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A SYSTEMATIC MAPPING OF SCHOLARSHIP ON BROADENING PARTICIPATION OF AFRICAN AMERICANS IN ENGINEERING AND COMPUTER SCIENCE

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Trends in broadening participation of African Americans in engineering and computer science have not significantly improved despite significant investments and efforts of educators, practitioners, researchers, and policymakers. Given the lack of progress, it is imperative for the field of engineering education to synthesize and use insights from existing literature to readjust its strategy for addressing this persistent problem. Unfortunately, the work that has been done in this area is fragmented in disparate bodies of literature. The purpose of this study is to describe the landscape of existing scholarship germane to broadening participation in engineering and computer science, particularly as it relates to African Americans. The guiding research question is: What are the salient characteristics of literature on broadening the participation of African Americans in engineering and computer science? Using a systematic mapping methodology, we identified and screened 1180 scholarship records. We categorized and tabulated the 470 that met our eligibility criteria after extracting data on publication year, publication type, population race, population gender, segment, study type, and methods. Our results revealed numerous trends in this scholarship, dealing with both the focus of the scholarship as well as the manner in which it has been produced. As stakeholders continue working towards broadening participation of African Americans, we hope that this mapping review not only raises awareness of the current state of efforts dedicated to each segment of the K-12-to-workforce pathway, but also illuminates gaps in the literature yet to be filled.

KEY WORDS: *systematic map, broadening participation, scholarship trends, African Americans*

1. INTRODUCTION

"The potential for losing students along all segments of the pathway from preschool through graduate school necessitates a comprehensive approach that focuses on all segments of the pathways, all stakeholders, and the potential of

> *all programs, targeted and non-targeted"* (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2011, p. 144).

According to the United States (U.S.) Census Bureau, people who identify as Hispanic or African American will account for 28.6% and 14.3% of the U.S., respectively, by the year 2060 (Colby and Ortman, 2015). As the demographics continue to shift and the importance of the technical workforce grows, one can anticipate that national calls for broadening participation of underrepresented racial and ethnic groups in engineering and computer science (e.g., Alaska Natives, Native Americans, African Americans, Hispanics, and Native Hawaiians) will continue to swell. Despite Asian Americans, Hispanic Americans, and African Americans collectively representing a significant portion of the U.S. population, students of color account for a relatively small portion of the bachelor's degrees awarded in engineering. Consequently, tapping into the talents of underrepresented ethnic/racial groups is a commonly cited way to meet the changing needs of a global economy (National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2007, 2011).

To date, efforts to broaden participation of underrepresented racial and ethnic groups in technical fields tend to respond to this national problem with local solutions. Moreover, most research studies focused on this issue investigate localized problems instead of exploring the extent of the problem(s) across each major segment of the pathway from K-12 to the workforce. Though valuable, such efforts are insufficient, as local, incremental progress has not led to the wide-scale improvements the field would like to realize. Given the lack of progress the field of engineering has realized thus far—and the amount of time it takes to realize national-level effects of efforts and investments—now is the opportune time for the field of engineering education to readjust its strategy for addressing this persistent problem. Herein we focus on one aspect of this strategy, education research.

According to the Research Agenda for the New Discipline of Engineering Education (Adams et al., 2006a), engineering education researchers argued that "*systematic research* of how we educate engineers *must be the path* by which we transition from episodic cycles of educational reforms and move to long-lasting improvements in our education systems" (p. 259, emphasis added). Unfortunately, the work that has been done in this area is fragmented, in disparate bodies of literature, and yet to be synthesized. Because of this, we argue that there is a need to take a step back and reexamine what has been done in terms of research and practice as part of developing a transformative and holistic strategy for moving forward, while acknowledging that the efforts documented in scholarship are limited and represent only a subset of attempts to address a number of complex and interrelated factors that contribute to the lack of progress.

1.1 Purpose of This Study

The purpose of the current study is to produce a systematic map of scholarship on broadening the participation of African Americans in engineering and computer science. A systematic map "categorizes existing literature from which to commission further research

and/or primary research by identifying gaps in research literature" (Grant and Booth, 2009, p. 94). The results of a mapping characterize literature on a particular topic by documenting trends surrounding features of study designs. Accordingly, this methodology is most useful when the scope of scholarship in an area is unknown, which is the case here. To this end, our inquiry is guided by the following overarching research question: *What are the salient characteristics of literature (empirical or otherwise) on broadening the participation of African Americans in engineering and computer science?*

The literature map presented in this paper unifies current literature on this topic, serving as the basis for framing key issues and posing significant questions around the development of a diverse engineering and computer science workforce. Such an investigation will facilitate streamlining, aligning, and coordinating future research efforts on increasing African American participation in engineering and computer science throughout the U.S. Our findings include a database of bibliographic details about scholarship on this topic, a classification of work that dates back to 1975, and recommendations for future research. This systematic mapping is the first of its kind on this topic and is one of many steps in an ongoing effort to propose a national solution to a national problem.

1.2 An Emphasis on African Americans

In this study, we focus on issues of broadening participation by investigating elements of the research-to-practice cycle, with particular emphasis on African Americans in engineering and computer science. Focusing on this group provides an opportunity to advance our understanding of the impedances to broader participation, in general. We believe that focusing on African Americans is most opportune—when considering the three largest minority groups—for realizing progress in broadening participation for three reasons. First, Asian Americans are not considered underrepresented in engineering degree attainment (Su, 2010) and thus, are not typically included in the discussion on broadening participation. Second, though Hispanic Americans are considered underrepresented, there has been an increase in the percentage of students who identify as Hispanic earning engineering bachelor's degrees over the last decade. For example, according to the American Society of Engineering Education (ASEE), Hispanics accounted for 5.8% of bachelor's degrees awarded by engineering disciplines in 2000 and 10.7% in 2016 (Gibbons, 2009; Yoder, 2017); this trend is encouraging and leads us to our third reason. The field of engineering has seen a decline in the percentage for African Americans earning bachelor's degrees, accounting for 5.6% of bachelor's degrees in 2000 (Gibbons, 2009); and only 3.9% in 2017 (Yoder, 2017; Anderson et al., 2018); this trend illustrates how imperative it is to make a concerted effort, sooner rather than later, to broaden the participation of African Americans.

1.3 Inclusion of Computer Science

Focusing on computer science in addition to engineering is beneficial because there are similarities and distinctions between the two fields that should be noted as it relates to

broadening participation. Regarding similarities, computer science is often housed in engineering colleges. In fact, computer science accounted for the second-largest number of degrees (over 15,000) awarded by engineering colleges across the U.S. in 2016–2017 (Yoder, 2017), and there is significant overlap between the skills emphasized in computer science and some of the largest engineering disciplines, evidenced by curricular similarities in programs. Computer science also shares in the disparity of underrepresented ethnic and racial groups, similarly calling for diversification. Consequently, the interest of the fields as well as pathways and education that lead students to these professions are fairly similar.

While there are similarities between the two disciplines, the lines between them are not always clear and it is important to acknowledge that there are also notable differences. Computer science is recognized as a unique discipline according to the National Science Foundation's (NSF) science, technology, engineering, and mathematics (STEM) classification system and is often viewed as a distinct field that requires some skills that are distinct from engineering. In light of this, highlighting computer science in this study provides an opportunity to advance our understanding of where these similarities and differences lie with regard to broadening participation.

2. CONCEPTUAL FRAMEWORK

Among the numerous calls for broadening participation in engineering, many emphasize the role that research has in achieving change, and literature includes examples of efforts that focus on broadening participation from both research and practice perspectives (Didion et al., 2012). However, despite the field making some progress, several publications comment on the disconnect between research and practice in engineering education broadly, and offer suggestions regarding what should be done to bridge the gap (Borrego et al., 2010; Felder and Hadgraft, 2013; London, 2018). Notably, in a report commissioned by the American Society for Engineering Education (ASEE), Jamieson and Lohmann (2010) articulated the interrelationships between *what* needs to be changed in engineering education, *how* to drive change in this context, and *who* should drive change. In doing so, they proposed a model of systematic engineering education innovation, which is based on a continual cycle of research and practice and adapted from *The Craft of Research* (Booth et al., 2008).

The proposed model suggests that educational practice should facilitate the identification of questions to be addressed by educational research, resulting in research-based insights that can improve said educational practice. According to Jamieson and Lohmann, if adopted, such a cycle would "*both* continually advance the body of knowledge on engineering learning *and* result in the implementation of more effective and replicable educational innovations, with the end result being better-educated students" (Jamieson and Lohmann, 2010, p. 5). This framework serves as the lens for our study because it summarizes what *should* be happening as it relates to the connection between research and practice in this area. However, a central premise of this investigation is that the lack of progress as it relates to broadening participation suggests that there is either (1) a

breakdown in the research-to-practice cycle, or (2) it does not operate in the same way across research areas. In either case, the efforts of engineering education researchers and practitioners have proved ineffective in solving this problem.

By framing the current study with this conceptual lens, we are examining both educational research and practice in this space as it relates to literature (e.g., published research, evaluations, and program overviews), illuminating the current relationship between the two. Furthermore, employing this lens helps ensure that we are asking the right questions throughout the study, and assists in ensuring that the proposed solutions are situated in the context of both research and practice.

3. METHODS

To address our purpose, we categorized existing literature using the systematic mapping methodology. A systematic map is a categorization of existing literature that is useful for identifying gaps and providing a basis for commissioning further reviews (Grant and Booth, 2009). While the more familiar methods of systematic literature reviews (SLR) are often considered the "gold standard" for synthesizing evidence on a topic, and more commonly used in engineering education research (Borrego et al., 2014), SLRs are not always feasible, because of time or other constraints, nor the most appropriate methodology for synthesis, depending on the aims of the study (Grant and Booth, 2009). In particular, mapping the literature is most advantageous in instances where the scope of scholarship in an area is unknown. Given the current state of the literature on African American's participation in engineering and computer science, we leveraged the systematic mapping methodology to identify and create a map of the existing relevant literature. Because systematic maps are not commonly used in the field of engineering education, we will describe the systematic mapping methodology and explain how it is different than a SLR in the following section. We will then provide an overview of the steps we followed in this analysis.

3.1 Systematic Literature Map vs. Systematic Literature Review

The procedures that guided this systematic mapping (Clapton et al., 2009; James et al., 2016) are similar to the initial steps of the more familiar SLR (Petticrew and Roberts, 2006). Regarding similarities, both methodologies involve a process of combining multiple studies to produce a synthesis that addresses a question, following the same rigorous and transparent process for collecting evidence relevant to a particular topic as they strive to avoid the typical pitfalls associated with literature reviews (e.g., reviewer and publication bias). Both reports can also include implications for policy, practice, and research. However, there are key differences between the methodologies that should be noted. According to James et al. (2016), these differences relate to the (1) research objective and question formulation; (2) search strategy and article screening; (3) data extraction and critical appraisal; and (4) synthesis and reporting.

First, while the goal of a SLR is to answer questions with a quantitative or qualitative answer, a systematic mapping aims to *describe* the state of knowledge on a topic or for a question. Accordingly, while the questions posed in a SLR are closed-ended, the research question guiding a systematic mapping can be either open-ended or closed-ended. Next, while the evidence included in a SLR is limited to primary research, there is no limitation on the type of evidence that can be included in a systematic mapping. Under these circumstances, while the full text of an article is required in order to extract relevant information during a SLR, studies with limited data (e.g., the article abstract) may be included in a systematic mapping. Third, when extracting data as part of a SLR, a description of the study, its methods, and the results must be pulled out for inclusion in the report; in contrast, the results of a study may or may not be extracted as part of a systematic mapping. A critical appraisal of the study's internal and external validity is similarly optional for systematic mappings, whereas this step is required for a SLR. Lastly, when reporting the findings of a SLR, it is usually in the form of a narrative and qualitative or quantitative synthesis of the results. However, the results of a systematic mapping may instead be graphical or tabular, characterizing the literature based on key features. This difference enables a systematic mapping to describe and catalog the available evidence on a topic, facilitating the identification of clusters and gaps in knowledge.

3.2 Stages of the Mapping Process

We present the stages associated with the mapping process employed herein using a truncated version of the widely accepted PRISMA flowchart, which adheres to guidelines of the PRISMA checklist (PRISMA Checklist, 2009) (PRISMA stands for Preferred Reporting Items for Systematic Reviews and Meta-Analyses). Figure 1 summarizes the quantity of records and the overall process of (1) identifying records, (2) screening them, and (3) extracting data from them for the purpose of synthesizing it. Each of these stages will be described in more detail in the next sections, as well as methods for (4) enhancing research quality, and (5) visualizing the data. For readers interested in learning more about the details of planning the systematic review, please see Phillips et al. (2017).

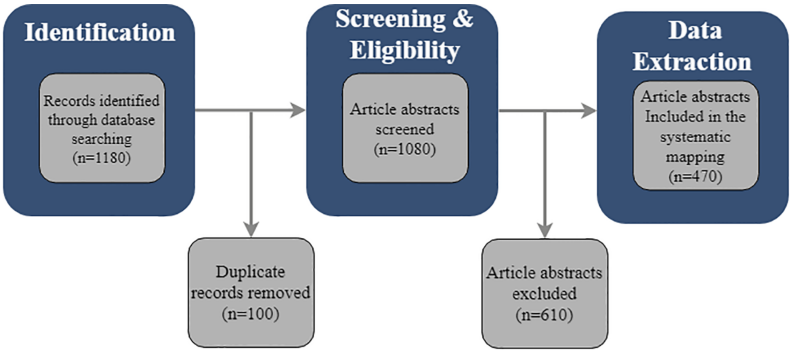

FIG. 1: PRISMA flowchart for systematic map

3.3 Identification

Through a series of four hour-long weekly meetings among the research team—which often included a librarian—we decided on three pieces of information that would serve as the basis for the identification of records: (1) publication date range, (2) database selection, and (3) search string selection. The date range was informed by historical events associated with efforts to broaden participation of African Americans in engineering and computer science. We chose 1975 as the start date of the search because of the development of several national initiatives focused on this issue during the 1970s. Specifically, critical organizations such as the National Action Council for Minorities in Engineering, Inc. (NACME, established in 1974) and the National Society for Black Engineers (NSBE, established in 1975) emerged during this time.

Next, we selected databases to include in the search and identified search strings. (Note: The data for this study were collected in January 2017). Table 1 includes a list of the databases and corresponding search strings. As part of validating the search strings, we identified "sentinel articles" that fit our eligibility criteria and could be used to perform a preliminary check on whether the search results were yielding the types of articles we hoped to find. Leveraging our professional network for suggestions, we identified 11 sentinel articles (Allen, 1992; Chang et al., 2014; Google and Gallup, 2016; Long et al., 2015; McGee and Martin, 2011; Moore et al., 2003; Reid et al., 2016; Rice and Alfred, 2014; Robinson et al., 2016; Tomasko et al., 2016; Weinberger, 2017). Additional details on how the librarian refined the search strings in a way that maximized the number of sentinel articles in the search results are presented in a prior publication (Phillips et al., 2017).

Though each database in a web interface was searched individually, they are presented together in Table 1 because the search strategy within each interface was the same for both databases. To limit publication bias in this study, we relied on the librarian's 20 years of library science expertise to select databases that would provide a wide range of literature types (e.g., theses, journal articles, books, magazine articles, conference proceedings) and to perform the database searches. (It is worth noting that the librarian involved in this study holds degrees in both engineering and library science, and is working on a terminal degree in engineering education. This combination of expertise was beneficial for minimizing bias and developing a rigorous search string). The selection of search strings was informed by the librarian's expertise, input from researchers in our professional network that conduct research related to this topic, and keywords in the *Engineering Education Research Taxonomy* (Finelli et al., 2015). Terms in the taxonomy associated with the "Diversity" heading were particularly relevant (e.g., underrepresentation, inclusivity). This process resulted in the retrieval of 1180 items that needed to be screened.

3.4 Screening and Eligibility

We initiated screening by looking for duplicate publications. After removing 100 duplicates, the abstracts of the remaining 1080 articles were analyzed to determine eligibil-

TABLE 1: Databases and corresponding search protocol

Database Name	Search String	Note
Education Source and PsycINFO (EBSCOhost interface)	((bias OR discrimination OR multicultural* OR inclusive* OR racism OR prejudice) OR (motivation OR attainment OR achievement OR aspiration OR persist* OR retention)) AND ((AB african w2 american OR SU african w2 american OR TI african w2 american) OR (AB black OR SU black OR TI black) OR (AB people N2 color* OR SU people N2 color* OR TI people N2 color*)) AND ((AB STEM OR SU STEM OR TI STEM) OR (AB engineer* OR SU engineer* OR TI engineer) OR (AB "computer science" OR SU "computer science" OR TI "computer science"))	Search all fields for words used to include or exclude people. Search Abstract, Title, Subject headings for terms used for African American. Search Abstract, Title, Subject headings for STEM, engineering, and computer science.
Compendex and INSPEC (Ei Village interface)	< ((motivation OR attainment OR achievement OR aspiration OR persist* OR retention) WN All fields) > OR < ((bias or discrimination or multicultural* or inclusive* or racism or prejudice) WN All fields) > AND < ((((african ONEAR/2 american) WN KY) OR ((black) WN KY)) OR ((people NEAR/2 color) WN KY)) > AND < ((STEM OR engineer* OR "computer science") WN KY) >	Quick search, Autostemming off, Search all fields. Search Subject/ Title/Abstract, Autostemming off. Search Subject/ Title/Abstract, Autostemming off.

ity for inclusion in the mapping. Analysis was completed using a codebook that was iteratively developed among the researchers. The codebook included a section on how to code an article as part of determining eligibility, and a section on how to code the descriptors of an eligible article. We describe the former in this section, and the latter in the *Data Extraction* section.

To complete the initial round of screening, we used three hierarchical eligibility criteria, each of which was expressed in the form of a yes-no question: (1) Is the article written in English and about education or the STEM workforce in the United States? (2) Is the article focused on engineering or computer science in any context, or on STEM disciplines in K-12 context? (3) Is the article focused on issues or the experiences of Blacks or African Americans, or on some aspect of the wide variety of

topics associated with broadening participation? Figure 2 includes a flowchart illustrating how the answer to each eligibility question was used to determine whether or not an article that was considered related to education or the STEM workforce was to be included in the systematic mapping. Table 2 includes example quotes from articles that were screened.

At most, three coders reviewed an article during this stage of the process. As illustrated in Fig. 2, if the first reviewer coded "Yes" for all three eligibility questions, it was automatically included in the systematic mapping. Similarly, if an article was coded with two "No" codes or was not about education or the STEM workforce, it was automatically excluded. In instances where only one eligibility question was answered "No," a second reviewer was required. In instances where a second reviewer was required and the first two coders could not agree on which codes should be applied, a third reviewer was required. In these instances, the third reviewer determined the final codes assigned to the article, serving as a tie breaker. During this phase of the study,

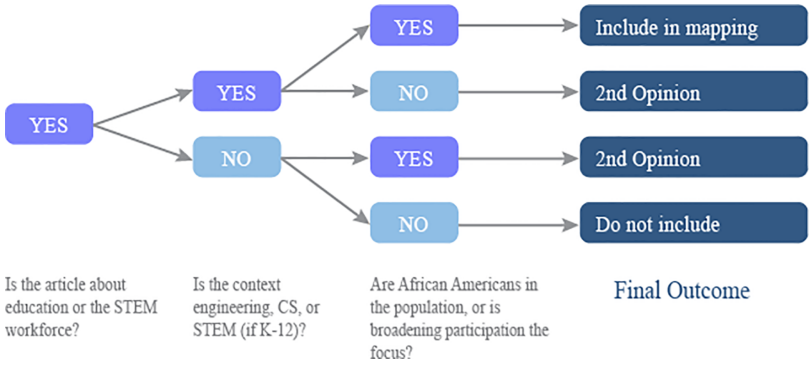

FIG. 2: Flowchart depicting eligibility criteria

TABLE 2: Example quotes corresponding to eligibility criteria

Eligibility Criteria	Quotes from Article Abstracts that Met Eligibility Criteria
Is the article about education or the STEM workforce in the US and written in English?	• "The goal of this panel session is to share the first-hand experiences of African American women faculty in engineering" (Adams et al., 2006b, p. 1). • "The article announces the election of 67 members at the U.S. National Academy of Engineering and no African Americans are among the electees" ("Blacks Appear to Be Shut Out in Election of New Members to the National Academy of Engineering Field in Breaking News on February 14, 2014," 2014, p. 1).

TABLE 2: (*continued*)

Eligibility Criteria	Quotes from Article Abstracts that Met Eligibility Criteria
Does the article focus on STEM disciplines in the K-12 context, or engineering, or computer science in any context? Reviewers applied one of the following codes after reading the abstract, and identifying the sentence seemed like the purpose of the article. • CS: The abstract focused on computer science/IT/computing (in some form) only. • ENG: The abstract refers to engineering discipline(s). If the segment is K-12 or informal learning environments, but focuses solely on ENG, reviewers coded it as ENG. • STEM: The abstract focuses on (1) pre-college experiences or issues that correspond to STEM; or (2) mentions "science and engineering," but is not focused on the K-12 or informal learning environments.	CS: • "The research presented in this paper used a mixed methods approach to understand the attitudes of African American middle school girls toward computer science and investigated the factors that influence these attitudes" (Robinson et al., 2015, p. 1) • "Needed is a better understanding of the background and psychosocial factors that attract, or repel, minority students from computing disciplines" (Buzzetto-More et al., 2010, p. 115). ENG: • "The purpose of this study will be to present the first phase of a long term study in the evaluation of preferred teaching styles and classroom techniques for African American engineering students" (Berry et al., 2007, p. 1) • "Examined whether there are significant racial differences in measured personality characteristics for female engineering majors (17–40 yrs old) at an urban university and whether there is a distinctive profile for this sample of women" (Brown, 1997, p. 1). STEM • "The objective of this research study was to investigate whether an association exists between teacher demographic factors (years of teaching experience and gender), 2 educational factors (certification type and certification pathway) and the percent passing rate of tenth grade African American male students on the 2010 science TAKS" (Cottledge, 2014, p. 1). • "This technique represented an important improvement of traditional lecture format, encouraging the retention of African American and female students in science and engineering majors" (Buncick et al., 2001, p. 1237).
Is the article focused on issues or the experiences of African Americans/Blacks, or on some aspect of the wide variety of topics associated with broadening participation (e.g., awareness, interest, recruitment, retention)?	• "The team seeks to develop a "research-oriented approach" designed to attract and retain a greater number of high-quality minority students in Science, Technology, Engineering, and Mathematics (STEM) disciplines" (Crosby et al., 2007, p. 1). • "Reports on the launch of the initiative "Learning Communities for Science, Technology, Engineering and Mathematics Academic Achievement" by the Howard University Graduate School and other historically black colleges and universities" (Jones, 2010, p. 4)

the three coders met each week to discuss the articles that required a second opinion (In all instances, the third coder's selections turned out to be the same as one of the two previous codes).

In total, 470 out of 1180 (40%) articles met the eligibility criteria. See Table 3 for the complete list of eligible articles. After a cursory glance at the articles that were excluded, we were not surprised by this outcome because of the broad applicability of some keywords. For example, the use of the keyword "black" led to the many search results about a plethora of unrelated topics (e.g., Kuo, 2009; Lance et al., 2013). Similar outcomes occurred with many of the search results involving keywords that were generic (e.g., multicultural, bias), though relevant to this study.

3.5 Research Quality and Data Extraction

Articles that met the eligibility criteria were subsequently coded using descriptive codes that were iteratively developed by the research team. Insights from literature on the key characteristics of a systematic mapping (James et al., 2016) and the purpose of the study informed the development of these codes. We drafted a set of codes and preliminary definitions after multiple rounds of inductive coding, applied to 20% (n = 94) of the eligible articles, to determine which categories of information are typically associated

TABLE 3: List of ~75 articles that met eligibility criteria and included in mapping. A complete list of articles included can be found in the supplementary material online.

Author	Year	Work Title	Source
Adams et al.	2006a	The Research Agenda for the New Discipline of Engineering Education	Journal of Engineering Education
Adams et al.	2006b	The Experiences of African American Women Engineering Faculty (Panel Presentation)	Frontiers in Education 36th Annual Conference
Ahn et al.	2014	"I Want To Be a Game Designer Or Scientist": Connected Learning and Developing Identities with Urban, African-American Youth	Proceedings of International Conference of the Learning Sciences
Allen	1992	The Color of Success: African-American College Student Outcomes at Predominantly White and Historically Black Public Colleges and Universities	Harvard Educational Review
Austin	2010	Perceived Factors That Influence Career Decision Self-Efficacy and Engineering Related Goal Intentions of African American High School Students	Career and Technical Education Research

TABLE 3: (*continued*)

Author	Year	Work Title	Source
Berry et al.	2007	A Survey of Teaching Styles and Classroom Techniques to Engage African-American Students in the Engineering Classroom	Proceedings of the American Society of Engineering Education Annual Conference and Exposition
	2012	Black Degree Attainments in Engineering Field in Degree Attainments, Research & Studies, STEM Fields	Journal of Blacks in Higher Education
	2014	Blacks Appear to be Shut Out in Election of New Members to the National Academy of Engineering Field in Breaking News	Journal of Black in Higher Education
Black Issues in Higher Education	2004	UGA Graduate School to Fund Research on Completion Rates of Doctoral Students	Black Issues in Higher Education
Booth et al.	2008	*The Craft of Research*, 3rd Edition	University of Chicago
Booth et al.	2016	*The Craft of Research*, 4th Edition	University of Chicago Press
Bowe	2012	Achievement Emotions As Predictors of High School Science Success Among African-American and European American Students	Humanities and Social Sciences
Bowman	2009	Studying Up, Down, Sideways and Through: Situated Research and Policy Networks	The Future of Sociology: Proceedings of the Annual Conference of the Australian Sociological Association
Brawner et al.	2010	Work in Progress—Flexibility and Career Opportunity As Motivation for Women Selecting Industrial Engineering Majors	IEEE Frontiers in Education Conference
Brown	1997	Description of Personality Similarities and Differences of a Sample of Black and White Female Engineering Students	Psychological Reports

TABLE 3: (*continued*)

Buncick et al.	2001	Using Demonstrations as a Contextual Road Map: Enhancing Course Continuity and Promoting Active Engagement in Introductory College Physics	International Journal of Science Education
Buzzetto-More et al.	2010	Unlocking the Barriers to Women and Minorities in Computer Science and Information Systems Studies: Results from a Multi-Methodical Study Conducted At Two Minority Serving Institutions	Journal of Information Technology Education
Carr	2016	Closing the Stem Gap with Culturally and Cognitively Appropriate Cyber-Instruction in an All-Girl Inner-City Charter School Stem Program: A Case Study	The Sciences and Engineering
Chang et al.	2014	What Matters in College for Retaining Aspiring Scientists and Engineers from Underrepresented Racial Groups	Journal of Research in Science Teaching
Clapton et al.	2009	*SCIE Systematic Mapping Guidance*	—
Clark	1960	The "Cooling-Out" Function in Higher Education	The American Journal
Colby and Ortman	2015	Current Population Reports	—
Cottledge	2014	An Examination of the Association between Demographic and Educational Factors and African American Achievement in Science	Humanities and Social Science
Creswell and Creswell	2017	Research Design: Qualitative, Quantitative, and Mixed Methods Approaches	Sage Publications
Crosby et al.	2007	Tiered Mentoring in a Cross-Disciplinary and Multi-Institutional Research Project	American Society for Engineering Education
Devore	2012	Probability and Statistics for Engineering and the Sciences (8th Ed.)	—
Didion et al.	2012	Colloquy On Minority Males in Science, Technology, Engineering, and Mathematics	—

TABLE 3: (*continued*)

Author	Year	Work Title	Source
Eccles and Jacobs	1986	Social Forces Shape Math Attitudes and Performance	Signs: Journal of Women in Culture and Society
Entwisle and Hayduk	1988	Lasting Effects of Elementary School	Sociology of Education
Finelli et al.	2015	Development of a Taxonomy of Keywords for Engineering Education Research	Journal of Engineering Education
Gibbons	2009	Engineering by the Numbers	—
Google and Gallup	2016	*Diversity Gaps in Computer Science: Exploring the Underrepresentation of Girls, Blacks, and Hispanics*	—
Grant and Booth	2009	A Typology of Reviews: An Analysis of 14 Review Types and Associated Methodologies	Health Info Library
Gutman et al.	2002	The Academic Achievement of African American Students during Early Adolescence: An Examination of Multiple Risk, Promotive, and Protective Factors	American Journal of Community Psychology
Hayes	2014	Understanding Him in STEM: Sharing the Stories of African American Male Scholars in Engineering Academic Programs At a Predominantly White University	Dissertation Abstracts International Section A: Humanities and Social Sciences
Hernandez et al.	2013	"Sustaining Optimal Motivation: a Longitudinal Analysis of Interventions To Broaden Participation of Underrepresented Students in STEM": Correction To Hernandez et al. (2013)	Journal of Educational Psychology
James et al.	2016	A Methodology for Systematic Mapping in Environmental Sciences	Environmental Evidence
Jamieson and Lohmann	2010	Creating a Culture for Scholarly and Systematic Innovation in Engineering Education: Ensuring U.S. Engineering Has the Right People with the Right Talent for the Global Society	American Society for Engineering Education
Kuo	2009	Multi-Proxy Approach on Black Carbon Characterization and Combustion Products Source Discrimination in Environmental Media	Texas A & M University

TABLE 3: (*continued*)

Lance et al.	2013	Opening the Black Box of Donor Influence on Digital Earth in Africa	International Journal of Digital Earth
Landis and Koch	1977	The Measurement of Observer Agreement for Categorical Data	Biometrics
LeBreton and Senter	2008	Answers to 20 Questions About Interrater Reliability and Interrater Agreement	Organizational Research Methods
Lent et al.	2005	Social Cognitive Predictors of Academic Interests and Goals in Engineering: Utility for Women and Students at Historically Black Universities	Journal of Counseling Psychology
Long et al.	2015	Black Male "Buoyant Believers" in Engineering and Engineering-Related Fields	—
Ma and Baum	2016	Trends in Community Colleges: Enrollment, Prices, Student Debt, and Completion	College Board Research Brief
McGee and Martin	2011	"You Would Not Believe What I Have to Go Through to Prove My Intellectual Value!" Stereotype Management Among Academically Successful Black Mathematics and Engineering Students	American Educational Research Journal
Miles and Huberman	2013	*Qualitative Data Analysis*	Sage Publishing
Moore et al.	2003	The Prove-Them-Wrong Syndrome: Voices from Unheard African-American Males in Engineering Disciplines	The Journal of Men's Studies
National Academy of Engineering	2014	*Surmounting the Barriers: Ethnic Diversity in Engineering Education: Summary of a Workshop*	National Academies
National Academy of Sciences, National Academy of Engineering, and Institute of Medicine	2011	*Expanding Underrepresented Minority Participation: America's Science and Technology Talent At the Crossroads*	National Academy of Engineering

TABLE 3: (*continued*)

Author	Year	Work Title	Source
National Academy of Sciences, National Academy of Engineering, & Institute of Medicine	2007	*Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*	National Academy of Sciences, National Academy of Engineering, & Institute of Medicine
National Academy of Sciences, National Academy of Engineering, & Institute of Medicine	2011	*Expanding Underrepresented Minority Participation: America's Science and Technology Talent At the Crossroads*	National Academy of Sciences, National Academy of Engineering, & Institute of Medicine
National Research Council	2001	*From Scarcity To Visibility: Gender Differences in the Careers of Doctoral Scientists and Engineers*	National Research Council
National Research Council	2010	*Gender Differences At Critical Transitions in the Careers of Science, Engineering, and Mathematics Faculty*	National Research Council
National Research Council	2011	*Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads*	National Research Council
Noguera	2003	The Trouble with Black Boys: The Role and Influence of Environmental and Cultural Factors on the Academic Performance of African American Males	Urban Education
Ohland et al.	2011	Race, Gender, and Measures of Success in Engineering Education	Journal of Engineering Education
Oliveira	2010	Impacting Students' Interest in Stem Fields: An Electronic Communication Course for K-12 Underrepresented Students	American Society for Engineering Education. Electrical Engineering Technology Program, Michigan Technological University
Petticrew and Roberts	2006	*Systematic Reviews in the Social Sciences: A Practical Guide*	Blackwell Publishing
Phillips et al.	2017	Reflections On the Messiness of Initiating a Systematic Literature Review On Broadening Participation in Engineering and Computer Science	Frontiers in Education Annual Conference

TABLE 3: (*continued*)

	2009	Prisma Checklist	www.prisma-statement.org
Ramsey	2013	The Effect of the Advanced Placement Training and Incentive Program on Increasing Enrollment and Performance on Advanced Placement Science Exams	Humanities in Social Science
Reid et al.	2016	Paving the Way: Institutional Interventions for Academic Excellence and Success in Engineering	—
Rice and Alfred	2014	Personal and Structural Elements of Support for African American Female Engineers	Journal of STEM Education Research
Ritchie et al.	2007	Transforming an Academy through the Enactment of Collective Curriculum Leadership	Journal of Curriculum Studies
Robinson et al.	2015	Understanding the Attitudes of African American Middle School Girls toward Computer Science	Institute of Electrical and Electronics Engineers Inc.
Robinson et al.	2016	Addressing Negative Racial and Gendered Experiences That Discourage Academic Careers in Engineering	Computing in Science and Engineering
Smith and Paretti	2015	Understanding the Mentoring Needs of African American Female Engineering Students: A Phenomenographic Preliminary Analysis	American Society for Engineering Education
Stevens and Vinson	2016	Institutional Obstacles to Ethnographic Observation in Engineering Industry	American Society for Engineering Education
Su	2010	Quantification of Diversity in Engineering Higher Education in the United States	Journal of Women and Minorities in Science and Engineering
Suber	2003	Removing the Barriers to Research: An Introduction to Open Access for Librarians	College & Research Libraries News
Terenzini et al.	2014	America's Overlooked Engineers: Community Colleges and Diversity in Undergraduate Education	University of Michigan
Tinsley and Weiss	2000	Interrater Reliability and Agreement	Handbook of Applied Multivariate Statistics and Mathematical Modeling

TABLE 3: (*continued*)

Author	Year	Work Title	Source
Tomasko et al.	2016	Association of Summer Bridge Program Outcomes with STEM Retention of Targeted Demographic Groups	Journal of College Science Teaching
Weinberger	2017	Engineering Educational Opportunity: Impacts of 1970s and 1980s Policies to Increase the Share of Black College Graduates with Major in Engineering or Computer Science	National Bureau of Economic Research
Yoder	2017	Engineering by the Numbers	American Society for Engineering Education

with the corpus of articles. All coding was based on reviewing each article's abstract and standard publication details (e.g., publication year).

After settling on a tentative set of codes and definitions, we performed two rounds of inter-rater reliability (IRR) testing to determine the extent to which the researchers consistently applied the codes to the studies being examined. During the first round of IRR testing, we randomly selected 30 articles to review. Each researcher then independently applied the tentative codes to the text, documenting instances when the codebook needed more clarification. Subsequently, the three coders met to discuss discrepancies and to ultimately improve the codebook. Once the codebook was updated, we selected 30 additional articles to review during the second round. Each researcher then independently coded these articles using the revised codebook and noted where the codebook could benefit from additional clarification or an example.

The main difference between the first and second round of IRR analysis was the use of a quantitative measure to evaluate the extent of agreement among coders during the latter. While there are many measures that can be used to evaluate IRR (LeBreton and Senter, 2008; Tinsley and Weiss, 2000), we used the F_1 score during round 2. Although traditional methods of evaluating IRR (e.g., Cohen's Kappa, Fleiss's Kappa, Krippendorf's Alpha, Scott's Pi) address issues of chance and what to do if there are multiple raters, these methods are only useful for texts that belong to mutually exclusive categories as they do not account for instances when multiple codes may be assigned to the same text—which is the case in this study. Typically, the F_1 score (Devore, 2012) is used in contexts where categories are not mutually exclusive. A F_1 score is the harmonic mean between two data sets.

Since the F_1 score is not commonly used in engineering education research, the calculation for it will be explained. The IRR calculation for the F_1 score is as follows: Assume there is a total of N article abstracts coded as part of the IRR analysis. For the i-th abstract: x_{1i} represents the number of codes assigned to the abstract by the coder A;

x_{2i} denotes the number of codes assigned to the abstracts by coder B; and s_i represents the number of codes that are agreed upon between researchers A and B. Let $p_{1i} = s_i/x_{1i}$, and $p_{2i} = s_i/x_{2i}$, then complete the following formula:

$$F_1 = \frac{1}{N} * \Sigma^{(2p*p_{2i})/(p+p_{2i})} \quad (1)$$

As illustrated in the above equation, the F_1 score equals 1 when the code assignments between the multiple coders' data sets are exactly the same; conversely, a score of 0 indicates no agreement. In this context, this measure represents the closeness of two sets of codes assigned to the same set of *N* abstracts by different researchers. Overall, we obtained a F_1 score of 0.851 after testing the interrater reliability among all three coders for the articles reviewed after the codebook was developed. Although the calculations for generating this metric are different from the way IRR is usually calculated (e.g., Cohen's Kappa), the way to interpret it is consistent with how kappa values are typically understood. According to Landis and Koch (1977), a kappa value between 0.8 and 1.0 can be interpreted as "Almost Perfect Agreement." We deemed this an acceptable threshold for validating the codebook and coding the eligible articles for the purpose of creating a systematic map of the literature. Table 4 includes the list of codes and descriptions. It also includes examples of texts from articles to which the codes were applied.

Once the codebook was finalized and there was consistency among the coders regarding how to apply the codes, the three reviewers evenly divided all 470 articles to assign codes to each for the purpose of systematically mapping the literature. Each article was randomly assigned to a coder and independently coded; these codes were subsequently reviewed by a second coder, and a third coder when necessary. This is consistent with quality checks commonly associated with systematic literature reviews (Petticrew and Roberts, 2006). Any discrepancies about the assignment of the descriptive codes were discussed and resolved among the three coders during the weekly team meetings.

3.6 Data Visualization

After the research team finished coding the 470 eligible articles, we generated pivot tables, descriptive statistics, and other graphical representations to identify and summarize trends in the data. The Result and Discussion section includes the findings of the systematic mapping. Data visualization is a central step in the mapping process (Clapton et al., 2009; James et al., 2016) and other analysis procedures (Miles and Huberman, 2013).

3.7 Limitations

Before proceeding to the results sections, several limitations of the systematic mapping methodology (Grant and Booth, 2009) should be noted by the reader to ensure our findings are interpreted appropriately. First, the mapping process focused solely on abstracts or equivalent overviews, which include limited information and are not

TABLE 4: List of codes and descriptions

Article Descriptors	Examples of Coded Text
Publication Year The year of publication, based on bibliographic information.	1987
Publication Format The format in which the article was published, based on bibliographic information. Reviewers applied one of the following codes: • CONF: Conference proceeding. • JRNL: Journal article. • THES: Dissertation or Master's thesis. • BOOK: Book or section/chapter of a book. • OTHER-PUB: Any other type of publication that does not fall within the other four categories.	CONF: • 2016 ASEE Annual Conference and Exposition JRNL: • Journal of Diversity in Higher Education THES: • Dissertation Abstracts International Section A BOOK: • In Leonard, J., & Martin, D. B. (Eds.). (2013). *The Brilliance of Black Children in Mathematics.* Charlotte, NC: Information Age Publishing (pp. 247–272). OTHER-PUB: • IEEE Technology and Society Magazine, 22(3 SPEC), 20–27.

TABLE 4: (*continued*)

Population Race The umbrella term that describes the race(s)/ ethnicity of people described in the article; if multiple groups are mentioned, the focus was on the participants in the study/experience. Reviewers applied the most inclusive code among the following options: • AA: The abstract only refers to African Americans or Black people. • POC: The abstract refers to African Americans and other people of color, but does not include White participants. • MIX: The abstract refers to underrepresented groups and/or underserved populations using terms like "marginalized," "urban," "first generation," "women," or "HBCU." • GEN: The abstract refers to a general population that includes African Americans, but also either intends to study other races/ ethnicities including White people, or does not provide specific details about the population's race.	AA: • "To address this gap, the aim of this study is to gain an understanding of how undergraduate African American women in engineering experience effective faculty mentoring" (Smith and Paretti, 2015, p. 1). • "The article reports on the findings of an American Society for Engineering Education (ASEE) survey indicating that 4.2% of bachelor's degrees awarded in engineering were earned by Blacks in 2011" ("Black Degree Attainments in Engineering Field in Degree Attainments, Research & Studies, STEM fields on August 2, 2012," 2012, p. 1). POC: • "This paper presents an Electronic Communication course that is part of an out of school time educational program targeting urban African American and Hispanic American students in high school to make STEM disciplines more culturally relevant for these underrepresented youths" (Oliveira, 2010, p. 1). • "We followed a large sample of high-achieving African American and Latino undergraduates in STEM disciplines attending 38 institutions of higher education in the United States over 3 academic years" (Hernandez et al., 2013, p. 1). MIX: • "Through two focus groups with undergraduate women industrial engineering majors at an historically black university and a predominantly white institution, we found these primary themes" (Brawner et al., 2010, p. 1). • "Using qualitative research methods, a study examined the leadership dynamics of a science, engineering, and mathematics academy within a large urban high school with mostly African American students" (Ritchie et al., 2007, p. 2). GEN: • "Increases in the number of female and African American students' test takers and their qualifying scores were seen in all three years of the APTIP intervention" (Ramsey, 2013, p. xi). • "The objective of this study was to test the control-value theory (CVT) of achievement emotions to determine if the eight discrete achievement emotions would be predictive of test scores on the High School Graduation Test (GHSGT)-Science for African-American compared to European-American science students" (Bowe, 2012, p. 1).

TABLE 4: (*continued*)

Article Descriptors	Examples of Coded Text
Population Gender The term that describes the gender of the population in the study/experience, based on what was provided in the abstract. If multiple groups are mentioned, reviewers applied the most inclusive code among the following options: • M: The abstract only refers to men or boys. • F: The abstract only refers to women or girls. • BOTH: The abstract does not mention a specific gender or mentions both genders.	M: • "This study explores the life stories of five African American male scholars in the college of engineering at a predominantly white university" (Hayes, 2014, p. ii). • "We focus our analysis on two African-American boys, Damian and Jamal, who are best friends and avid gamers" (Ahn et al., 2014, p. 1). F: • "45 black and white female engineering students were assessed on Gough's Adjective Checklist and Schultz's FIRO-B" (Brown, 1997, p. 603). • "In this mixed-methods study, the researcher observed a cyber-learning math program and its effects on the experiences and outcomes of African American middle school girls (AAMSG) in an inner-city all girl middle school" (Carr, 2016, p. 1). BOTH: • "Results also show that gender was not significant in either dependent variable" (Austin, 2010, p. 119).

TABLE 4: (*continued*)

Segment: The location of the participants referred to in the article. Apply one of the following 8 categories: • K12: The abstract specifies that participants are still enrolled in any educational system before college. • UG: The abstract specifies that participants are enrolled in a 4-year college system. • CC: The abstract specifies that participants are enrolled in a 2-year community college system. • GRAD: The abstract specifies that participants are enrolled in a graduate program, whether Master's or PhD level. • ACAD: The abstract specifies that participants are professionals in an academic setting (i.e., faculty). • NACAD: The abstract specifies that participants are professionals in a nonacademic setting. • ACROSS: The abstract specifies participants being studied across segments, or as they transition from one segment to another. • OTHER-JUNC: The abstract specifies a segment that does not fit within the above 7 categories or if the segment is not clear from the abstract.	K12: • African American high school students • A nationally representative sample of first graders from the Early Childhood Longitudinal Study was used UG: • First year student academic success and retention • Results indicate that physical science/engineering (PS/E) majors are dominated by men, but not, however, disproportionately by White men CC: • St. Louis Community College at Florissant Valley • This study analyzes how ethnicity, gender, and nontraditional student characteristics relate to differential online versus face-to-face outcomes in science, technology, engineering, and mathematics (STEM) courses at community colleges GRAD: • Study obtained information from minority graduates about factors impacting persistence to graduate studies • SEAGEP is a comprehensive minority graduate-level program ACAD: • WOC faculty in engineering • Racism against African American faculty NACAD: • Engineering identity implications on the retention of Black women in the engineering industry • Career self-efficacy of Black engineers ACROSS: • Various levels of academic status (bachelor's, master's, and PhD levels) • Students who have successfully transferred to a four-year institution were interviewed. OTHER-JUNC: • He states that hackathons are an outlet for creativity and self-expression via technology • It mentions the seven young Black scientists who are among the 100 winners of the Presidential Early Career Awards for Scientists and Engineering (PECASE)

TABLE 4: (*continued*)

Article Descriptors	Examples of Coded Text
Study Type: The way the topic is presented. Apply one of the following four categories: • EVAL: The abstract specifies that the article is an assessment or evaluation of some sort. • RES: The abstract specifies that the article is a research study. • OVERVIEW: The abstract specifies that the article is only a description or overview of an intervention. • OTHER-TYPE: The abstract specifies a study type that does not fit in the above three categories or the abstract is unclear about the study type.	EVAL: • Study evaluated an after-school science program aimed at increasing minority girls' interest in science and engineering • This paper discusses the factors around creating such a conference and the impact it has made RES: • Focus group transcripts were coded and analyzed qualitatively • Scholars from three McNair Programs were surveyed OVERVIEW: • The authors summarize MECCA OTHER-TYPE: • This paper presents the strategies for: engaging science and engineering faculty and students • The article reports on the hunger strike

TABLE 4: (*continued*)

Method: The method referenced in an article, if the article was EVAL or RES. Apply one of the following five categories: • QUANT: The abstract only specifies the use of one or more forms of quantitative data. If "statistics" or another type of method that you know is quantitative is explicitly mentioned as the only method, select QUANT. • QUAL: The abstract only specifies the use of one or more forms of qualitative data. If a method such as "phenomenography" or any other type of method that you know can only be qualitative is mentioned, mark QUAL. • BOTH: The abstract specifies the use of both qualitative and quantitative data. The abstract may or may not explicitly mention "mixed methods" (but if it does, use this code). • INC: The abstract specifies data or a method incompletely, and as a result could be either quantitative or qualitative are INC. Case studies, surveys, and other methods that can be either quantitative or qualitative and are not clarified as either only quantitative or only qualitative are INC. • OTHER-METH: The abstract specifies a method that does not fit in the above four categories or does not clearly specify a method.	QUANT: • Hierarchical logistic regression models were developed • A comparison of the students' third grade end-of-grade (EOG) math scores to their fourth grade EOG math scores QUAL: • This qualitative study employs a phenomenological approach • Interpretive case studies focusing on such trajectories of identification were conducted in a program combining an out-of-school science and engineering learning BOTH: • Specifically, this paper draws on both quantitative and qualitative data to examine factors influencing Black males' college readiness and success in STEM • We use a mixed-methods approach INC: • Using several data analysis techniques • Conducted case study research OTHER-METH: • The article examines the relatively low levels of academic achievement among Black males in science, technology, engineering, and mathematics (STEM) fields and why those that do major in such areas often switch disciplines or do not purse a doctoral degree • Descriptive overview; critique of the current literature

always well-written. In instances where things were unclear, we did not probe or search the entire document for clarity. In times of ambiguity, we relied on a second opinion of other coders within the research team to ensure a consistent interpretation. Second, literature maps can oversimplify the picture or mask variations between studies, depending on the degree of specificity in the coding process. In developing the codebook, our research team made judgements with regard to specificity that undoubtedly impacted our results. We similarly made choices about which databases to include. Third, the mapping process does not include all forms of quality checks that are commonly associated with systematic literature reviews (Petticrew and Roberts, 2006). As a result, the methodology does not address research questions related to the quality of scholarship conducted in this area, merely the quantity. Said differently, the aim is simply on the quantity of scholarship based on various categorizations. When interpreting the information in the following section, the reader should remember that the resulting literature map is purely based on the article's research design and not an in-depth synthesis across all articles. Despite these limitations, the systematic mapping revealed several insights in response to the overarching research question posed in the study.

3.8 Researchers' Positionality

In addition to providing a description of the experience of data included in the review, we would also like to provide information about the positionality of ourselves as a research team. This information is important because our positions are the lenses through which we approached this work. Three out of five of the authors are African American and faculty members in the same department of engineering education. For all three authors, their primary research interest is in engineering diversity, equity, and inclusion. The other two authors are White and/or Native American and conduct engineering education research as part of their roles within other university settings. One of them has formal training in both library sciences and engineering education. Across all members of the team, we have worked in a variety of contexts: the university, K-12, government, and industry. As a result, we have experience with both research and practice.

4. RESULTS AND DISCUSSION: SYSTEMATIC MAP

We present the results of the analysis below with the aim of answering the larger research question posed at the beginning of the study: *What are the salient characteristics of literature (empirical or otherwise) on the broadening participation of African Americans in engineering or computer science since 1975?* More specifically, we use trends from each of the features coded (e.g., population race, gender) to identify noticeable gaps in literature and answer the following sub-questions:

1. Which demographics best represent the subjects of scholarship?
2. Which sectors of STEM pathways are investigated?
3. Which types of scholarship have been published over time?

4. Which types of information have been produced?
5. What are the most salient trends regarding scholarship focused specifically on African Americans, particularly research?

In the following sections, we address each sub-question, specifying which features were used to answer the question and highlighting important trends and patterns. Since systematic mappings help outline future directions for research, practice, and policy, we will discuss the implications of the findings in tandem with the results.

4.1 Demographics: Population Race and Gender

Efforts to broaden participation typically focus on specific demographic groups, making *social identity* a germane topic. In light of the overarching research question, we aimed to understand which dimensions of social identities scholars considered salient for their respective participants. Examining the extent to which different dimensions of identity are centered in the literature is important because it has implications for understanding which demographic groups are being used as sources of evidence as we work towards identifying solutions.

It is important to note that we made specific choices about which groups and topics were considered "related to broadening the participation of African Americans" as these decisions most directly impact this sub-question. To ensure our examination was not too narrow, literature did not have to focus *solely* on African Americans to be considered relevant. For example, a study about students, in general, that considered race in the analysis and focused on a topic explicitly connected to broadening participation in engineering was included.

To understand the subject demographics, we focused on race and gender, as well as their intersection. We focused on the treatment of these two dimensions due to their prevalence in the literature and historical priority in conversations around broadening participation (e.g., National Research Council, 2001, 2010, 2011). Regarding race, Fig. 3 highlights the ways in which African Americans as a population were included in scholarship. Because we decided to consider the literature on increasing participation broadly, a large portion of scholarship in our map unsurprisingly included a broader subject population, emphasizing Africans Americans without focusing on them solely. More specifically, approximately one-third of the identified scholarship focused on African Americans as a singular racial group, whereas the remaining abstracts included African Americans within larger umbrella groups, suggesting that African Americans are regularly specified within larger umbrella groupings.

Regarding gender, our results indicated that focusing on two genders (i.e., men and women simultaneously) is most common, as opposed to focusing on men or women, boys or girls. As illustrated in Fig. 4, 79% of articles focused on women and men simultaneously, or did not mention gender at all; 12% of articles were about women and girls; and 9% were about men and boys. It is likely that more scholarship explicitly focused on women than men because women are another underrepresented group in STEM, and

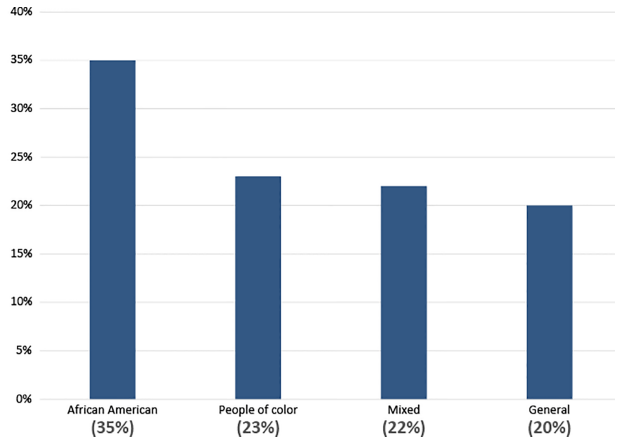

FIG. 3: Subject demographics by race

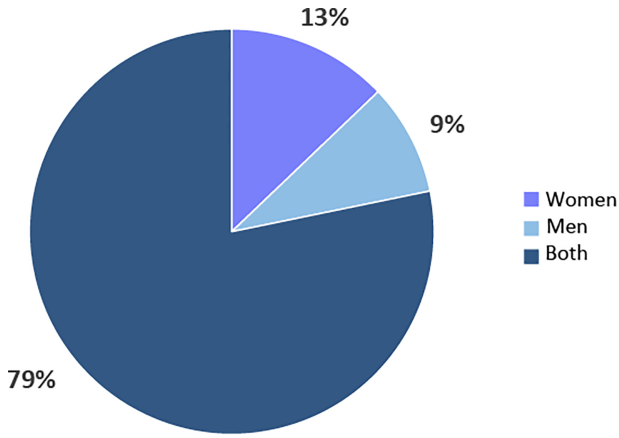

FIG. 4: Subject demographics by gender (binary)

gender sometimes goes unmentioned in scholarship with a predominately, if not entirely, focus on boys or men.

Combined, these trends highlight the implications of decision related to how race and gender are to be considered in reviewing the literature: the specificity given to either gender or race will influence the amount of relevant scholarship available. When focusing on a specific group such as African Americans, whether men or women, one should be open to looking at seemingly related literature that is focused on broader demographics because not doing so might prematurely limit their search by too much. Furthermore, automatically excluding studies with a broader demographic focus can mask insights generated through research methods that include comparison or control groups across racial lines, which is a common practice in educational research. An example of such a study is Ohland et al. (2011), where "eight-semester persistence

and six-year graduation rates are compared for various race-gender populations using a longitudinal, comprehensive dataset of more than 75,000 students matriculating in engineering at nine universities from 1988–1998." Conversely, it is similarly important to realize that when African American participation is studied in this manner, the specific needs and experiences of the population as well as within-group variability may be lost in the larger sample (Smith and Paretti, 2015). As African American participation in engineering and computer science continues to be stagnant and/or declining, unlike other racial ethnic groups (Gibbons, 2009; Yoder, 2017), it is clear that the needs of prospective African American engineering and computer science students are unique, and merit focused attention. All in all, balance is needed as it relates to demographic focus.

To better understand the extent to which more specific demographics may need isolated attention, we turn to the intersection of race and gender. When we overlay both, we get a more complete picture. For example, our results suggest that when the focus of an article is solely on African Americans, men receive more attention; whereas when the focus is on people of color, women receive more attention. As shown in Table 5, 90% of articles that focused solely on boys or men (n = 37) were specifically about African Americans, whereas there was a greater mixture in scholarship that focused solely on girls or women. In particular, only 47% of articles focused solely on girls or women were about African American women (n = 28). This pattern could suggest that there is lack of attention given to the unique experiences of African American women; or it could be the result of women being considered underrepresented in general whereas men are not. Because men are not gender minorities, literature related to broadening participation that specifically focuses on men is almost guaranteed to focus on men of color, particularly African Americans. These trends should be considered when making scoping, programmatic, or research design decisions related to race and gender.

4.2 Sectors: Discipline and Segment

As it was stated at the beginning of this manuscript, "[t]he potential for losing students along all segments of the pathway from preschool through graduate school necessitates a comprehensive approach that focuses on all segments of the pathways, all stakehold-

TABLE 5: Overlap of race and gender in the literature

Population Race	**Population Gender**			
	Women	**Men**	**Both**	**Grand Total**
African American	28	37	101	166
People of color	13	2	92	107
Mixed	18	1	83	102
General	0	1	94	95
Grand total	59	41	370	470

ers, and the potential of all programs, targeted and non-targeted" (National Academies, 2011, p. 144). To explore the extent to which the current approach has been comprehensive, we examined trends related to the attention given to various sectors along the STEM education-to-workforce pathway. Here we focus on discipline (e.g., engineering) and segment (e.g., K-12).

Again, to ensure our probe was not too narrow, we aimed to include literature focused on every segment between K-12 and the workforce, both academe and industry. Our results suggest that K-12 and undergraduate education receive the bulk of the attention—a pattern that manifests regardless of discipline. Unsurprisingly, abstracts that specifically focus on computer science are not as prevalent. As illustrated in Fig. 5, abstracts focused on either STEM broadly (as opposed to only engineering or computer science) or engineering accounted for 92% of literature, whereas abstracts focused solely on computer science accounted for 8% of the total. We hesitate to give an explanation for this trend as there are several plausible rationales available, the most likely being the hierarchy of the terms: STEM specifically includes the subject engineering, and engineering often includes computer science. Furthermore, the interest in computer science as it relates to broadening participation of African Americans is more contemporary, and the field could be receiving less attention. More information is needed here.

Our results suggested a similar imbalance as it relates to the attention given to different segments of the STEM pathway. As illustrated by Fig. 6, the undergraduate segment represented the largest proportion (54%) of scholarship, by far, and was followed by the K-12 segment. Unfortunately, yet unsurprisingly, the workforce segments (both academic and nonacademic) receive much less attention, and community colleges received even less. Though a more equal distribution of scholarship may be warranted, the attention given to K-12 is promising because participation in STEM is a socialization process that often begins in early childhood (Entwisle and Hayduk, 1988; Eccles and Jacobs, 1986) and efforts earlier along the STEM pathways may be more efficacious

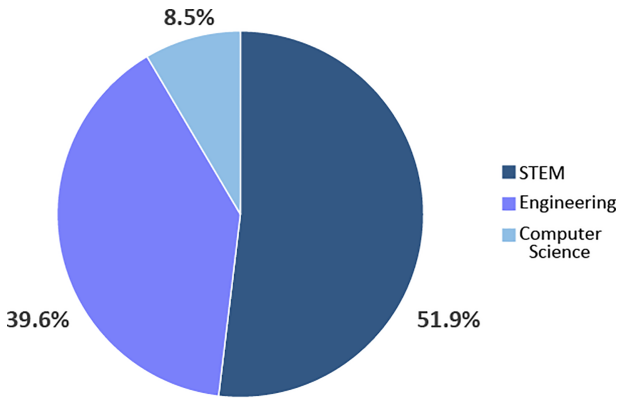

FIG. 5: Disciplinary emphasis

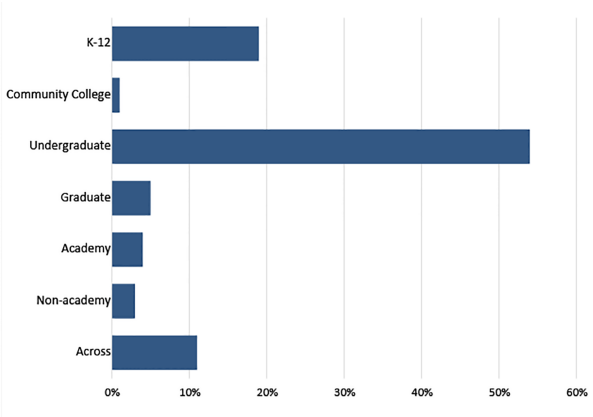

FIG. 6: Segment along education-to-workforce pathway

(Lent et al., 2005). This is especially relevant when considering African American participation in engineering and computer science given the frequency of many additional childhood and adolescent stressors this population faces (Gutman et al., 2002; Noguera, 2003). Then again, the lack of scholarship focused solely on community college students is disheartening given the demographic of the student body—a significant number of African Americans begin their postsecondary education here (Ma and Baum, 2016). The lack of focus on this segment was unsurprising, unfortunately, as previous scholars have noted the tendency to overlook this population (Clark, 1960; Terenzini et al., 2014). The lack of focus on the workforce was similarly expected, though for different reasons. In particular, this trend regarding the nonacademic workforce is likely due to the influence of power dynamics on accessibility as industry employers are often reluctant to open their doors to social science researchers (Stevens and Vinson, 2016). The trend regarding the academic workforce could be due to the locations of those producing most of the scholarship (i.e., universities), where researchers are more likely to study those with less power than to study their peers (i.e., other faculty). Similar tendencies have been noted in fields such as psychology, where studies are often about undergraduate students (Bowman, 2009). Because most researchers are at universities, this population is extremely accessible when compared to other contexts, such as industry, where gatekeepers are not always as receptive to researchers.

Combined, the implication of the discipline and segment trends is that more scholarship is needed to advance our understanding of less prioritized areas, whether due to interest or accessibility. To better understand the extent to which certain sectors should be given attention, we turn to the intersection of discipline and segment. When cross-tabbed by discipline (see Table 6), abstracts about the K-12 segment were largely written using the STEM umbrella term, whereas abstracts about the undergraduate segment featured a greater balance of both engineering and STEM descriptors. Though a central focus to a smaller extent, computer science has stronger representation in the K-12 and undergraduate literature.

TABLE 6: Overlap of segment and discipline in the literature

Segment	STEM	Engineering	CS	Subtotals
K-12	69	7	12	88
Community college	5	2	0	7
Undergraduate	106	132	17	255
Graduate	16	5	1	22
Academy	9	11	0	20
Nonacademy	3	8	1	12
Across	28	18	5	51
Other	8	3	4	15
Grand total	244	186	40	470

4.3 Scholarship: Publication Format and Year

In addition to identifying trends related to demographics and sectors, it is important to understand scholarship production (e.g., research output) because it has implications for which audiences are targeted and have access, as well as the manner in which gatekeepers monitor quality (e.g., peer-reviewed or non-peer-reviewed). We focus on publication format and year, aiming to acquire a general sense of scholarship production over time (see Fig. 7).

Regarding publication format, our results suggest that a large majority of the scholarship we identified was disseminated through traditional academic venues—a significant majority of abstracts (70%) were either from conference proceedings or journal articles. Though this trend is likely a result of the scholarly focus of our re-

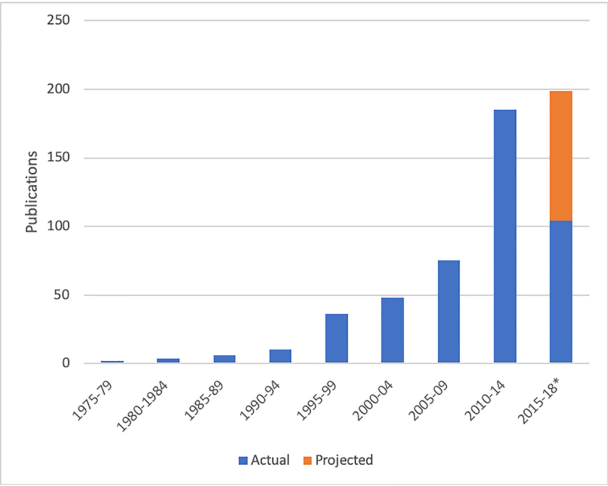

FIG. 7: Publication trends over time

search process, an important point to consider here is the manner in which stakeholders in various segments access and appraise knowledge generated by the literature. For example, stakeholders beyond university settings likely do not have great accessibility to journal articles, which are often behind pay walls (Suber, 2003). Furthermore, even when these stakeholders can access journal articles, the information may not be communicated in a manner intended to facilitate their understanding and implementation. On the contrary, non-peer-reviewed media may raise concerns regarding quality or credibility, as the review process can vary drastically or be nonexistent for certain formats. Moving forward, the impact of the knowledge medium should be kept in mind among knowledge producers interested in expanding participation rates of African Americans in engineering and computer science, as well as knowledge consumers interested in advancing their own understanding. The field should also examine the extent to which scholarship focused on broadening participation is published in open-access venues, as many of the practitioners, leading efforts beyond the university, may otherwise not have access to the knowledge researchers are working so hard to disseminate.

Access to information may become a higher priority as increasingly more information is produced, as indicated by our results. As shown in Fig. 7, the quantity of germane scholarship increased after every five-year period during our search timetable (1975–2017), and a significant portion of this scholarship was published after 2000. The largest proportional growth in frequency occurred from 1990–1994 to 1995–1999, where scholarship more than tripled, increasing from 10 to 36. The next greatest jump occurred from 2005–2009 and 2010–2014, where the number increased from 75 to 185. Though the last five-year period in the timetable is incomplete, the numbers appear to be stabilizing. As more and more scholarship is being produced, the field should continue making an effort to ensure work is not being unnecessarily duplicated.

Combined, the implication of the publication format and year trends is that scholarship production in this area has experienced exponential growth since 1975 and is being produced in various formats. To better understand the extent to which certain formats have been produced over time, we turn to the intersection of publication format and year, as shown in Table 7. Predictably, the three more popular formats—journal articles, confer-

TABLE 7: Prevalence of scholarship formats in the literature

Format	Count	% Total
Conference proceedings	161	34%
Journal article	160	34%
Thesis	96	20%
Book	13	3%
Other	40	9%
Grand total	470	100%

ence papers, and theses—experienced an overall increase during each successive five-year period, up until 2014. We note that theses publication increased the most exponentially over a single period, more than quadrupling in number from 2005–2009 to 2010–2014. This included work from various fields, such as educational psychology, higher education, education and human development, urban education, mathematics curriculum and instruction, economics, public policy, etc. Such variation in academic disciplines was encouraging as solving this challenge will likely require interdisciplinary expertise. Furthermore, the frequency of journal articles more than tripled from 2005 to 2009, and the frequency of conference articles nearly tripled from the 2000–2004 to 2005–2009 period. The most prevalent journals included the *Journal of Negro Education*, *Science Education*, *Journal of Research in Science Teaching*, *Journal of Engineering Education*, *Journal of College Student Development*, *Journal of College Science Teaching*, *Journal of Blacks in Higher Education*, *Journal of Applied Psychology*, the *International Journal of Engineering Education*, and the *Harvard Education Review*. Unfortunately, it is difficult to determine why the frequency of scholarship has grown so rapidly; or why, in particular, the growth has been concentrated in conference articles, journals, and theses. While this increase may indicate increased interest, some of it may be attributed to an increase in the volume of publishing, in general. Nevertheless, these trends are encouraging.

4.4 Information: Study Type and Methods

Next, we explored which style of information was being produced, focusing on study type and data collection methods used to investigate research and assessment questions. It is important to understand the nature of the information being produced because different approaches to data collection enable us to answer different questions (Booth et al., 2016; Creswell and Creswell, 2017; Miles and Huberman, 2013). Because each method has different strengths and weaknesses, it is useful to understand the extent to which stakeholders are leveraging the range of methodological paradigms available. As illustrated in Fig. 8, most abstracts were research focused, though a considerable amount of practice-focused scholarship was also present in the form of overviews and evaluations. This trend could be attributed to the likelihood that most assessment and evaluation conducted by practitioners is not being published, and is unlikely the result of more research being conducted than practice-based efforts.

Next, we focused on data collection described in abstracts considered as either research or evaluations according to study type. As illustrated in Table 8, the grand total here is 363 as opposed to 470 because articles categorized as “overview” or “other” for study type (n = 107) were excluded. In total, 59% of research or evaluation articles had a method that was discernible from the abstract, including quantitative methods, qualitative methods, and mixed or multimethods; and only 21% mentioned utilizing a method in a nonconclusive way. While the largest type of research method was quantitative (31%), qualitative articles were still a large minority at (19%). This trend suggests that a variety of methods are being used to study the issue, but this warrants further unpacking.

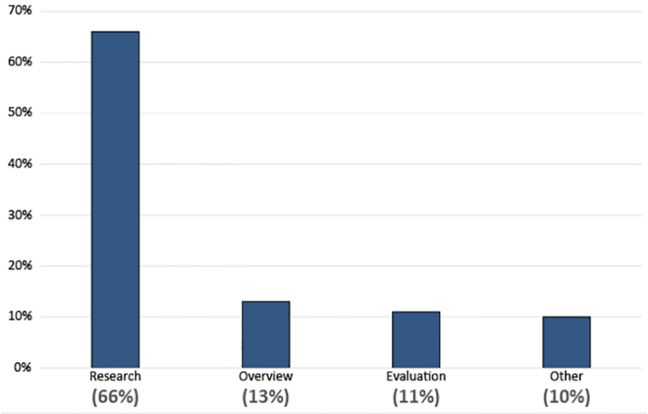

FIG. 8: Study types reflected in scholarship

TABLE 8: Prevalence of data-collection methods in the literature

Method	Count	% Total
Quantitative	113	31%
Qualitative	68	19%
Both	33	9%
Inconclusive	77	21%
Other	72	20%
Grand total	363	100%

To further understand the implication of these trends as it relates to research and evaluation studies specifically, we cross-tabbed study type and research methods. As shown in Table 9, research articles were more likely to have a discernible method compared to evaluation articles as most evaluation articles were either INC or OTHER-METH, indicating that the methods were either indiscernible or unclear based on the abstract. This is likely due to differences in expectations and communicative practices across writing research vs. evaluation abstracts, methods being more prioritized in the former and context in the latter. Further work is needed to unpack the methodological choices in these two areas. As the field continues working towards solving the persistent

TABLE 9: Overlap of study type and research method

Method	Quant.	Qual.	Both	Inconclusive	Other	Subtotals
Research	107	66	27	67	45	312
Evaluation	6	2	6	10	27	51
Grand total	113	68	33	77	72	363

challenge of broadening participation, researchers and evaluators should continue leveraging both qualitative and quantitative methods in their scholarship.

4.5 Salient Trends: Race, Gender, and Other Variables

Lastly, to ensure we did not overlook any salient trends regarding scholarship focused specifically on African Americans, we concluded our analysis by more closely examining the interactions between race, gender, and other variables (e.g., study type, methods) using cross tabulations. In doing so, we were able to identify more specific trends related to research that specifically focused on African American men and women. As shown in Table 10, most evaluation studies report findings with respect to each gender. This is likely due to most interventions being either focused on race (e.g., people of color) or gender (e.g., girls), but seldom targeting those with an intersectional identity (e.g., girls of color). However, such programs do exist. This finding suggests that a possible gap in the literature is evaluation evidence from interventions that specifically target African American boys or girls. These investigations might provide insight into whether such interventions are effective.

Next, because there were so many research abstracts (n = 310), we looked more closely at how race and gender intersected for research in particular, focusing on data collection methods (Table 11), discipline (Table 12), and segment (Table 13). This data enabled us to identify several gaps. For example, research focused solely on African American men or women was mostly qualitative, whereas research specifically about African Americans that studied both genders was generally a mix of quantitative and qualitative studies (Table 11). The results here may be indica-

TABLE 10: Overlap of race, gender, and study type in the literature

Race	Gender	Research	Overview	Evaluation	Other	Total
AA	F	25	1	1	1	28
	M	28	3	1	5	37
	BOTH	68	9	10	14	102
POC	F	8	2	0	3	13
	M	2	0	0	0	2
	BOTH	51	21	11	9	93
MIX	F	17	1	0	0	18
	M	0	0	1	0	1
	BOTH	44	17	16	6	83
GEN	F	0	0	0	0	0
	M	1	0	0	0	1
	BOTH	68	7	11	8	94
Total		312	61	51	46	470

TABLE 11: Overlap of race, gender, and methods in the literature [research only]

Race	Gender	Quant	Qual	Both	Other-meth	Inc	Total
AA	F	2	10	4	3	6	25
	M	1	12	5	3	7	28
	BOTH	21	16	5	15	11	68
POC	F	2	3	0	1	2	8
	M	1	0	0	0	1	2
	BOTH	14	8	5	12	12	51
MIX	F	10	5	1	0	1	17
	M	0	0	0	0	0	0
	BOTH	18	8	6	6	6	44
GEN	F	0	0	0	0	0	0
	M	0	0	0	0	1	1
	BOTH	38	4	1	5	20	68
Total		107	66	27	67	45	312

TABLE 12: Overlap of race, gender, and discipline in the literature [research only]

Race	Gender	STEM	ENG	CS	Total
AA	F	16	7	2	25
	M	15	10	3	28
	BOTH	32	29	7	68
POC	F	7	1	0	8
	M	2	0	0	2
	BOTH	25	22	4	51
MIX	F	6	11	0	17
	M	0	0	0	0
	BOTH	25	17	2	44
GEN	F	0	0	0	0
	M	1	0	0	1
	BOTH	33	27	8	68
Total		162	124	26	312

tive of the nature of researching small populations of men or women, where, due to small numbers, large comprehensive statistical analysis is less feasible. This trend suggests that there may be a need for quantitative studies (that utilize quantitative methodologies amenable to small sample sizes) focused specifically on the participation of African American men and separately on that of African American women.

TABLE 13: Overlap of race, gender, and segment in the literature [research only]

Race	Gender	K-12	CC	UG	GRAD	ACAD	N-ACAD	Across	Other	Total
AA	F	5	0	13	2	1	1	2	1	25
	M	8	0	18	0	0	0	2	0	28
	BOTH	10	1	40	3	1	5	7	1	68
POC	F	1	0	2	0	3	0	2	0	8
	M	0	0	2	0	0	0	0	0	2
	BOTH	5	1	31	6	2	0	4	2	51
MIX	F	4	0	12	0	1	0	0	0	17
	M	0	0	0	0	0	0	0	0	0
	BOTH	8	0	26	2	2	3	2	1	44
GEN	F	0	0	0	0	0	0	0	0	0
	M	0	0	1	0	0	0	0	0	1
	BOTH	22	1	40	1	0	1	3	0	68
Total		63	3	185	14	10	10	22	5	312

These trends also have implications for which sorts of systematic literature reviews are needed, and can assist in scoping. For example, whereas a review of evaluation reports generally may be feasible, a comprehensive review of research might not be as advisable. Instead, researchers should consider exploring smaller subsets of research, such as scholarship focused on broadening participation in computer science, in general (n = 26), or scholarship focused on the academic and nonacademic workforce (n = 20, combined). For segments such as K-12 or undergraduate education, further scoping may be required, such as focusing on articles that centered only on African Americans. Our aim is for this mapping review to facilitate such decisions.

4.6 Summary

There are numerous trends in scholarship focused on broadening participation of African Americans in engineering and computer science, dealing with both the focus of the scholarship as well as the manner in which it has been produced. The first two trends we discussed related to the focus. According to our results, a significant portion of scholarship includes a broader subject population, emphasizing Africans Americans yet not focusing solely on this group, suggesting that African Americans are regularly specified within larger umbrella groupings. In light of the need to reverse the participation trends associated with this particular minority group, there is a need for more research that is focused on the unique challenges and opportunities associated with this demographic. Similarly, most abstracts focus on women and men simultaneously, or did not mention gender at all. We also noted an imbalance as it relates to the attention given to different segments of the STEM pathway, with undergraduate and K-12 segments representing the largest proportion. With this in mind, increasing scholarship on graduate education and the workforce sectors offers the largest opportunity for advancing scholarship in this area. STEM and engineering are also typically the focus of these studies, as opposed to computer science. Because of this, more scholarship on computer science across all segments of the pathway represents a significant untapped opportunity.

Regarding the manner in which scholarship has been produced, scholarship production has significantly increased since 1975, and a large majority of the scholarship we identified was disseminated through traditional academic venues, such as conference proceedings and journals. Most abstracts were research focused, though a considerable amount of practice-focused scholarship in the form of overviews and evaluations was examined. The most frequent type of research method used overall (which included African American in particular as well as other minority groups) was quantitative, although qualitative articles still constituted a large proportion. Lastly, most evaluation studies report findings with respect to two genders, and there is a need for more reports focused on the effectiveness of single-gender interventions. There is also a dire need for research focused on African Americans in segments other than K-12 and undergraduate education.

5. CONCLUSIONS

Despite continual effort to broaden participation and an emphasis on connecting research and practice (Jamieson and Lohmann, 2010), the percentage of African Americans earning degrees, and by extension pursuing careers in engineering and computer science has actually declined in recent years (Gibbons, 2009; Yoder, 2017). In response to this alarming trend, a reexamination of our approach to solving this problem is desperately needed at this time, especially by the research community. An advanced understanding of where scholarly efforts have focused prior work is a necessary component of developing a comprehensive agenda that enables an advanced strategy to solving this national problem. Consequently, it is important to take a step back and examine the state of the literature on the topic at this point in time. To that end, the goal of this current study was to synthesize the literature on the topic through a literature map to identify knowledge gaps and areas for future research. One reason for optimism that emerged from the literature map was the expanding number of articles generated on the topic of broadening African American participation in STEM and the breadth of academic fields working towards identifying solutions. In terms of future work, this mapping now serves as the basis for a set of in-depth systematic literature reviews that illuminate deeper insights about topics that have been investigated and key findings that have emerged over time (London et al., 2019; Pee et al., 2019). This work has the potential to motivate many other efforts as well. As stakeholders continue working towards broadening participation of African Americans, we hope that this mapping review not only raises awareness of the current state of efforts dedicated to each segment of the K-12-to-workforce pathway, but also illuminates gaps in the literature yet to be filled.

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COMPLETE TABLE 3: This table is a complete list of the articles that met eligibility criteria and included in mapping

Author	Year	Work Title	Source
Adams et al.	2006	The Experiences of African American Women Engineering Faculty (Panel Presentation)	The Journal of Negro Education
Ahn et al.	2014	"I Want To Be a Game Designer Or Scientist": Connected Learning and Developing Identities with Urban, African-American Youth	The Journal of Negro Education
Alba-Flores, R., & Rios-Gutierrez, F.	2016	Experiences in Establishing an Outreach Program for Attracting and Retaining Minorities to Engineering	American Society for Engineering Education
Albers, L., Clark, S., Parry, E., & Smith, R.	2010	The Impact of Active Learning through Cooperation on Science Fair Projects on Elementary School Students	Dissertation Abstracts International Section a: Humanities and Social Sciences
Alkhasawneh, R., & Hargraves, R. H.	2014	Developing a Hybrid Model to Predict Student First Year Retention in STEM Disciplines Using Machine Learning Techniques	American Educational Research Journal
Alkhasawneh, R., & Hobson, R. S.	2009	Summer Transition Program: A Model for Impacting First Year Retention Rates for Underrepresented Groups	American Society for Engineering Education
Alkhasawneh, R., & Hobson, R. S.	2012	Identifying Significant Features that Impact URM Students Academic Success and Retention Upmost Using Qualitative Methodologies: Focus Groups	American Society for Engineering Education
Allendoerfer et al.	2016	Student Perceptions of Faculty Support: Do Class Size or Institution Type Matter	Frontiers in Education Annual Conference
Amenkhienan, C. A.	2000	Perception of the Impact of Freshmen Academic Involvement Activities, and Use of Academic Support Services on Academic Performance - (A Case Study of Virginia Tech Second Year Engineering Students): Implications for Counseling	Career & Technical Education Research
Amon, J. L.	2010	Male Students Give Voice to Supportive Campus Environments: A Qualitative Case Study of Undergraduate STEM Majors	Engineering Design Graphics Journal
Andersen, L. & Ward, T. J.	2014	Expectancy-Value Models for the STEM Persistence Plans of Ninth-Grade, High-Ability Students: A Comparison between Black, Hispanic, and White Students	Doctoral Dissertation, University of Dayton
Anderson-Rowland, M., & Ruben, C.	2008	Academic Achievement and Retention in a Minority Engineering Programs	Dissertation Abstracts International Section a: Humanities and Social Sciences
Archer, L., Dewitt, J., & Osborne, J.	2015	Is Science for Us? Black Students' and Parents' Views of Science and Science Careers	Doctoral Dissertation, The Ohio State University
Ataai, M. M., Holder, G. D., & Toplak, R. F.	1997	Research Experience for Undergraduates at the University of Pittsburgh Department of Chemical and Petroleum Engineering	Doctoral Dissertation, Georgia Institute of Technology
Atwater, M. M., & Simpson, R. D.	1984	Cognitive and Affective Variables Affecting Black Freshmen in Science and Engineering at a Predominately White University	The International Society for Computers and Their Applications
Atwater, M. M.	1995	The Multicultural Science Classroom, Part I: Meeting the Needs of a Diverse Student Population	American Society for Engineering Education

Atwater, M. M.	1981	The Influence of Cognitive and Affective Variables on the Success of Black Undergraduate Students in Science and Engineering Curricula at a Predominately White University	American Society for Engineering Education
Austin, C. Y.	2010	Perceived Factors That Influence Career Decision Self-Efficacy and Engineering Related Goal Intentions of African American High School Students	American Society for Engineering Education
Bancroft, S. F., Benson, S. K., & Johnson-Whitt, E.	2016	McNair Scholars' Science, Technology, Engineering, and Mathematics (STEM) Graduate Experience: A Pilot Study	Psychology of Women Quarterly
Barrett, J.	2014	Elementary School Computer Access, Socioeconomic Status, Ethnicity, and Grade 5 Student Achievement	Journal of Black Psychology
Bartlett, T.	2007	Racism at MIT?	Dissertation Abstracts International Section a: Humanities and Social Sciences
Basile, V., & Lopez, E.	2015	And Still I See No Changes: Enduring Views of Students of Color in Science and Mathematics Education Policy Reports	Doctoral Dissertation, University of South Florida
Batch, M. L.	1983	A Study of Self-Actualizing Concepts as They Relate to Academic Success of Minority Engineering Students in a Special Program	American Society for Engineering Education
Belle, W.	2000	Community Colleges: Storied Success	Chronicle of Higher Education
Bennett, A., & Eglash, R.	2013	cSELF (Computer Science Education from Life): Broadening Participation through Design Agency	Student Aid News
Bernadin, S.	2007	Influential Factors Affecting the Attraction and Retention of Minority Faculty in Engineering and Technology Programs	American Psychologist
Berry, C., & Walter, D.	2013	ROSE-BUD (Rose Building Undergraduate Diversity) MAPS (Mentoring and Professional Skills)	Journal for Research in Mathematics Education
Berry, C., Brown, C., St. Omer, I., Adams, S., & Smith, M.	2007	A Survey of Teaching Styles and Classroom Techniques to Engage African American Students in the Engineering Classroom	Dissertation Abstracts International Section a: Humanities and Social Sciences
Berry, C., Cox, M., & Main, J.	2014	An Examination of the Numbers: African American Female Faculty in Engineering	Doctoral Dissertation, Morgan State University
Berry, C.A.	2014	They Call Me Dr. Berry	Journal of Blacks in Higher Education
Besterfield-Sarcre, M.	2001	Gender and Ethnicity Differences in Freshmen Engineering Student Attitudes: A Cross-Institutional Study	Doctoral Dissertation, Walden University
Bhattacharjee, Y.	2007	MIT Hunger Strike: Sour Grapes, Or the Bitter Taste of Racism?	Science
Birky, G. D., Chazan, D., & Farlow Morris, K.	2013	In Search of Coherence and Meaning: Madison Morgan's Experiences and Motivations as an African American Learner and Teacher	National Association of Student Affairs Professionals Journal
Bliss, L., Brunetta, F., Fleming, L., Williams, D., Smith, K.	2015	Integration and Achievement: Predicting Persistence Among Hispanic and Black	Peabody Journal of Education

		Engineering Students at Minority Serving Institutions	
Bond, J., Wang, Y., Sankar, C., Raju, P. K., & Le, Q.	2014	Female and Minority Students Benefit from Use of Multimedia Case Studies	Doctoral Dissertation, The University of North Carolina at Charlotte
Bonner, F., Nave, F., Frizell, S., Villa, C., & Cook, H.	2009	Internal Motivation as a Factor for the Success of African American Engineering Students Enrolled in a Historically Black College and University (HBCU)	American Society for Engineering Education
Bonous-Hammarth, M.	2000	Pathways to Success: Affirming Opportunities for Science, Mathematics, and Engineering Majors	Harvard Educational Review
Bonsangue, M. V.	1993	The Effects of Calculus Workshop Groups on Minority Achievement and Persistence in Mathematics, Science, and Engineering	Economics of Education Review
Bowe, M. L. S.	2012	Achievement Emotions As Predictors of High School Science Success Among African American and European American Students.	Education & Urban Society
Bracey, J.	2013	The Culture of Learning Environments: Black Student Engagement and Cognition in Math	ACM SIGCSE Bulletin
Bracey, J. M.	2011	Assessing African American and Latino Middle School Student Engagement and Motivation to Persist in STEM Domains	Dissertation Abstracts International Section a: Humanities and Social Sciences
Bradford, S. M.	2010	Patching the Pipeline: Identifying Salient Characteristics of Academic Intervention Programs that Increase the Number of Underrepresented Minorities Pursuing Graduate Level Biomedical Research. A Case Study: Minority Opportunities in Research (MORE) Programs	American Society for Engineering Education
Brawner, C. E., Camacho, M. M., Lord, S. M., Long, R. A., & Ohland, M. W.	2012	Women in Industrial Engineering: Stereotypes, Persistence, and Perspectives	American Society for Engineering Education
Brawner, C. E., Frillman, S. a., Lord, S. M., & Ohland, M. W.	2010	Work in Progress - Flexibility and Career Opportunity as Motivation for Women Selecting Industrial Engineering Majors	Dissertation Abstracts International Section a: Humanities and Social Sciences
Brawner, C. E., Lord, S. M., Layton, R. A., Ohland, M. W., & Long, R. A.	2015	Factors Affecting Women's Persistence in Chemical Engineering	Dissertation Abstracts International Section a: Humanities and Social Sciences
Brazziel, M. E., & Brazziel, W. F.	2001	Factors in Decisions of Underrepresented Minorities to Forego Science and Engineering Doctoral Study: A Pilot Study	International Journal of Engineering Education
Brown, B. A., Mangram, C., Sun, K., Cross, K., & Raab, E.	2017	Representing Racial Identity: Identity, Race, the Construction of the African American STEM Students	Doctoral Dissertation, ProQuest Information & Learning
Brown, E.	2007	The St@R Project: An Initiative To Increase the Retention Rates of 1st And 2nd Year Underrepresented Students Enrolled in Electrical Engineering	American Society for Engineering Education
Brown, L.	1999	Creating Opportunities for Faculty Research	Dissertation Abstracts International Section a:

			Humanities and Social Sciences
Brown, N. W	1997a	Description of Personality Similarities and Differences of a Sample of Black and White Female Engineering Students	Urban Education
Brown, N. W. & Cross Jr, E. J.	1993	Retention in Engineering and Personality	Journal of College Student Retention: Research, Theory & Practice
Brown, N. W., & Cross, J. E.	1997	Coping Resources and Family Environment for Female Engineering Students	Frontiers in Education Annual Conference
Brown, N. W., & Cross JR, E. J.	1992	A Comparison of Personality Characteristics for Entering Freshmen, Persistors, and Norm Groups in Engineering	Dissertation Abstracts International Section a: Humanities and Social Sciences
Budny, D., & Newborg, B.	2015	Using a Career Conference to Promote Advising in the Freshman Curriculum	Institute of Electrical and Electronics Engineers
Budny, D., Blalock, M., & LeBold, W.	1991	Supplying the Missing Link with MECCA-A	American Society for Engineering Education
Buncick, M. C., Betts, P. G., & Horgan, D. D	2001	Using Demonstrations as a Contextual Road Map: Enhancing Course Continuity and Promoting Active Engagement in Introductory College Physics	Journal of Information Technology Education
Burrell , J., Fleming , L., Fredericks, A ., Moore, I.	2015	Domestic and International Student Matters: The College Experiences of Black Males Majoring in Engineering at an HBC	Social Forces
Buzzetto-More, N., Ukoha, O., & Rustagi, N.	2010	Unlocking the Barriers to Women and Minorities in Computer Science and Information Systems Studies: Results from a Multi-Methodical Study Conducted at Two Minority Serving Institutions	Frontiers in Education Annual Conference
Byars-Winston, A., Estrada, Y., Howard, C., Davis, D., & Zalapa, J.	2010	Influence of Social Cognitive and Ethnic Variables on Academic Goals of Underrepresented Students in Science and Engineering: A Multiple-Groups Analysis	American Society for Engineering Education
Cain, C. C.	2012	Underrepresented Groups in Gender and STEM: The Case of Black Males in CISE	Black Issues in Higher Education
Cain, C., & Trauth, E.	2015	Theorizing the Underrepresentation of Black Males in Information Technology (IT)	American Society for Engineering Education
Calhoun, W. J.	2013	An Exploratory Study on Initial Stem Classes and African American Freshman Males Who are STEM Majors at a Large Mid-Atlantic State University: Factors Affecting Self-Efficacy Beliefs and Persistence in the STEM Pipeline	American Society for Engineering Education
Camacho, A., & Hum, D.	2016	Measuring the Effectiveness of an Intensive Math Preparation Program to Enhance the Success of Underrepresented Students in Engineering	Doctoral Dissertation, Arizona State University
Campbell-Rock, C. C.	1992	African American Engineers: Turning Dreams into Reality	American Society for Engineering Education
Campo, L., Rice, S., Rimer, D., & Houchens, B.	2009	Mentoring to Increase Interest in the Study of Engineering in Underrepresented High-School Students via a Design Mechanism	American Society for Engineering Education
Cantor, N., Mack, K. M., McDermott, P., & Taylor, O. L.	2014	If Not Now, When? The Promise of STEM Intersectionality in the Twenty-First Century	American Society for Engineering Education

Carr, B. H.	2012	Examining the Relationship of Ethnicity, Gender and Social Cognitive Factors with the Academic Achievement of First-Year Engineering Students	Doctoral dissertation, University of Miami
Carr, M. D.	2016	Closing The Stem Gap With Culturally and Cognitively Appropriate Cyber-Instruction in An All-Girl Inner-City Charter School Stem Program: A Case Study	Journal of the Scholarship of Teaching and Learning
Carter-Sowell, A. R., & Zimmerman, C. A.	2015	Hidden in Plain Sight: Locating, Validating, and Advocating the Stigma Experiences of Women of Color	Routledge
Cartwright, R.	2014	Hackathons Take on Myths and Stereotypes	Information Age Publishing
Chang, M. J., Sharkness, J., Hurtado, S., & Newman, C. B.	2014	What Matters in College for Retaining Aspiring Scientists and Engineers from Underrepresented Racial Groups	Dissertation Abstracts International Section a: Humanities and Social Sciences
Chapman, A.	2013	An Investigation of the Effects of an Authentic Science Experience among Urban High School Students	Doctoral Dissertation, Howard University
Charitable, R.	2011	A Model for Predicting a Career Success in Engineering among Women and African American Men	American Society for Engineering Education
Charleston, L. J., Charleston, S. A., & Jackson, J. F.	2014	Using Culturally Responsive Practices to Broaden Participation in the Educational Pipeline: Addressing the Unfinished Business 0/Brown in the Field of Computing Sciences	Harvard Educational Review
Charleston, L. J.	2010	Examining Key Factors that Contribute to African Americans' Pursuit of Computing Science Degrees: Implications for Cultivating Career Choice and Aspiration	Dissertation Abstracts International Section a: Humanities and Social Sciences
Charleston, L. J.	2012	A Qualitative Investigation of African Americans' Decision to Pursue Computing Science Degrees: Implications for Cultivating Career Choice and Aspiration	Journal of Negro Education
Chatman, K.	1994	A Study of The University of Tennessee Ronald McNair Post Baccalaureate Achievement Program: Factors Related to Graduate School Enrollment for First Generation, Low-Income and Under-represented College Students	Dissertation Abstracts International Section a: Humanities and Social Sciences
Chenoweth, K.	1997	Forthcoming ETS Report Proclaims the Importance of HBCUs	International Journal of Engineering Education
Cheong, Y. F., Pajares, F., & Oberman, P. S.	2004	Motivation and Academic Help-Seeking in High School Computer Science	American Society for Engineering Education
Chitsaz, M., & Holbrook, K.	1991	The Achievement of Blacks in Introductory Computer Science at a Predominantly White Public University	Journal of Engineering Education
Cho, P., & Predebon, W. W.	1997	Engineering Learning Center Coach Training Program for Minority Students	
Chowdhury, S., & Chowdhury, T.	2007	Increasing Enrollment of Minority Women in Engineering	Journal of Career Development
Chowdhury, S., & Seif, M.	2010	Enhancement of Learning Outcome and Retention of Minority Students in Engineering	Doctoral Dissertation, Teachers College, Columbia University

Chowdhury, S., Jalloh, A., Rojas-Oviedo, R., Seif, M., Mobasher, A.	2007	Capstone Design Course as a Tool for Assessment and Improvement	Doctoral Dissertation, UC San Diego
Chrisman, B.	1993	The Results of Culture-Free Test Instruments in Predicting Academic Performance of Black Undergraduate Engineering Students	IEEE Integrated STEM Conference
Christie, B.	2008	Results of Seven Year Community Outreach Program to Improve the Pipeline of Underrepresented Minorities Studying Science, Engineering or Mathematics at College Level	Urban Education
Christie, B.	2006	Creating Community Outreach Partnerships that Help Improve the Pipeline of Underrepresented Minorities in Engineering	Frontiers in Education Annual Conference
Christie, B. A.	2003	Working with Community Organizations to Improve the Pipeline of Minorities in Engineering	Frontiers in Education Annual Conference
Christner, T.	2015	Holding Fast to Dreams: Empowering Youth from the Civil Rights Crusade to STEM Achievement	The Chronicle of Higher Education
Clark, C. J., Ardley, T. W., & Black, J. T.	2015	The Program of Excellence in STEM: Involvement of Traditionally Underrepresented Students in STEM Education through Research and Mentoring at Florida A&M University	Dissertation Abstracts International Section a: Humanities and Social Sciences
Cohen, W.	2001	Role Model for Diversity	Journal of Women and Minorities in Science and Engineering
Cohoon, J. P.	2007	An Introductory Course Format for Promoting Diversity and Retention	Doctoral Dissertation, State University of New York Albany
Connor, J. B., Kampe, J. M., & Aning, A. O.	2000	Instructor's Race and Gender and Freshman Student Perceptions	Harvard Educational Review
Constant, K. P., & Bird, S. R.	2009	Recognizing, Characterizing, and “Unsettling” Unintended Bias in the Faculty Search Process in Engineering	Doctoral Dissertation, University of Maryland College Park
Cook, L.	2014	Mentor/Mentee Relationships: The Experience of African American STEM Majors	Mid-Western Educational Researcher
Cordes, C.	1988	Colleges Try to Attract Women and Minority Students to the Sciences	Educational Evaluation & Policy Analysis
Cornick, S.	2013	African American Adolescent Female Identification with Engineering and Participation in Engineering Education	American Society for Engineering Education
Cosentino, C., Sullivan, M. D., Gahlawat, N. T., Ohland, M. W., & Long, R. A.	2014	Black Engineering Transfer Students: What Explains their Success?	Journal of Blacks in Higher Education
Cottledge, M. C.	2014	An Examination of the Association between Demographic and Educational Factors and African American Achievement in Science	Doctoral Dissertation, Liberty University
Crawford, D. K.	2015	Tailor-Made: Meeting the Unique Needs of Women of Color STEM-SBS Faculty through Mentoring	American Society for Engineering Education
Crawford, D. K.	2014	Considerations for the Effective Mentoring of STEM Women of Color Faculty at a Striving Private Technical University	Doctoral Dissertation, Auburn University

Crisco, J.	1976	The Prediction of Academic Performance for Minority Engineering Students from Selected Achievement-Proficiency, Personality, Cognitive Style, and Demographic Variables	Community College Review
Cromley et al.	2013	Changes in Race and Sex Stereotype Threat Among Diverse STEM Students: Relation to Grades and Retention in the Majors	American Society for Engineering Education
Cropanzano, R., Slaughter, J. E., & Bachiochi, P. D.	2005	Organizational Justice and Black Applicants' Reactions to Affirmative Action	IEEE Transactions on Education
Crosby, K., Ibekwe, S., Li, G., Pang, S. S., & Lian, K.	2007	Tiered Mentoring in a Cross-Disciplinary and Multi-Institutional Research Project	Journal of Women and Minorities in Science and Engineering
Cross, K. J.	2014	The Impact of African American Engineers on Contemporary Life: Remembering Who We Are	Western Journal of Black Studies
Cross, K. J., & Paretti, M. C.	2015	The Impact of Personal Interactions on the Experience of African American Males on Multiracial Student Teams	American Society for Engineering Education
Crumpton-Young, L., Etemadi, S., Little, G., Carter, T.	2016	Supportive Practices Used with Underrepresented Minority Graduate Students	American Society for Engineering Education
Cruz, J. M., Hasbun, I. M., Adams, S. G., Banks-Hunt, J. M., & Barabino, G. A.	2016	Perceptions of Treatment for Underrepresented Minority Faculty in Engineering	Frontiers in Education Annual Conference
Dagley, M., Georgiopoulos, M., Reece, A., & Young, C.	2016	Increasing Retention and Graduation Rates Through a STEM Learning Community	Institute of Electrical and Electronics Engineers
Daniels, K. K.	1997	Exploring Science, Engineering, and Mathematics Career Interests among Rural Women: A Qualitative Analysis	Doctoral Dissertation, Nova Southeastern University
Davis, O. B.	2015	The Influence of Racial and Mathematical Identities on African American Male Engineering Transfer Students	American Society for Engineering Education
Day, B. W.	2015	The Persistence of Black Males in the STEM Fields at Texas State University	Science Teacher
DeGennaro, D.	2008	Sociotechnical Cultural Activity: Expanding an Understanding of Emergent Technology Practices	Journal of Counseling Psychology
DeRamus-Suazo, N. L.	2012	The Influence of College Choice on the Success, Ethnic Identity, and Professional Sense of Belonging of African American Engineers	American Society for Engineering Education
DeSpain, J.	2016	A Feminist Digital Humanities Pedagogy Beyond the Classroom	Dissertation Abstracts International
Dickerson, D. L., Eckhoff, A., Stewart, C. O., Chappell, S., & Hathcock, S.	2014	The Examination of a Pullout STEM Program for Urban Upper Elementary Students	Dissertation Abstracts International
Diemer, M. A., Marchand, A. D., McKellar, S. E., & Malanchuk, O.	2016	Promotive and Corrosive Factors in African American Students' Math Beliefs and Achievement	American Society for Engineering Education

Dika, S. L., Pando, M. A., Tempest, B. Q., & Foxx, K. A.	2014	Pre-College Interactions, Early Expectations, and Perceived Barriers of First Year Black and Latino Engineering Students	Doctoral Dissertation, UMBC
Dillard, G.	1985	A Descriptive Analysis of the Relationship of Selected Variables to the Success of Black "At Risk" Engineering Students	Educational and psychological measurement
Dimmig, H. H.	2007	Post-College Choices of Meyerhoff Program Scholars	Harvard Educational Review
DiSalvo, B., Guzdial, M., Bruckman, A., & McKlin, T.	2014	Saving Face While Geeking Out: Video Game Testing as a Justification for Learning Computer Science	ASEE Prism
DiSalvo et al.	2013	Workifying Games: Successfully Engaging African American Gamers with Computer Science	Frontiers in Education Annual Conference
DiSalvo, E. B.	2012	Glitch Game Testers: The Design and Study of a Learning Environment for Computational Production with Young African American Males	European Society for Engineering Education
Donnelly, A.	2007	The South East Alliance for Graduate Education and the Professoriate Program: Graduate Minority Retention and Preparedness for Academic Careers	American Society for Engineering Education
Donnelly, A. E., & Jacobi, J.	2010	Attracting, Retaining, and Preparing a Diverse Academic Engineering Workforce: The AGEP Model for Success	American Society for Engineering Education
Donohue, S. K., Richards, L. G., & Vallas, C.	2008	Factors Supporting Persistence of Females in Undergraduate Engineering Studies: Insights Gained through a Qualitative Analysis of Consistently Performing Programs	Journal of Science Education & Technology
Drazan et al.	2015	Experimental and Credentialing Capital: An Adaptable Framework for Facilitating Science Outreach for Underrepresented Youth	Science Education
Dunn, C. & Veltman, G.	1989	Addressing the Restrictive Career Maturity Patterns of Minority Youth: A Program Evaluation	Humanities and Social Sciences
Eagan Jr, M. K.	2010	Moving beyond Frontiers: How Institutional Context Affects Degree Production and Student Aspirations in STEM	Doctoral Dissertation, Penn State
Eglash, R., Gilbert, J. E., Taylor, V., & Geier, S. R.	2013	Culturally Responsive Computing in Urban, After-School Contexts: Two Approaches	Journal of Undergraduate Neuroscience Education
Eglash, R., Krishnamoorthy, M., Sanchez, J., & Woodbridge, A.	2011	Fractal Simulations of African Design in Pre-College Computing Education	Black Issues in Higher Education
Else-Quest, N. M., Mineo, C. C., & Higgins, A.	2013	Math and Science Attitudes and Achievement at the Intersection of Gender and Ethnicity	American Society for Engineering Education
Ericson, B., Engelman, S., McKlin, T., & Taylor, J. Q.	2014	Project Rise Up 4 CS: Increasing the Number of Black Students Who Pass Advanced Placement CS A	Doctoral Dissertation, Wilmington University
Espenshade, T. J.	2001	Doing Engineering: The Career Attainment and Mobility of Caucasian, Black, and Asian-American Engineers	Research in Engineering Education Network

Espinosa, L.	2011	Pipelines and Pathways: Women of Color in Undergraduate STEM Majors and the College Experiences That Contribute to Persistence	Dissertation Abstracts International
Evans, S. Y.	2015	Examining the Relationship between Student Engagement and STEM Persistence at an HBCU	Dissertation Abstracts International Section a: Humanities and Social Sciences
Facen, J.	1989	Persistence of Black Engineering Students at Wayne State University	Doctoral Dissertation, Alabama State University
Fan, X., Chen, M., & Matsumoto, A. R.	1997	Gender Differences in Mathematics Achievement: Findings From the National Education Longitudinal Study of 1988	American Society for Engineering Education
Ferreira, M.	2002	Ameliorating Equity in Science, Mathematics, and Engineering: A Case Study of an After-School Science Program	Computing in Science & Engineering
Fields, C. D.	1998	Gems of Wisdom: Avoiding Derailment on the Doctorate Track	International Journal of Doctoral Studies
Fife, J. E., Bond, S., & Byars-Winston, A.	2011	Correlates and Predictors of Academic Self Efficacy Among African American Students	College Student Journal
Figueroa, T.	2016	Underrepresented Racial/Ethnic Minority Graduate Students in Science, Technology, Engineering, and Math (STEM) Disciplines: A Cross Institutional Analysis of Their Experiences	Doctoral Dissertation, University of Illinois at Urbana-Champaign
Fleming, J.	2016	Success Factors for Minorities in Engineering: Analysis of Focus Group Mini-Surveys	International Journal of Mechanical Engineering Education
Fleming, L., Engerman, K., & Griffin, A.	2005	Persistence in Engineering Education: Experiences of First Year Students at a Historically Black University	Frontiers in Education Annual Conference
Fleming, L., Smith, K., & Williams, D.	2013	Broadening the Pipeline through the Study of Pathways and Persistence of Black and Hispanic Engineering Undergraduates	Black Issues in Higher Education
Flowers III, A. M.	2015	The Family Factor: The Establishment of Positive Academic Identity for Black Males Engineering Majors	Research in Science Education
Floyd, D. L.	2014	Guest Editors' Introduction	Journal of College Student Development
Fredericks, M. A., Fleming, L., Burrell, J., Griffin, A.	2012	Perspectives on the Learning Environment: Classroom Culture and Social Transactions at an HBCU	American Society for Engineering Education
Freeman, A., Persaud, A., Kharem, D., Rothwell, W. J., & Yoder, E.	2010	Money, Math and Engineering Graduation: More High School Funding Could Mean More Underrepresented Engineers	Science
Freeman, A.L.	2009	Money, Math and Engineering: The Relationships between Community Economics, Math Preparation and the Graduation of Racially Underrepresented Engineers	Frontiers in Education Annual Conference
Freeman, K., Alston, S., Winborne, D.	2008	Do Learning Communities Enhance the Quality of Students' Learning and Motivation in STEM?	Journal of Psychoeducational Assessment
Frillman, S. A., Brawner, C. E., & Waters, C.	2010	Work in Progress - Tracking the Success of African American Women Undergraduates Majoring in Engineering	Computers & Education

Frizell, S. & Nave, F.	2008	Work in Progress - Reexamining the Problem of Engineering Persistence for African American Female Students	Journal of College Science Teaching
Frizell, S. & Nave, F.	2008	A Preliminary Analysis of Factors Affecting the Persistence of African-American Females in Engineering Degree Programs	Journal of African American Males in Education
Garcia-Otero, S., Ghariban, N., Fedra, A.	2013	Reform the Intro to Engineering Course for Retaining Minority Engineering Freshmen	American Society for Engineering Education
Garcia, A. A., Keller, G. D., McHenry, A., & Begay, F.	1998	Enhancing Underrepresented Student Opportunities through Faculty Mentoring and Peer Interactions	American Society for Engineering Education
Gardner-McCune, C., McCune, D. B. D., Edwards, C. M., & Stallworth, C.	2013	I-3 Experience: Expanding Research and Design Opportunities for Under-represented High School Students	Journal of Educational Computing Research
Gasman, M., Nguyen, T., Conrad, C., Lundberg, T., Commodore, F.	2016	Black Male Success in STEM: A Case Study of Morehouse College	Frontiers in Education Annual Conference
Gassant, L.	2013	Assessing Cultural Validity in Standardized Tests in STEM Education	Doctoral Dissertation, Temple University
Gatchair, S. D.	2007	Representation and Reward in High Technology Industries and Occupations: The Influence of Race and Ethnicity	American Society for Engineering Education
George Mwangi, C. A., Fries-Britt, S., Peralta, A. M., & Daoud, N.	2016	Examining Intraracial Dynamics and Engagement between Native-Born and Foreign-Born Black Collegians in STEM	Journal of College Student Development
Georgiopoulos et al.	2009	Progress of the EXCEL Program at the University of Central Florida: An NSF STEP Funded Project	American Society for Engineering Education
Gibbs, T. S.	2008	From Retention to Detention: A Phenomenological Study of the African American Engineer Experience	ACM Transaction on Computing Education
Giguette, M. S., Lopez, A. M., & Schulte, L. J.	2006	Perceived Social Support: Ethnic and Gender Differences in the Computing Disciplines	American Society for Engineering Education
Godwin, A., Klotz, L., Hazari, Z., & Potvin, G.	2016	Sustainability Goals of Students Underrepresented in Engineering: An Intersectional Study	American Society for Engineering Education
Good, J., Halpin, G., & Halpin, G.	2002	Retaining Black Students in Engineering: Do Minority Programs Have a Longitudinal Impact?	Frontiers in Education Annual Conference
Good, J., Halpin, G., Halpin	2000	A Promising Prospect for Minority Retention: Students Becoming Peer Mentors	American Institute of Chemical Engineers
Greene, M.L.	1997	Sociocultural Orientation Among Talented African American College Students in a Race-Specific Program: Patterns, Predictors and Correlates	American Society for Engineering Education
Griffin, A., Fredericks, A., & Fleming, L.	2011	Does Social Capital Matter? Impacts of Social Capital on African American Male Achievement	The Journal of Negro Education
Griggs, L., Stringer, J. K., Rankins, F., & Hargraves, R. H.	2016	Investigating the Impact of a Hybrid Summer Transition Program	Information Age Publishing
Hanifin, L. & Schumack, M.	2001	The Ford/University of Detroit Mercy Engineering Opportunity Program	University of Southern California

Hargrave, C. P.	2015	Counter Space: Analysis of Educational Structures of an After-School Program that Fosters Black Academic Success Narratives	Education
Hargrove, S., Wheatland, J., Ding, D., & Brown, C.	2008	The Effect of Individual Learning Styles on Student GPA in Engineering Education at Morgan State University	Frontiers in Education Annual Conference
Harrington, M. A., Lloyd, A., Smolinski, T., & Shahin, M.	2016	Closing the Gap: First Year Success in College Mathematics at an HBCU	Teachers College Record
Hart, B. & Mohsen, S.	1995	Engineering Orientation Course for African American Students	American Society for Engineering Education
Hart, B. G., Holloman, T. L., & O'Connor, C. A.	1995	A Calculus Retention Program for Students at Risk in Engineering	Journal of College Science Teaching
Hasbún, I. M., Matusovich, H. M., & Adams, S. G.	2016	The Dissertation Institute: Motivating Doctoral Engineering Students Toward Degree Completion	Research in Higher Education
Hayes, III, R. E	2014	Understanding Him in STEM: Sharing The Stories of African American Male Scholars in Engineering Academic Programs at a Predominantly White University	New Directions for Institutional Research
Hendricks, J. T.	2014	"STEMulating" Success Factors: An Investigation of the Academic Talents of Successful Black Male College Graduates from STEM Programs	Doctoral Dissertation, Capella University
Hermond, D. S.	1993	Evaluation of Retention Strategies of Texas A&M University's Minority Engineering Program	American Society for Engineering Education
Hernandez, C. D.	2015	First Generation College Students in STEM: Counter Stories of Success	Sex Roles
Hernandez, P., Woodcock, A., Schultz, P., Estrada, M., Chance, R.	2013	Sustaining Optimal Motivation: A Longitudinal Analysis of Interventions to Broaden Participation of Underrepresented Students in STEM	Frontiers in Education Annual Conference
Hinton-Hudson, V. & Hart, B.	2000	CAMP IE—A Discipline-Specific Model for the Recruitment of Minorities into Engineering	American Society for Engineering Education
Hofacker, S. A.	2014	Career Self-Efficacy of the Black Engineer in the U.S. Government Workplace	Doctoral Dissertation, The George Washington University
Hofacker, S. A.	2014	Career Self-Efficacy as a Means of Understanding the Gap between Career Attainment and Opportunity for the US Government Black Engineer	Dissertation Abstracts International Section: The Sciences and Engineering
Hollebrands, K., Smith, R., Albers, L., Parry, E., & Bottomley, L.	2010	Attitudes Towards and Support Provided for Mathematics Learning Reported By Parents of Students Involved In a GK - 12 Program	Journal of College Science Teaching
Holmes, K.	2016	The Perceived Undergraduate Classroom Experiences of African American Women in Science, Technology, Engineering, and Mathematics (STEM) Education	Journal of Science Education & Technology
Holton, B. & Horton, G.	1996	The Rutgers Physics Learning Center	Dissertation Abstracts International
Hrabowski III, F. A.	2014	Institutional Change in Higher Education: Innovation and Collaboration	Chemical and Engineering News

Hrabowski III, F. A., & Maton, K. I.	1995	Enhancing the Success of African-American Students in the Sciences: Freshman Year Outcomes	American Society for Engineering Education
Hrabowski III, F. A., Maton, K. I., Greene, M. L., & Greif, G. L.	2002	Overcoming the Odds: Raising Academically Successful African American Young Women	Frontiers in Education Annual Conference
Hrabowski, III F.	2014	How to Get More Black Men into Science	Doctoral Dissertation, UCLA
Hua, V.	2011	Planting Seeds, Growing Diversity	American Society for Engineering Education
Hughes, Q. & Shehab, R.	2010	What They Say Matters: Parental Impact on Pre-College Academic Identity of Successful African American Engineering Students	The Journal of Negro Education
Hughes, Q., Shehab, R., Walden, S.	2011	"Success is Different to Different People": A Qualitative Study of How African American Engineering Students Define Success	American Society for Engineering Education
Hum, D. & Camacho, A.	2015	Developing an Intensive Math Preparation Program to Enhance the Success of Underrepresented Students in Engineering	Journal of STEM Education: Innovations & Research
Igbinoba, E. P.	2015	Exploration of Factors Affecting Success of Undergraduate Engineering Majors at a Historically Black University	American Society for Engineering Education
Inniss, L., & Perry, R.	2003	A Retrospective Profile of Electrical Engineering Graduates from the FAMU-FSU College of Engineering	The Journal of Negro Education
Jackson, D.	2014	A Synthesis of the Research on Community Colleges and Universities Regarding STEM Success among Racial and Ethnic Minorities	Proceedings of the American Society for Engineering Education Annual Conference and Exposition
Jenkins-Stark, L. & Chklovski, T.	2010	Engineers as Teachers: Bringing Cutting-Edge Math and Science Topics into Underprivileged Classrooms ia Student and Professional Engineers	American Society for Engineering Education
Jenkins-Stark, L., & Chklovski, T.	2010	K-12 Pre-Engineering Education Engineers as Teachers: Helping Engineers Bring Cutting Edge Science to Underserved Communities	The Journal of Blacks in Higher Education
Jenkins, F. L.	2011	Career Commitment and African American Women in Undergraduate STEM Majors: The Role of Science/Math Self-Efficacy, Department Climate, and Campus Climate at the Intersection of Race and Gender	American Society for Engineering Education
Jenkins, R.	2016	A Case Study of an African American Community's Perceptions of Problems in Mathematics Education	Frontiers in Education Annual Conference
Jia, N.	2015	Essays in Education Economics	American Society for Engineering Education
Jiang, X., Sarin, S., Williams, M., & Young, L.	2005	Assessment of the NC-LSAMP Project: A Longitudinal Study	American Society for Engineering Education
John, E. P. S., Hu, S., Simmons, A., Carter, D. F., & Weber, J.	2004	What Difference Does a Major Make? The Influence of College Major Field on Persistence by African American and White Students	American Society for Engineering Education
Johnson, D.	2007	Sense of Belonging among Women of Color in Science, Technology, Engineering, and Math	Dissertation Abstracts International Section a:

		Majors: Investigating the Contributions of Campus Racial Climate Perceptions and Other College Environments	Humanities and Social Sciences
Jones, S. K.	2007	Academic Achievement and Career Choice in Science: Perceptions of African American Urban High School Students	American Society for Engineering Education
Jones, W.	1990	Careers in Aerospace	American Society for Engineering Education
Jordan, K. L.	2014	Intervention to Improve Engineering Self-Efficacy and Sense of Belonging of First-Year Engineering Students	American Society for Engineering Education
Joseph, J.	2007	The Experiences of African American Graduate Students: A Cultural Transition	American Educational Research Journal
Joseph, J.	2012	From One Culture to Another: Years One and Two of Graduate School for African American Women in the STEM Fields	American Society for Engineering Education
Jovanovic, J., & Armstrong, M. A.	2014	Mission Possible: Empowering Institutions with Strategies for Change	American Society for Engineering Education
Kahl, N.	2016	Striving for Inclusiveness	The Social Science Journal
Karanja, E., & Austin, N.	2014	"What are African Americans Doing in College? A Review of the Undergraduate Degrees Awarded by US Institutions to African Americans: 2005–2009"	American Society for Engineering Education
Katz, S., Aronis, J., Allbritton, D., Wilson, C., & Soffa, M. L.	2003	Gender and Race in Predicting Achievement in Computer Science	Black Issues in Higher Education
Kendricks, K., & Arment, A.	2011	Adopting a K-12 Family Model With Undergraduate Research to Enhance STEM Persistence and Achievement in Underrepresented Minority Students	Journal of Multicultural Counseling and Development
Kerr et al.	2012	Development of the Distance from Privilege Measures: A Tool for Understanding the Persistence of Talented Women in STEM	American Society for Engineering Education
Kevorkian, M., & Simco, G.	2016	Co-Curricular Activities for Soft Skills and Underserved Minority Student Success	The Sciences and Engineering
Kim, M. M., & Conrad, C. F.	2006	The Impact of Historically Black Colleges and Universities on the Academic Success of African-American Students	American Society for Engineering Education
King Miller, B.	2013	The Experiences of Panamanian Afro-Caribbean Women in STEM: Voices to Inform Work with Black Females in STEM Education	Diverse Issues in Higher Education
King, B.A.	2011	Epistemological Beliefs of Engineering Students: A Comparison of Educational Levels and Institutional Type	American Society for Engineering Education
King, C. D.	2013	Are Black Girls the New Number Runners? An Analysis of Black Girls and High School Mathematics	Journal of Personality and Social Psychology
Kirby, K. K.	2003	Prairie View A&M University: Assessing the Impact of the STEM Enrichment Program on Women of Color	Teaching Tolerance
Klassen, M., Stockard, R., & Akbari, A.	2004	Stimulating Information Technology Education Among Underrepresented Minorities	Diverse: Issues in Higher Education
Klein et al.	2007	Handbook for Achieving Gender Equity through Education, 2nd Ed.	Community College Journal of Research and Practice

Knight, D., Corner, K., Louie, B., Shoals, A., & Cabrales, C.	2010	Successful Women Engineering Students: A Survey Assessment to Guide Our Efforts to Boost Women's Retention	American Society for Engineering Education
Knight et al.	2013	The Impact of Inclusive Excellence Programs on the Development of Engineering Identity Among First-Year Underrepresented Students	Black Issues in Higher Education
Kramer-Koehler, P., Tooney, N. M., & Beke, D. P.	1995	The Use of Learning Style Innovations to Improve Retention	The Physics Teacher
Ladeji-Osias et al.	2016	Increasing STEM Engagement in Minority Middle School Boys through Making	American Society for Engineering Education
Lam, P. C.	1997	Increasing Diversity in Engineering Academics (IDEAs): Development of a Program for Improving African American Representation	Teachers College Record
Lartson, C. A.	2013	Effects of Design-Based Science Instruction on Science Problem-Solving Competency among Different Groups of High-School Traditional Chemistry Students	Black Issues in Higher Education
Lasser, S. J., & Snelsire, R. W.	1996	The Case for Proactive Mentoring for Minorities in Engineering	USA Today
Layton, R. A., & Ohland, M. W.	2000	Peer Evaluations in Teams of Predominantly Minority Students	Dissertation Abstracts International Section a: Humanities and Social Sciences
Lee, D., & Harmon, K.	2013	The Meyerhoff Scholars Program: Changing Minds, Transforming a Campus	Dissertation Abstracts International
Lee, J., Marszalek, J., Medina, A., & Linnemeyer, S.	2008	Student Assisted Guidance in Engineering (SAGE): A Mentoring Course to Retain Freshmen on Academic Probation	Doctoral Dissertation, California State University, Long Beach
Lee, W. C., & Cross, K. J.	2013	Help Me Help You: Building a Support Network for Minority Engineering Students	Crisis
Lee, W. C., & Matusovich, H. M.	2016	A Model of Co-Curricular Support for Undergraduate Engineering Students	Doctoral Dissertation, Walden University
Leggett-Robinson, P. M., Mooring, S. R., & Villa, B. C.	2015	A 3+ 8 Model of Undergraduate Research for Community College STEM Majors	Diverse: Issues in Higher Education
Lehr, J. L.	2015	Exploring the Notion of the Paradoxical in Tang Wee Teo's "Paradoxical Positionality"	Doctoral Dissertation, SIUC
LeMire, L. E.	2015	Fostering Technology Student Success through Community Building and Financial Support	Doctoral Dissertation, Hills College
Lent, R. W. et. al.	2013	Social Cognitive Predictors of Adjustment to Engineering Majors Across Gender and Race/Ethnicity	Dissertation Abstracts International Section a: Humanities and Social Sciences
Lent et al.	2005	Social Cognitive Predictors of Academic Interests and Goals in Engineering: Utility for Women and Students at historically Black Universities	Journal of Education for Students Placed at Risk
Lent, R. W., Schmidt, J. A., & Schmidt, L. C.	2003	Predicting the Academic Engagement of Women and Students at Historically Black Universities: A Social Cognitive Approach	Dissertation Abstracts International Section a: Humanities and Social Sciences
Leonard, S. E., Pearcy, B. M., Shehab, R. L., & Walden, S. E.	2013	Minority Student Informed Retention Strategies	American Society for Engineering Education

Leonard, W. J., Kelly, J. C., & Gerace, W. J.	2010	Work in Progress—Implementation and Research of Mastery Learning at an HBCU	Journal of Engineering Education
Lichtenberger, E., & George-Jackson, C.	2013	Predicting High School Students' Interest in Majoring in a STEM Field: Insight into High School Students' Postsecondary Plans	Frontiers in Education Annual Conference
Little, S. D.	2014	The PhD as a Contested Intellectual Site: A Critical Race Analysis of the Personal and Institutional Factors that Influence the Persistence and Retention of Academically Successful Black Doctoral Students	Journal of Electroceramics
Litzler, E., Jaros, S., Brainard, S., & Metz, S.	2010	Gender and Race/Ethnicity in Engineering: Preliminary Findings from the Project to Assess Climate in Engineering	Journal of Engineering Education
Lord, S. M., Camacho, M. M., Layton, R. A., & Ohland, M. W.	2010	Who Enrolls in Electrical Engineering? A Quantitative Analysis of USA Student Trajectories	Journal of Research in Science Teaching
Lord, S. M., Layton, R. A., & Ohland, M. W.	2011	Trajectories of Electrical Engineering and Computer Engineering Students by Race and Gender	American Conference on Information Systems
Lord, S. M., Layton, R. A., & Ohland, M. W.	2014	Multi-Institution Study of Student Demographics and Outcomes in Electrical and Computer Engineering in the USA	Computer Science Education
Lord, S. M., Layton, R. A., Ohland, M. W., & Orr, M. K.	2013	Student Demographics and Outcomes in Electrical and Mechanical Engineering	American Society for Engineering Education
Lovencin, W., Najafi, F., & Safai, N.	2007	A Review of Strategies Employed on Minority Recruitment and Retention in Engineering Education	Frontiers in Education Annual Conference
Lynch, M.	2014	5 Reasons HBCUs are Still Relevant	Proceedings of International Conference of the Learning Sciences
Madsen, L. D., & Tessema, G. X.	2009	The Next Generation: Education and Broadening Participation in Science and Engineering	Negro Educational Review
Magner, D.	1989	Life Gets Better' Program; 'Multicultural Awareness' at Temple U; More	
Maine, J. D., Freeman, T. L., Keely, B., & Roberts, J.	2001	Affinity Groups: More Bang for the Buck	Journal of College Science Teaching
Malcom, L., & Malcom, S.	2011	The Double Bind: The Next Generation	Information Age Publishing
Manning, K. R.	1998	Science and Opportunity	Journal of Blacks in Higher Education
Marable, T. D.	1999	The Role of Student Mentors in a Precollege Engineering Program	Dissertation Abstracts International Section a: Humanities and Social Sciences
Margle et al.	2010	Toys and Mathematical Options for Retention in Engineering (Toys'n MORE) Broad Impact-The Campuses	Frontiers in Education Annual Conference
Marra et al.	2010	Peer Mentoring: Impact on Mentees and Comparison with Non-Participants	Journal of Negro Education
Marshall, K. S.	2013	Creating Computer Simulations in Middle Grades Mathematics: A Study of a Technology-Integrated Statistics Curriculum	American Society for Engineering Education

Martin-Dunlop, C., & Johnson, W.	2014	Intersections of African American Women in STEM and Lingering Racial and Gender Bias	Research in Engineering Education Symposium
Martin, B.	2014	Minority STEM Students' Perceptions of Academic Advisement and the Impact of Academic Advisement on Satisfaction and Academic Success of Minority STEM Students at an HBCU in Southeastern Louisiana	American Society for Engineering Education
Martin, J. P., Revelo, R. A., Stefl, S. K., Garrett, S. D., & Adams, S. G.	2016	Ethnic Student Organizations in Engineering: Implications for Practice from Two Studies	Dissertation Abstracts International Section a: Humanities and Social Sciences
Maton, K. I., & Hrabowski III, F. A.	2004	Increasing the Number of African American PhDs in the Sciences and Engineering- A Strengths-Based Approach	Journal of College Student Retention: Research, Theory & Practice
Maton, K. I., Hrabowski III, F. A., & Schmitt, C. L.	2000	African American College Students Excelling in the Sciences: College and Postcollege Outcomes in the Meyerhoff Scholars Program	Dissertation Abstracts International Section: The Sciences and Engineering
Matthews, F. L.	2006	The Envy of Its Peers?	Doctoral Dissertation, Virginia Commonwealth University
Mau, W. C., Domnick, M., & Ellsworth, R. A.	1995	Characteristics of Female Students Who Aspire To Science and Engineering or Homemaking Occupations	Teaching, Learning, and Human Development
Mayes, T.	2014	Campus Climate and the Underrepresented Minority Engineering Student Experience: A Critical Race Study	American Society for Engineering Education
McCullough et al.	2014	ENGAGE 2Be Engineers Mentoring Program for Minority Students	Dissertation Abstracts International Section a: Humanities and Social Sciences
McGee, E.	2015	Robust and Fragile Mathematical Identities: A Framework for Exploring Racialized Experiences and High Achievement among Black College Students	Journal of Management in Engineering
McGee, E. O.	2009	Race, Identity, and Resilience: Black College Students Negotiating Success in Mathematics and Engineering	Educational Researcher
McGee, E. O.	2016	Devalued Black and Latino Racial Identities: A By-Product of STEM College Culture?	Journal of Research in Science Teaching
McGee, E. O.	2013	Growing Up Black and Brilliant: Narratives of Two Mathematically High-Achieving Adults	Doctoral Dissertation, Georgia Institute of Technology
McGee, E. O., & Pearman, F.	2015	Understanding Black Male Mathematics High Achievers from the Inside Out: Internal Risk and Protective Factors in High School	American Society for Engineering Education
McGee, E. O., & Spencer, M. B.	2013	The Development of Coping Skills for Science, Technology, Engineering, and Mathematics Students	Frontiers in Education Annual Conference
McGee, E. O., & Spencer, M. B.	2015	Black Parents as Advocates, Motivators, and Teachers of Mathematics	Chronicle of Higher Education
McGee, E. O., & Martin, D.	2011	You Would Not Believe What I Have to Go Through to Prove My Intellectual Value!" Stereotype Management Among Academically Successful Black Mathematics and Engineering Students	Frontiers in Education Annual Conference

Mcpherson, E.	2012	Undergraduate African American Women's Narratives on Persistence in Science Majors at a PWI	American Society for Engineering Education
Meadows et al.	2006	Work in Progress: An Initial Assessment of the Effect of the First Year Experience on Under-Represented Student Retention in Engineering	IEEE Computer Society
Mehalik, M. M., Doppelt, Y., & Schuun, C. D.	2008	Middle-School Science Through Design-Based Learning Versus Scripted Inquiry: Better Overall Science Concept Learning and Equity Gap Reduction	American Society for Engineering Education
Mehalik, M., Doppelt, Y., & Schunn, C.	2006	Using a Systems Engineering Approach to Teach Middle School Science Concepts	American Society for Engineering Education
Mervis, J.	2014	Minority Voice	Frontiers in Education Annual Conference
Metghalchi, M., Harris, R., Mason, E., & Duggan, C.	2013	The Impact of Self-Efficacy, through Experiential Education, On the Retention of Engineering Students	Black History Bulletin
Miller, M.	2006	Science Self-Efficacy in Tenth Grade Hispanic Female High School Students	American Society for Engineering Education
Mitchell, A.	2011	An Investigation of Faculty Relationships as a Source of Motivation for STEM Undergraduates at a Historically Black University	ACM SIGCSE Bulletin
Mitchell, T., & Daniel, A.	2007	START: A Formal Mentoring Program for Minority Engineering Freshmen	Doctoral Dissertation, University of Maryland
Mondisa, J. L.	2015	Increasing Diversity in Higher Education by Examining African-American STEM Mentors' Mentoring Approaches	Doctoral Dissertation, Cambridge College
Monterrosa, C. E.	2015	Latino and African American Students' Self-Efficacy in AP Calculus Courses	American Society for Engineering Education
Montgomery, L.	2009	Case Study Analysis of the Effect of Contextual Supports and Barriers on African American Students Persistence in Engineering	Black Collegian
Moore III, J. L., Flowers, L. A., Guion, L. A., Zhang, Y., & Staten, D. L.	2004	Improving the Experiences of Non-Persistent African American Males in Engineering Programs: Implications for Success	American Society for Engineering Education
Moore III, J. L., Madison-Colmore, O., & Smith, D. M.	2003	The Prove-Them-Wrong Syndrome: Voices from Unheard African-American Males in Engineering Disciplines	Doctoral Dissertation, Texas State University
Moreno, S. E.	2001	Keeping the Door Open: Latino and African American Friendships as a Resource for University Mathematics Achievement	American Enterprise
Moreno, S. E., & Muller, C.	1999	Success and Diversity: The Transition through First-Year Calculus in the University	American Society for Engineering Education
Morris, V. V., Stein, R. A., Keller, J. F., & Kumar, V.	2011	Robotics in Urban STEM Education: The Philadelphia Model	Research in Higher Education
Morrissey, S. R.	2003	Innovation, Creativity for Black Chemists	Journal of Counseling Psychology
Morsi, R.	2005	Girls in Science, Engineering, and Technology (GISET)	International Journal of Engineering Education
Moyer III, J. F.	2013	Probeware in 8th Grade Science: A Quasi-Experimental Study on Attitude and Achievement	Journal of Career & Technical Education

Muller, C., Blake-Beard, S., Barsion, S., Wotipka, C.	2012	Learning from the Experiences of Women of Color in Mentornet's One-on-One Program	Doctoral Dissertation, UT Austin
Muller, P. A.	2000	Precollege Science Achievement Growth: Racial-Ethnic and Gender Differences in Cognitive and Psychosocial Constructs	American Society for Engineering Education
Murphy, T. E., Gaughan, M., Hume, R., & Moore Jr, S. G.	2010	College Graduation Rates for Minority Students in a Selective Technical University: Will Participation in a Summer Bridge Program Contribute to Success?	Education and Urban Society
Museus, S. D., Palmer, R. T., Davis, R. J., & Maramba, D.	2011	Factors That Influence Success among Racial and Ethnic Minority College Students in the STEM Circuit	American Society for Engineering Education
Mutahi, T.	2015	Black Women in Science: African American Women Completing Doctorate Degrees in Science, Technology, Engineering, and Mathematics—Obstacles and Success Strategies	The Journal of Negro Education
Nagchaudhuri, A., Eydgahi, A., Shakur, A.	2000	SLOPE: An Effort towards Infusing Service-Learning into Physics and Engineering Education	Black Issues in Higher Education
Nave, F. & Frizell, S.	2008	A Preliminary Assessment Examining Factors Impacting the Persistence of African American Undergraduates in Chemical Engineering	American Society for Engineering Education
Nguyen, T. H. P.	2015	Exploring Historically Black College and Universities' Ethos of Racial Uplift: STEM Students' Challenges and Institutions' Practices for Cultivating Learning and Persistence in STEM	International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)
O'Brien, V.	1996	Relationships of Mathematics Self-Efficacy, Gender, and Ethnic Identity to Adolescents' Math/Science Career Interests	Currents in Teaching & Learning
Obeng, M., & Wu, X.	2007	Engineering Student Development and Retention Strategies at a Historically Black University	American Society for Engineering Education
Oberman, P. S.	2002	Academic Help-Seeking in the High School Computer Science Classroom: Relationship to Motivation, Achievement, Gender, and Ethnicity	American Society for Engineering Education
Ogilvie, A.	2011	EOE First Year Interest Groups: Success in Engineering Starts Here a Progress Report on Successes Ongoing Improvements	School Science and Mathematics
Ogilvie, A.	2007	EOE First Year Interest Groups: A Success Model for Increasing Retention	Information Age Publishing
Ogilvie, A., Jimenez, J., & Sills, K.	2009	Texas Research Experience (TREX) Program: A Progress Report on Successes, Challenges, and Ongoing Improvements	Frontiers in Education Annual Conference
Ogunfunmi, T.	2007	Minority Graduate Student Advising and Mentoring for Career Advancement	Journal of Engineering Education
Ogunfunmi, T.	2008	Impact and Results of Minority Engineering Student Advising and Mentoring for Career Advancement	New Directions for Institutional Research
Oh, S. S., & Lewis, G. B.	2011	Stemming Inequality? Employment and Pay of Female and Minority Scientists and Engineers	American Society for Engineering Education

Ohland et al.	2011	Race, Gender, and Measures of Success in Engineering Education	Journal of Youth & Adolescence
Ohland, M. W., Chrestman, R. E., & Lasser, S. J.	2003	Improving Multiple Outcomes for Minority Engineering Students: The Math Excellence Workshop at Clemson University	American Society for Engineering Education
Ohland, M. W., Lord, S. M., & Layton, R. A.	2015	Student Demographics and Outcomes in Civil Engineering in the United States	ASEE Prism
Oliveira, A. M.	2012	Summer Program for Transitioning STEM Minority Students from 2-Year to 4-Year College Degrees	American Journal of Education
Oliveira, A.M.	2010	Impacting Students' Interest in STEM Fields: An Electronic Communication Course for K 12 Underrepresented Students	Peer Review
Olszewski-Kubilius, P., Steenbergen-Hu, S., Thomson, D., & Rosen, R.	2017	Minority Achievement Gaps in STEM: Findings of a Longitudinal Study of Project Excite	The Black Collegian
Omer, I. S., Sampson, C., & Lee, M.	1999	Minority Student Retention: Importance of Ethnicity Based Technical Organizations for Students at Majority Institutions	ProQuest Dissertations and Theses
Oner et al.	2014	T-STEM Academies' Academic Performance Examination by Education Service Centers: A Longitudinal Study	New York Times
Ong, M., Wright, C., Espinosa, L., & Orfield, G.	2011	Inside the Double Bind: A Synthesis of Empirical Research on Undergraduate and Graduate Women of Color in Science, Technology, Engineering, and Mathematics	American Society for Engineering Education
Orr, M. K., Lord, S. M., Layton, R. A., & Ohland, M. W.	2014	Student Demographics and Outcomes in Mechanical Engineering in the U.S.	Journal of Professional Issues in Engineering Education & Practice
Orr, M. K., Lord, S. M., Ohland, M. W., & Layton, R. A.	2014	Student Demographics and Outcomes in Mechanical and Aerospace Engineering Including Migration between the Disciplines	Journal of Aerospace Information Systems
Orr, M. K., Ramirez, N. M., Lord, S. M., Layton, R. A., & Ohland, M. W.	2015	Student Choice and Persistence in Aerospace Engineering	Association for Computing Machinery
Ott, M. D.	1978	Retention of Men and Women Engineering Students	American Society for Engineering Education
Palardy, G.	2015	Classroom-Based Inequalities and Achievement Gaps in First Grade: The Role of Classroom Context and Access to Qualified and Effective Teachers	Career Development Quarterly
Palmer, R. T., Davis, R. J., & Thompson, T.	2010	Theory Meets Practice: HBCU Initiatives That Promote Academic Success Among African Americans in STEM	American Society for Engineering Education
Palmer, R. T., Maramba, D. C., & Dancy, T. E.	2011	A Qualitative Investigation of Factors Promoting the Retention and Persistence of Students of Color in STEM	Journal of Diversity in Higher Education
Pang, Q., & Whalin, R.	2012	Gender of Students and Graduates from a USA HBCU School of Engineering	The Journal of Experimental Education
Parker, A. D.	2013	Family Matters: Familial Support and Science Identity Formation for African American Female STEM Majors	ASHE Higher Education Report

Patton, S.	2014	Black Man in the Lab: Why Do So Few Black Men Earn STEM Degrees? The Reasons, and the Remedies, Go Beyond Numbers	Journal of Diversity in Higher Education
Payton, F. C., Suarez-Brown, T. L., & Smith Lamar, C.	2012	Applying IRSS Theory: The Clark Atlanta University Exemplar	Science Education
Perez-Felkner, L., McDonald, S. K., & Schneider, B. L.	2014	What Happens to High-Achieving Females after High School? Gender and Persistence on the Postsecondary STEM Pipeline	International Journal of Science Education
Perkins, S. C.	2013	An Implementation Study of the Science and Technology Entry Program (STEP) in New York State	Dissertation Abstracts International Section a: Humanities and Social Sciences
Perna, L. W., Gasman, M., Gary, S., Lundy-Wagner, V., & Drezner, N. D.	2010	Identifying Strategies for Increasing Degree Attainment in STEM: Lessons from Minority-Serving Institutions	American Society for Engineering Education
Perna et al.	2009	The Contribution of HBCUs to the Preparation of African American Women for STEM Careers: A Case Study	American Society for Engineering Education
Pfatteicher, S. K., & Tongue, M. P.	2002	What Drives Diversity?	The Journal of Negro Education
Pinkard, N.	2005	How the Perceived Masculinity and/or Femininity of Software Applications Influences Students' Software Preferences	Library Journal
Polman, J. L., & Miller, D.	2010	Changing Stories: Trajectories of Identification Among African American Youth in a Science Outreach Apprenticeship	Contemporary Educational Psychology
Pong, C., & Shahnasser, H.	2006	Case Study: Steps to Reach Out to Hidden Underrepresented Student Candidates in Engineering	ProQuest Dissertations and Theses
Palmer, R. T., Davis, R. J., Moore III, J. L., & Hilton, A. A.	2010	A Nation at Risk: Increasing College Participation and Persistence among African American Males to Stimulate U.S. Global Competitiveness	
Prewitt, A., Daily, S., & Eugene, W.	2007	Minority Retention and Success in Engineering: Diversifying the Pipeline through the Development of Social Capital	Gifted Child Quarterly
Price, J.	2010	The Effect of Instructor Race and Gender on Student Persistence in STEM Fields	Harvard Educational Review
Ramsey, S. B.	2012	The Effect of the Advanced Placement Training and Incentive Program on Increasing Enrollment and Performance on Advanced Placement Science Exams	Journal of STEM Education
Ransom, T. S.	2013	When Do Faculty Inputs Matter? A Panel Study of Racial/Ethnic Differences in Engineering Bachelor's Degree Production	Research in Higher Education
Reece, M. A., Rone, T. R., & White, C.	2012	Implementation of Cooperative Learning Techniques to Increase Minority Student Interest in RF/Microwave Engineering	American Society for Engineering Education
Reichert, M., & Absher, M.	1997	Taking Another Look at Educating African American Engineers: The Importance of Undergraduate Retention	International Journal of Engineering Education
Reid, E. L.	2010	Exploring the Experiences of African American Women in an Undergraduate Summer Research	Dissertation Abstracts International Section a:

		Program Designed to Address the Underrepresentation of Women and Minorities in Neuroscience: A Qualitative Analysis	Humanities and Social Sciences
Reyes, M. E.	2011	Unique Challenges for Women of Color in STEM Transferring from Community Colleges to Universities	Urban Review
Riegle-Crumb, C., & King, B.	2010	Questioning a White Male Advantage in STEM: Examining Disparities in College Major by Gender and Race/Ethnicity	Association for Computing Machinery
Rigaux, P.	1995	The High Price of Opting Out	Frontiers in Education 36th Annual Conference
Rincón, B. E., & George-Jackson, C. E.	2016	Examining Department Climate for Women in Engineering: The Role of STEM Interventions	Evaluation and Program Planning
Ritchie, S. M., Tobin, K., & Roth, W. M.	2007	Transforming an Academy through the Enactment of Collective Curriculum Leadership	Journal of College Student Development
Ro, H. K., & Loya, K. I.	2015	The Effect of Gender and Race Intersectionality on Student Learning Outcomes in Engineering	Urban Ills: Twenty-First-Century Complexities of Urban Living in Global Contexts
Roach, R.	2015	STEM Success	Journal of Curriculum Studies
Robinson, A., Pérez-Quinones, M. A., & Scales, G.	2015	Understanding the Attitudes of African American Middle School Girls toward Computer Science	Computers and People Research Annual Conference
Robinson, A., Pérez-Quiñones, M. A., & Scales, G.	2016	African American Middle School Girls: Influences on Attitudes toward Computer Science	Black Collegian
Robinson, W., & McGee, E. O.	2016	Panel: Viewing Engineering Education through the Lens of Social Science: A Candid Dialogue on Race and Gender	Journal of Applied Psychology
Rogers-Chapman, M. F.	2014	Accessing STEM-Focused Education: Factors That Contribute to the Opportunity to Attend STEM High Schools across the United States	Doctoral Dissertation, ProQuest Information & Learning
Rosenberg-Kima, R. B., Plant, E. A., Doerr, C. E., & Baylor, A. L.	2010	The Influence of Computer-Based Model's Race and Gender on Female Students' Attitudes and Beliefs towards Engineering	American Society for Engineering Education
Ross, M. M. S., & Godwin, A.	2016	Engineering Identity Implications on the Retention of Black Women in Engineering Industry	American Society for Engineering Education
Ross, M. S., & Fletcher, T. L.	2015	African American Women in the Academe: A Comprehensive Literature Review through the Lens of Intersectionality	Routledge, Taylor & Francis Group
Ross, M. S., & McGrade, S.	2016	An exploration into the Impacts of the National Society of Black Engineers (NSBE) on Student Persistence	American Society for Engineering Education
Rosser, J.	2002	Science, Mathematics, Engineering and Technology: A Clarion Call	Journal of the Learning Sciences
Rowlett, J. E.	2013	The Psychosocial Factors Contributing to the Underrepresentation of African American Males in Advanced High School Mathematics Courses	Doctoral Dissertation, University of Southern California
Rumley, S.	2012	Factors Associated with Academic Achievement in Mathematics among African American Males in a Four-Year Educational Institution	Cultural Studies of Science Education

Russell, M. L., & Russell, J. A.	2015	Black American Undergraduate Women at a PWI: Switching Majors in STEM	IEEE Education Engineering Conference
Samuelson, C. C., & Litzler, E.	2016	Community Cultural Wealth: An Assets-Based Approach to Persistence of Engineering Students of Color	Black Issues in Higher Education
Sato, T.	2014	Examining How Youth of Color Engage Youth Participatory Action Research to Interrogate Racism in Their Science Experiences	Doctoral Dissertation, Texas A&M
Schulte et al.	1999	National Society of Black Engineers Community Outreach Program	Doctoral Dissertation, University of California Los Angeles
Schwartz, J.	2012	Faculty as Undergraduate Research Mentors for Students of Color: Taking into Account the Costs	American Society for Engineering Education
Scott-Harris, S.	2009	A Comparative Study of Variables That Predict the Retention of Black Pre-Engineering Students and White Pre-Engineering Students at a Majority University	Dissertation Abstracts International Section a: Humanities and Social Sciences
Seay, C.	2004	Using a "Socio-Cultural" Approach in Teaching Information Technology to African American Students with Academic Difficulties	Dissertation Abstracts International Section a: Humanities and Social Sciences
Seiler, G., Tobin, K., & Sokolic, J.	2001	Design, Technology, and Science: Sites for Learning, Resistance, and Social Reproduction in Urban Schools	Psychological Reports
Shapiro, J. R., Williams, A. M., & Hambarchyan, M.	2013	Are All Interventions Created Equal? A Multi-Threat Approach to Tailoring Stereotype Threat Interventions	Decision Sciences Journal of Innovative Education
Sharpe, S.T.	2011	Examining the Characteristics of High Schools in Which Black Students Achieve in Mathematics	Journal of Black Studies
Sheppard, E. J., & Harris, V. G.	2001	The Impact of the Aerospace Science Engineering Program at Tuskegee University	Research in Higher Education
Sheppard, E. J., & Millon, W.	1999	Undergraduate Engineering Student Retention at Tuskegee University	IEEE Transactions on Education
Sherley, J.	2007	It's No Picnic for Black Faculty at MIT	Science Education
Showers, T.T.	2015	In Their Own Voices: Exploring the Persistence of High-Achieving African American High School Students in Mathematics Leading to STEM Careers	Association for Computing Machinery
Sibley, J.G.	1997	The Relationship of Self-Others Understanding to Social and Academic Adjustment of African American College Students, As Related to Retention	Dissertation Abstracts International
Simmons, D. R., & Martin, J. P.	2011	Implications of Black Greek Letter Membership on the Development of the Engineer of 2020	American Society for Engineering Education
Simon, T.	2010	The Road Less Traveled: Exploring Factors that Influence African Americans to Pursue and Complete Doctoral Degrees in Engineering and Applied Science Disciplines	The Journal of Men's Studies
Simon, T. M.	2008	Engineering Success: Persistence Factors of African American Doctoral Recipients in Engineering and Applied Science	American Society for Engineering Education

Slaughter, G., Harris, T., Ngandu, K., Williamson, K., & Adom, K.	2009	Undergraduate Research Experience: A Tool for Student Pursuing a Graduate Degree in Engineering	Journal of Curriculum Studies
Slaughter, J. E., Bulger, C. A., & Bachiochi, P. D.	2005	Black Applicants' Reactions to Affirmative Action Plans: Influence of Perceived Procedural Fairness, Anticipated Stigmatization, and Anticipated Remediation of Previous Injustice	Journal of Applied Psychology
Slaughter, J. E., Sinar, E. F., & Bachiochi, P. D.	2002	Black Applicants' Reactions to Affirmative Action Plans: Effects of Plan Content and Previous Experience with Discrimination	Negro Educational Review
Smith, C. S., & Paretti, M. C.	2015	Understanding the Mentoring Needs of African American Female Engineering Students: A Phenomenographic Preliminary Analysis	Doctoral Dissertation, UCLA
Smith, D. R., DiTomaso, N., Farris, G. F., & Cordero, R.	2001	Favoritism, Bias, and Error in Performance Ratings of Scientists and Engineers: The Effects of Power, Status, and Numbers	Science Education
Snipes, V. T., & Waters, R. D.	2005	The Mathematics Education of African Americans in North Carolina: From the Brown Decision to No Child Left Behind	Journal of Engineering Education
Solomon, J., Unnikrishan, V., Viswanathan, V., & Hamilton, E.	2016	Course Material Delivery in Engineering Using Brain-Based Learning Techniques	The Journal of Negro Education
Somerville-Midgette, K.	2014	An Engineering Journey: A Transcendental Phenomenological Study of African American Engineers' Persistence	Journal of Blacks in Higher Education
Sparks, D.	2016	Reducing Stereotype Threat in the Science and Mathematics Classroom: An Overview of Research, Best Practices, and Intervention Strategies	Chronicle of Higher Education
Squires, S. M.	2015	A Study of the Lived Experiences of African American Women STEM Doctoral Degree Completers	Dissertation Abstracts International
Stanton, J. M., & Lin, L. F.	2003	Effects of Workplace Monitoring Policies on Potential Employment Discrimination and Organizational Attractiveness for African Americans in the Technical Professions	Doctoral Dissertation, University of Colorado Denver
Stitt, R.	2015	African American Women in STEM Fields	Dissertation Abstracts International Section a: Humanities and Social Sciences
Stolle-McAllister, K., Domingo, M. R. S., & Carrillo, A.	2011	The Meyerhoff Way: How the Meyerhoff Scholarship Program Helps Black Students Succeed in the Sciences	Doctoral Dissertation, Capella University
Stone et al.	2013	Building an Inclusive REU Program A Model for Engineering Education	Research in Engineering Education Network
Strayhorn, T. L.	2015	Factors Influencing Black Males' Preparation for College and Success in STEM Majors: A Mixed Methods Study	Dissertation Abstracts International Section a: Humanities and Social Sciences
Strayhorn, T. L., Long III, L., Kitchen, J. A.,	2013	Academic and Social Barriers to Black and Latino Male Collegians' Success in Engineering and Related STEM Fields	American Society for Engineering Education

Williams, M. S., & Stenz, M. E.			
Strayhorn, T.L.	2010	Work in Progress—Social Barriers and Supports to Underrepresented Minorities' Success in STEM Fields	IEEE Frontiers in Education Conference
Strayhorn, T.L.	2010	Undergraduate Research Participation and STEM Graduate Degree Aspirations among Students of Color	Turkish Journal of Education
Stringer, E. W.	2011	African American Students' Graphic Understanding of the Derivative: Critical Case Studies	Journal of Research in Science Teaching
Strubel, B., Main, J., Ramirez, N., Davis, J., & Ohland, M.	2015	Modeling Student Perceived Costs and Benefits to Cooperative Education Programs (Co-ops) and Pathways to Participation	Peer Review
Study, N. E.	2011	Long-Term Impact of Improving Visualization Abilities of Minority Engineering and Technology Students: Preliminary Results	Journal of Women and Minorities in Science and Engineering
Study, N. E.	2004	Assessing Visualization Abilities in Minority Engineering Students	Journal of College Reading and Learning
Sullivan et al.	2012	Understanding Engineering Transfer Students: Demographic Characteristics and Educational Outcomes	American Society for Engineering Education
Svarovsky, G. N., Bequette, M. B., & Causey, L.	2016	Making Connections: Exploring Culturally Embedded Making Practices and Perceptions (Work in Progress)	The Chronicle of Higher Education
Sweat, D., Northern, T., Green, B. ,& Northern, J.	2008	Retention and Mentoring of Underrepresented Minority Students for Electrical and Computer Engineering Programs	American Society for Engineering Education
Talley, C. P., & Scherer, S.	2013	The Enhanced Flipped Classroom: Increasing Academic Performance with Student-recorded Lectures and Practice Testing in a "Flipped" STEM Course	The Journal of Negro Education
Taylor, K. J.	2011	An Examination of the Identity Development of African American Undergraduate Engineering Students Attending an HBCU	Humanities and Social Science
Taylor, O. L., McGowan, J., & Alston, S. T.	2008	The Effect of Learning Communities on Achievement in STEM Fields for African Americans across Four Campuses	The Review of Higher Education
Taylor, R.	1996	Drop in Black Engineering Enrollments Confounds Experts	The Journal of Negro Education
Teague, B. J.	1996	Mathematics Achievement and Its Relation to Career Aspirations of Eighth-Grade African American, Anglo, and Hispanic Girls	Dissertation Abstracts International Section a: Humanities and Social Sciences
Thomas, C. F.	2013	Persistence and Resiliency of African American Computer Science Majors at an Historically Black University	Doctoral Dissertation, Virginia Tech
Thomas, G.	1992	Participation and Degree Attainment of African American and Latino Students in Graduate Education Relative to Other Racial and Ethnic Groups: An Update from Office of Civil Rights Data	Oxford University Press
Thomas, J. O., & Rankin, Y.	2015	It's All in the Mix: Leveraging Food to Increase Students' Persistence in Computer Science	Frontiers in Education Annual Conference

Ticknor, C. S., Shaw, K. A., & Howard, T.	2014	Assessing the Impact of Tutorial Services	Doctoral Dissertation, Grambling State University
Tolbert, D., & Douglas, K.	2016	A Hierarchical Linear Modeling Approach to Understanding the Role of Ethnicity and Socioeconomic Status on Precollege Engineering Conceptions Research to Practice	Transformations
Toldson, I. A.	2013	Historically Black Colleges and Universities Can Promote Leadership and Excellence in STEM	Sex Roles
Tomasko, D. L., Ridgway, J. S., Waller, R. J., & Olesik, S. V.	2016	Association of Summer Bridge Program Outcomes With STEM Retention of Targeted Demographic Groups	American Society for Engineering Education
Towns, M. H.	2010	Where Are the Women of Color? Data on African American, Hispanic, and Native American Faculty in STEM	Frontiers in Education Annual Conference
Tran, M.C.	2011	How Can Students be Scientists and Still be Themselves: Understanding the Intersectionality of Science Identity and Multiple Social Identities through Graduate Student Experiences	The Journal of Negro Education
Tyson, W., Lee, R., Borman, K. M., & Hanson, M. A.	2007	Science, Technology, Engineering, and Mathematics (STEM) Pathways: High School Science and Math Coursework and Postsecondary Degree Attainment	Science
Vallas, C., & Donohue, S.	2007	Identifying Factors Affecting Persistence Rates Among Undergraduate Engineering Students from Underrepresented Populations at the University of Virginia	Chronicle of Higher Education
Varma, R., & Hahn, H.	2007	Gender Differences in Students' Experiences in Computing Education in the United States	European Journal of Engineering Education
Varma, R., & Hahn, H.	2008	Gender and the Pipeline Metaphor in Computing	IEEE Technology and Society Magazine
Villa, C. G., Nave, F. M., Frizell, S. S., Alfred, M. V., & Bonner, F. A. I.	2011	The Role of Faculty in the Retention of African American Gifted Students in STEM Programs in HBCUs	Doctoral Dissertation, Middle Tennessee State University
Villiers et al.	2015	Development of a STEM Summer Program for Underrepresented High School Students–A Success Story	American Society for Engineering Education
Viswanathan, V., Solomon, J., Unnikrishnan, V., & Hamilton, E.	2016	Improving Student Engagement in Engineering Classrooms: The First Step towards a Course Delivery Framework using Brain-based Learning Techniques	Frontiers in Education Annual Conference
Walter, A. M., & Austin, S. J.	2012	Expanding the Engineering Pathway for Underrepresented Minorities	Doctoral Dissertation, North Carolina Agricultural and Technical State University
Ware, M. L.	1998	Academic Performance and Factors Affecting College Success as Perceived by African American Undergraduates with Majors in Four Areas: The Sciences, Engineering, Mathematics, and Technology (SEMT)	Dissertation Abstracts International Section a: Humanities and Social Sciences.
Washington, A. N., Burge, L., Mejias, M.,	2015	Improving Undergraduate Student Performance in Computer Science at Historically Black	American Society for Engineering Education

Jean-Pierre, K., & Knox, Q. A.		Colleges and Universities (HBCUs) Through Industry Partnerships	
Watson, C.	2012	Using Factors of Socioeconomic Status, Family Support, and Academic Preparation to Explain the Black-White Gap in Mathematics Achievement and Participation	Journal of Information Technology Education
Weatherby, D. W.	2002	Comparative Effects of Mathematics Intervention Strategies on Minority Engineering Students' Success	Journal of Engineering Education
Weaver, S.	2016	High Anxiety	American Society for Engineering Education
Weise, E., & Guynn J	2014	Tech Jobs: Minorities Have Degrees, But Don't Get Hired	Journal of Educational Psychology
Whalin, R., & Pang, Q.	2012	Solving the Engineering Pipeline Challenge-Revised, Validated and Cost Optimized	Journal of Vocational Behavior
Wheatland, J. A.	2002	Factors that Affect Grade Point Average and Retention Status of First-time Science, Engineering, and Mathematics Students at Morgan State University, a Historically Black University	Western Journal of Black Studies
White, C.	2007	Meyerhoff Scholars: Nurturing Excellence in Science and Engineering; Dr. Freeman Hrabowski UMBC President	Doctoral Dissertation, Morgan State University
White, J. L., Altschuld, J. W., & Lee, Y. F.	2008	Evaluating Minority Retention Programs: Problems Encountered and Lessons Learned from the Ohio Science and Engineering Alliance	ProQuest Dissertations and Theses
Whittaker, J. A., & Montgomery, B. L.	2012	Cultivating Diversity and Competency in STEM: Challenges and Remedies for Removing Virtual Barriers to Constructing Diverse Higher Education Communities of Success	International Journal of Web-Based Learning and Teaching Technologies (IJWLTT)
Williams, T. M.	1986	Racial Identity, College Environment, Self-Efficacy and Vocational Interest: Correlates of Academic Progress for Black Undergraduates in Computer Science and Engineering Programs	Journal of Engineering Education
Williams, T. M., & Leonard, M. M.	1988	Graduating Black Undergraduates: The Step Beyond Retention	American Society for Engineering Education
Williamson, S. Y.	2007	Academic, Institutional, and Family Factors Affecting the Persistence of Black Male STEM Majors	Dissertation Abstracts International Section a: Humanities and Social Sciences
Wilson, M. J. A.	2015	Bulls-EYE Mentoring: Developing a Program Intervention in the College of Engineering	Frontiers in Education Annual Conference
Wladis, C., Conway, K. M., & Hachey, A. C.	2015	The Online STEM Classroom—Who Succeeds? An Exploration of the Impact of Ethnicity, Gender, and Non-traditional Student Characteristics in the Community College Context	Metropolitan Universities
Wooten, M.	2016	College Admissions and Academic Ethic: How Context-Specific Evaluation Within a Science-Based Compensatory Program Benefits African American Students	School Science and Mathematics

Wright, B. L.	2011	Valuing the "Everyday" Practices of African American Students K-12 and Their Engagement in STEM Learning: A Position	International Conference on Interactive Collaborative Learning (ICL)
Yates, J. K.	2001	Retention of Nontraditional Engineering and Construction Professionals	Educational and Psychological Measurement
Yates, N. M., & Nagle, B.	2016	Engineering Achievement: An Exploratory Case Study of Minority Engineering Organization Chapter Activities	American Society for Engineering Education
Yohannes-Reda, S.	2010	STEMming the Tide: Understanding the Academic Success of Black Male College Students in Science, Technology, Engineering, and Mathematics Majors	American Society for Engineering Education
Zhang, M.	2014	Who are Interested in Online Science Simulations? Tracking a Trend of Digital Divide in Internet Use	Cambridge University Press
	2009	Young Blacks Are Beginning to Break Negative Stereotypes of a Racial Deficiency in the Sciences	Frontiers in Education Annual Conference
	2004	UGA Graduate School to Fund Research on Completion Rates of Doctoral Students	American Society for Engineering Education
	2013	The Top Undergraduate Feeder Institutions for Blacks Who Earn Scientific Doctorates Filed in Degree Attainments, Research & Studies, STEM fields	Peabody Journal of Education
	2012	Ronald McNair Scholars Program Faces Major Cuts Filed in Financial Aid	American Society for Engineering Education
	1999	Jesse Jackson Blasted Out of the Sky	Institute of Electrical and Electronics Engineers
	2009	Creativity Key to Boosting Aid for Minority Science Majors	Black Issues in Higher Education
	1999	Breaking the Science Barrier	The Journal of Blacks in Higher Education
	2014	Blacks Appear to Be Shut Out in Election of New Members to the National Academy of Engineering Filed in Breaking News	Dissertation Abstracts International Section a: Humanities and Social Sciences
	2012	Black Degree Attainments in Engineering Filed in Degree Attainments, Research & Studies, STEM Fields	Journal of Applied Social Psychology
	2007	An Avoidable Black Eye for MIT: Professor James Sherley is Dismissed and His Laboratory Padlocked	Equity & Excellence in Education