teachers has decreased over this same time period: from 8% to 6.7% and 1.1 to 0.4% respectively (Carver-Thomas, 2018).

Student populations have also continued to grow increasingly diverse (Frankenberg & Siegel-Hawley, 2008; Bernstein, 2013). As of 2013, the demographic composition of students in public elementary and secondary schools was 50% White, 25% Latinx, 16% Black, 5% Asian/Pacific Islander, and 1% Native American (Musu-Gillette et al., 2016). These data tell us that the mismatch between the proportion of racial/ethnically diverse teachers to students in K–12 education has continued to outpace the (uneven) growth of racial/ethnically diverse teacher hires (Meidl, 2018). If fact, despite a 22% increase in the number of male teachers between 1988 and 2012 across all races, the percent of Black male students remains more than three times the percent of Black male teachers (Lewis & Toldson, 2013) in the United States.

This disparity between students and teachers, combined with the overall dearth of Black male teachers (only 2% of teachers are Black men), is particularly detrimental for UR students (Toldson, 2011; Toldson, 2013). A teaching workforce should reflect the demographic composition of the student population and nation as a whole. For Black students in particular, teach-

ers not only influence their achievement and cognitive development, but also their self-concept, attitudes, and reported academic validation (Hurtado & Alvarado, 2013). Likewise, because Black children tend to be more teacher-dependent than their other-race peers, they tend to perform better when they are taught by teachers who have the same gender and race (Dee, 2005; Villegas & Irvine, 2010; Ingersoll & May, 2016; Dee & Penner, 2017; Egalite & Kisida, 2018). According to Gershenson et al., (2017), Black students assigned to a Black teacher in grades K–3 were 7% more likely to graduate from high school and 13% more likely to enroll in college than their peers in the same school who were not assigned a Black teacher. The absence of a teaching workforce capable and willing to help mitigate these negative student impacts and fill these roles will continue to affect underrepresented students by widening the academic achievement gap and their occupational outcomes.

In response to this growing need, policymakers have attempted to recruit more diverse teachers starting as early as high school. The National Science Foundation DRK–12 Discovery Research Education for African American Men in STEM to Teach (DREAMS to Teach) Program at Morehouse College was designed for this purpose. DREAMS sought to significantly enhance the learning and teaching of STEM among preK–12 students and teachers through education innovations and approaches aimed at increasing the number of Black male teachers in the fields of science, technology, engineering, math, and computer science (collectively referred to as STEM), which remain of critical importance for the U.S. economy. In fact, even though as many as 26 million jobs in the United States require significant STEM knowledge and skill (as much as 20% of all U.S. jobs), Black, Pacific Islander, Native American, and Latinx make up just 15% of science and engineering (S&E) degree holders and 11% of the S&E workforce even though they represent 27% of the U.S. population (National Science Board, 2018). (S&E occupations are very broadly defined as life scientists, computer and mathematical scientists, physical scientists, social scientists, and engineers.) For this reason, training enough STEM workers to fill these jobs will require a teacher workforce equipped with the STEM knowledge, cultural understanding, and skill to educate students of all backgrounds to pursue these careers (Xue & Larson, 2015).

## Background

### *College "DREAMS to Teach" program motivation and design*

DREAMS program objectives were threefold: (1) to produce well-prepared students for careers in secondary science and math teaching, (2) to enhance the quality of instruction at Morehouse College and (3) to recruit and retain Black males into teacher preparation and secondary STEM teaching careers. This paper focuses on the first and third goals pertaining directly to student STEM teaching and careers.

The DREAMS program began with a vision to create a pathway for young African American men to teach K–12 STEM courses in underserved communities (particularly in the immediate Atlanta area) by filling the "remedial gap" between what these STEM students were learning in high school and what they needed to know in order to be ready for STEM majors in college.

Morehouse faculty worked with Atlanta Public School (APS) and Fulton County School (FCS) teachers to develop a curriculum designed particularly for aspiring DREAMS students. The combination of academic supports (e.g., tutoring) and academic achievement (course and degree completions), while simultaneously removing any financial obstacles (e.g., tuition, books, transportation, housing, meals) was expected to transform the lives of 80 APS Black male high school students over the course of five years.

### *Recruitment and selection of participants*

DREAMS staff recruited promising Black male students in the eleventh grade from APS and FCS districts. Housed within the Division of Science and Mathematics at Morehouse College, DREAMS fostered collaboration between Morehouse, APS, and FCS STEM faculty, resulting in the development and implementation of six major program elements, including comprehensive financial support. Selection criteria included identifying students with an expressed interest in science and engineering, teacher recommendations, and a readiness (verified by courses taken in transcripts) for undergraduate-level work.

### *Program elements*

The DRK–12 program began with an intensive six-week summer program following the junior year of high school. Participants then engaged in a Saturday Academy during their senior year (Academy I) of high school and their first two years of college (Academy II and III). Students also engaged in a six-week prefreshman program the summer after their senior year and a summer research program immediately following their freshman year of college. In addition to programmatic support, participants received financial support for their participation in DREAMS.

### Teacher preparation

DREAMS students completed at least one education course, exposing them to the historical, economic, sociological, philosophical, and psychological understandings of American schooling and education. (Morehouse College does not currently have an education minor or certification program; as such, students took courses in education studies at Spelman College to fulfill this program requirement.) Courses, however, did not automatically lead to teacher certification unless students applied for and were successfully admitted to the Education Studies Program. Upon admission, participants were able to take additional education courses and sit for the Georgia Assessments for the Certification of Educators (GACE) exam. Students who either did not attempt or attempted but did not pass the GACE still received a minor in education if all other course requirements were met.

### Morehouse College

Morehouse College, the world's only Historically Black College and University (HBCU) for men, was founded in 1867 and is located in the historic West End in Southwest Atlanta, Georgia. According to the National Science Foundation, Morehouse College is one of the nation's top producers of African American male STEM doctoral recipients (Burrelli & Rapoport, 2008; Fiegener & Proudfoot, 2013). In the National Science Foundation's 2005–2010 Survey of Earned Doctorates, Morehouse was ranked as one of the top 10 HBCU institutions producing Black college graduates who go on to receive doctoral degrees and the third largest HBCU producer of Black PhDs in the biological and biomedical sciences (Upton & Tanenbaum, 2014). Morehouse is also known for cultivating successful pathways for Black males in STEM (Gasman et al., 2017; Thompson et al., 2016).

### Student participation

There have been two Morehouse DRK–12 cohorts. The first cohort began in 2012, the second in 2013. Of the 41 students accepted to the program in 2012, 46% ($n$ = 19) of these gained admission to college (11 at Morehouse College). Of the 35 students accepted to the program in the summer of 2013, (74%) ($n$ = 26) gained admission to college (19 at Morehouse College). The results that follow reflect the outcomes associated with the 11 students in cohort 1 and the 19 in cohort 2 who attended Morehouse College as first time freshmen in fall 2013 (cohort 1) and fall 2014 (cohort 2).

### Research question

This study seeks to enhance our understanding of the DREAMS program and the ability to successfully recruit and retain students in the STEM Teacher Education program. Specifically, we ask: What are the various pathways taken by DREAMS students toward STEM persistence and STEM teaching among Black/African American males?

## Methods

To answer the previously mentioned research question, we employed an exploratory sequential mixed methods collective case study design (Creswell & Plano Clark, 2017). It began with a qualitative phase aimed at exploring the phenomenon, followed by a quantitative phase where certain key variables were identified, connecting the qualitative and quantitative phases together. The results were then interpreted such that the quantitative results extend and generalize the initial qualitative findings. This approach allowed us to produce detailed description of DREAMS student pathways from the perspective of program staff. Furthermore, multiple case studies strengthened results by replicating patterns, thereby increasing the robustness of findings (Merriam, 1998; Yin, 2009).

### The case study approach

The collective case study approach was adopted, as there were several outcomes associated with the issue of STEM attrition as evidenced in the DREAMS context and in the literature (Chen & Soldner, 2013). A collective case study uses multiple instrumental case studies from the same site (or across multiple sites) to make analytical as opposed to statistical generalizations about a given phenomenon (see Ellinger et al., 2005; Baxter and Jack, 2008; Crowe et al., 2011). A detailed description of each case was provided, followed by within case analysis and cross-case analysis. This approach allowed for the illustration of the different pathways associated with STEM attrition in the DRK–12 context, not to illustrate a single case of STEM attrition in and of itself (Creswell, 2013).

### Data sources, collection, and analysis

Multiple sources of qualitative and quantitative evidence were analyzed, and later triangulated prior to the interpretation of findings (Yin, 2009). Data sources included archival program records, semi-structured interviews with program staff, and participant observations at end-of year professional development sessions. Data were categorized based on different graduation outcomes (on track versus not on track), different majors

(STEM, nonSTEM), and different levels of interest in teaching (interested and not interested). Next, a within-case analysis was followed by a thematic cross-case analysis (Yin, 2009). These data were then scrutinized for patterns that speak to the phenomenon of STEM persistence and attrition more broadly, as it existed in the Morehouse DREAMS context.

### *Variable definitions and analytical approach*

Principal DREAMS student outcomes included: persistence in STEM, graduation status, and interest in STEM teaching. However, within-case analysis revealed additional measures worthy of inclusion to better interpret student outcomes. These additional measures included high school grade point average (GPA), math SAT scores, Pell grant eligibility, and average cumulative Morehouse GPA. These metrics were then compared to nonDREAMS Morehouse first- time, first-year (FTFY) 2013 and 2014 STEM majors in order to better understand participant outcomes.

Table 1 summarizes overall outcomes by cohort. Data for each category and case were populated using decision rules meant to operationalize categories for study reproducibility and ongoing tracking of students. These values were later searched for patterns across cases (Miles & Huberman, 1994). Table 2 provides a high-level summary of outcomes. Table 3 compares DREAMS and nonDREAMS students on the key metrics previously specified and Table 4 provides a detailed breakdown of the metrics by outcome. Two-tailed *t*-tests of independence were calculated for both high school GPA, Math SAT, and cumulative Morehouse GPA comparisons while Pearson chi-square tests of independence were calculated for Pell grant eligibility, persistence in STEM, and graduation status.

## Results

Of the 11 DREAMS students who entered Morehouse in cohort 1, all 11 began as STEM majors and five (45%) graduated or were anticipated to graduate within six years of enrollment. Similarly, all 19 students in cohort 2 entered as STEM majors, however a greater percentage of cohort 2 students (74%, $n$ = 14) graduated or were on track to graduate within six years of enrollment. As of spring 2018, nine cohort 1 participants (82%) were on record for having a STEM major (as of spring, 2018), and four continued to demonstrate or express a continued commitment to K–12 STEM instruction postgraduation (44%). Similarly, 16 cohort 2 participants remained STEM majors (84%); yet, a greater percentage (68%, $n$ = 13) demonstrated or expressed an interest in K–12 teaching postgraduation (Table 1).

The major challenges faced by

**TABLE 1**

**Summary of DREAMS program student persistence and attrition outcomes by cohort.**

| Cohort | All | STEM[a] major on record (as of spring 2018) | Left the college without graduating | Graduated or on track for graduation (<6 years)[b] | Still interested in pursuing a K–12 teaching career |
|---|---|---|---|---|---|
| 1 | 11 | 9 (82%) | 3 (27%) | 5 (45%) | 4 (36%) |
| 2 | 19 | 16 (84%) | 1 (5%) | 14 (74%) | 13 (68%) |
| Total | 30 | 25 (83%) | 4 (13%) | 19 (63%) | 17 (56%) |

[a] Includes all students with a declared STEM major. Eligible majors include: applied physics, biology, chemistry, computer science, general science, mathematics, physics, pre-engineering, and psychology.
[b] Includes students who left the program (and Morehouse) temporarily for financial reasons, but not permanently.

**TABLE 2**

**DREAMS student outcomes: STEM persistence by K–12 teaching (as of spring 2018).**

| | **Pursuing a K–12 teaching career** ($n$ = 17) | **Not pursuing a K–12 teaching career** ($n$ = 9) |
|---|---|---|
| Pursuing a STEM degree ($n$ = 21) | Total: 14 (53%) | Total: 7 (27%) |
| Pursuing a nonSTEM degree ($n$ = 5) | Total: 3 (12%) | Total: 2 (8%) |

The table above only displays data on the 26 DREAMS participants still enrolled in Morehouse College as of spring 2018.

DREAMS participants were STEM attrition and time to graduation (Table 1). For the purposes of this study, STEM attrition refers to enrollment changes that resulted in would-be STEM graduates (i.e., undergraduates who declare a STEM major) switching to nonSTEM majors or leaving postsecondary education before earning a degree or certificate (Chen and Soldner, 2013; Sithole et al., 2017). Students who maintained their course of study in a STEM field on the other hand reflected what is widely known as STEM persistence (i.e., when a student declares a STEM major and remains a STEM major throughout their postsecondary studies with the intention of graduating with a STEM degree). The majority of DREAMS participants remained STEM majors. The majority (63%) of DREAMS participants either graduated or were on track to graduate within six years. Overall, cohort 2 participants had demonstrably improved outcomes compared to cohort 1 participants. (Note: The difference between cohorts 1 and 2 is not statistically significant for any outcome measure.) Specifically, a greater percentage of cohort 2 students persisted in their STEM major, a smaller percentage left

**TABLE 3**

**Comparison of DREAMS students to comparable peer group.**

| | *n* | Mean | SD | *t* | *df* |
|---|---|---|---|---|---|
| **High school GPA**[a] | | | | | |
| DREAMS participants | 30 | 2.97 | 0.49 | .000*** | 453 |
| STEM comparison group | 423 | 3.34 | 0.56 | | |
| | ***n*** | **Mean** | **SD** | ***t*** | ***df*** |
| **SAT Math**[b] | | | | | |
| DREAMS participants | 30 | 491 | 83 | .009** | 454 |
| STEM comparison group | 425 | 534 | 81 | | |
| | ***n*** | **Eligible** (*n*, %) | **Noneligible** (*n*, %) | $\chi^2$ | ***df*** |
| **Pell grant eligibility** | | | | | |
| DREAMS participants | 30 | 16, 53% | 14, 47% | .06 | 1 |
| STEM comparison group | 425 | 217, 51% | 209, 49% | | |
| | ***n*** | **Mean** | **SD** | ***t*** | ***df*** |
| **Cumulative Morehouse GPA**[a] (as of spring 2018) | | | | | |
| DREAMS participants | 30 | 2.40 | 0.52 | 0.006** | 456 |
| STEM comparison group | 426 | 2.70 | 0.79 | | |
| | ***n*** | **No change or STEM to STEM**[c] (*n*, %) | **Change to nonSTEM** (*n*, %) | $\chi^2$ | ***df*** |
| **STEM major persistence** (as of Spring 2018) | | | | | |
| DREAMS participants | 30 | 25, 83% | 5, 17% | .56 | 1 |
| STEM comparison group | 426 | 330, 78% | 96, 23% | | |
| | ***n*** | **Graduated or on track**[d] (*n*, %) | **Not on track**[e] (*n*, %) | $\chi^2$ | ***df*** |
| **Graduation status** (as of Spring 2018) | | | | | |
| DREAMS participants | 30 | 19, 63% | 11, 37% | .38 | 1 |
| STEM comparison group | 426 | 293, 69% | 133, 31% | | |

*$p$ <0.05; **$p$ < 0.01; ***$p$ < 0.001

Includes data on all 30 DREAMS participants as of spring 2018. High school GPA was missing for four and SAT math scores were missing for two comparison group students.

[a]Weighted grade point average. Scale: 1.42–5.09

[b]Scale: 200–800

[c]Includes students who either maintained their original STEM major or declared to a different STEM major as of spring 2018.

[d]On track to graduate status applies to students graduating within six years of first-time, first-year (FTFY) enrollment.

[e]Not on track includes students who may have left the college, but not yet formally unenrolled from the institution.

the college without returning, a greater percentage were on track to graduate within six years, and nearly double the percentage were interested in pursuing a K–12 teaching careers compared to cohort 1.

Of the DREAMS participants who remained enrolled at Morehouse, 53% were pursuing a STEM degree and a K–12 teaching career; 27% were pursuing a STEM degree and not a K–12 teaching career; 12% were no longer pursuing a career in STEM, but were still interested in K–12 instruction; and two (8%) were neither pursuing a STEM degree nor a K–12 teaching career (Table 2).

In order to better understand the achievements of DREAMS students across outcomes relative to their peers, we compared the FTFY entrance scores (high school GPA, math SAT score, Pell grant eligibility), STEM persistence, cumulative Morehouse GPA, and graduation status of DREAMS participants with other 2013 and 2014 FTFY STEM majors (Table 4). Based on the results, we find that DREAMS participants had significantly lower mean high school GPAs (2.97 versus 3.34, $p < 0.001$) and mean math SAT scores (491 versus 534, $p < 0.01$) than the nonDREAMS comparison group upon enrollment. Similarly, DREAMS students had significantly lower cumulative Morehouse GPAs than their peers (2.4 versus 2.7, $p < .01$). However, no significant differences were found between the two groups for Pell grant eligibility (53% versus 51%, $p > .05$), STEM persistence (83% versus 78%, $p > .05$), or graduation status (63% versus 69%, $p > .05$).

## Results summary by outcomes pathway

The evidence previously mentioned supports four categories of DREAMS student pathways (Pathways are described for the 26 DREAMS participants who maintained their enrollment in the program and excludes the four that left the college without returning to graduate or continue their studies.):

- Pathway 1—Persisting in STEM and interest in K–12 instruction: Nearly half of all DREAMS participants ($n = 14$) persisted in pursuing an undergraduate degree in a STEM field and continued to express an interest in pursuing a career as a K–12 instructor.
- Pathway 2—Persisting in STEM and no interest in K–12 instruction: Nearly one third of DREAMS participants ($n = 7$) were still pursuing a STEM degree, despite no longer being interested in K–12 instruction.
- Pathway 3—Not persisting in STEM and interest in K–12

**TABLE 4**

**Metrics for DREAMS participants persisting by pathway.**

| **Pathway** | **Average high school GPA** | **Average math SAT** | **Pell eligibility** (*n*, percent eligible) | **Average cumulative Morehouse GPA** | **Graduation status** (*n*, percent graduated or on track) |
|---|---|---|---|---|---|
| Pathway 1: STEM persistence and interest in K–12 instruction ($n = 14$) | 3.15 | 531 | 4 (28%) | 2.30 | 9 (64%) |
| Pathway 2: STEM persistence and no interest in K–12 instruction ($n = 7$) | 2.86 | 457 | 6 (86%) | 2.55 | 6 (86%) |
| Pathway 3: No STEM persistence and interest in K–12 instruction ($n = 3$) | 3.00 | 453 | 1 (33%) | 2.57 | 2 (67%) |
| Pathway 4: No STEM persistence and no interest in K–12 instruction ($n = 2$) | 2.34 | 490 | 1 (50%) | 2.79 | 2 (100%) |

Note: Data pertain to the 26 DREAMS participants still enrolled in Morehouse College as of spring 2018.

instruction: Just three DREAMS participants (12%) were no longer pursuing a STEM degree while maintaining an interest in K–12 instruction.
- Pathway 4—Not persisting in STEM and no interest in K–12 instruction: Only two DREAMS participants (8%) were no longer pursuing a STEM degree and were no longer interested in K–12 instruction.

Participants with a continued interest in K–12 instruction (pathway 1 and pathway 3) appear to have slightly higher high school GPAs (3.15 and 3.00, respectively), are slightly less likely to be Pell eligible (28% and 33%, respectively), and have slightly lower graduation and on track to graduation rates (64% and 67%, respectively) than the other two groups (Table 4).

## Conclusion and discussion

Two important outcomes of the DREAMS Program described in this study are that approximately 88% of participants remained in STEM throughout college and approximately 62% remained committed to K–12 teaching. National data indicate a much lower STEM retention for undergraduate students, particularly black males (Estrada et al., 2016). While we do not know the retention among undergraduates planning careers in teaching, particularly in STEM, we believe that it is far less than what we have achieved in this program (Stohlmann et al., 2012). Furthermore, even though students who participated in the program were statistically not as well prepared for college (based on high school GPAs and SAT math scores) as the average STEM student at the college, there was no statistically significant difference in STEM persistence and graduation status between the two groups.

Limited sample sizes prevent us from evaluating the individual components of the program; however, we believe that the design of the program, including the early intervention that students received while still in high school and the individual attention that they received in college accounts in large measure for their success. Additionally, the extensive interventions provided by the program, beginning in the summer after the 11th grade of high school and continuing throughout college, provided students with essentially one-on-one mentoring and academic support until they received Bachelor of Science degrees. We believe that this level of support is essential to retain less academically prepared African American male students in STEM majors and maintain their motivation to assume the precollege teaching jobs that are undervalued by the country. ■

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