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Expanding the Pool: Recognizing the Potential in Underprepared Students (Experience)

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Abstract

Students entering university bring with them a rich diversity of backgrounds, each shaped by unique experiences and perspectives. Some students come from families with a strong tradition of higher education, where parents and relatives have laid a well-established academic foundation. These students often enter college with a clear understanding of what to expect and how to navigate the demands of higher education. In contrast, first-generation college students, who lack this familial guidance, may face significant challenges. Without a background steeped in academic preparation, they might find themselves unprepared for the rigors of college coursework. This lack of preparation can create hurdles that affect their confidence and academic performance. While these issues can affect anyone, they disproportionately affect students of color due to a myriad of historical, social, and economic factors.

Professors and lecturers often express concern over the varying levels of academic preparedness among students when they first enter their courses. This disparity can be disheartening, sometimes leading to situations where students perceive that their instructors have lost faith in their ability to succeed. Such feelings of discouragement can create significant barriers to learning. Regardless of their starting point, though, every student deserves the opportunity to receive a high-quality education.

Lincoln University is a historically Black, land-grant public university dedicated to providing access to high-quality education for a diverse population. The university takes pride in its open-enrollment policy, which allows students from all academic backgrounds to pursue higher education. This inclusive approach gives educators the unique opportunity to engage with students who arrive with varying levels of academic preparation. During our tenure at Lincoln, we have observed that, regardless of their starting point, students demonstrate an extraordinary desire to learn and possess immense potential.

This paper presents our experiences and insights gained from working with students who, though often underprepared, exhibit remarkable resilience and a deep commitment to their education. We provide a detailed account of specific teaching methods employed to support underprepared students, focusing on active learning techniques, formative assessments, and individualized feedback. Additionally, we will discuss student outcomes, such as improvements in confidence, retention, and academic performance. Drawing on these experiences, we propose methods that can be applied at other institutions to enhance success in academic environments, ultimately leading to improvement of the engineering workforce and the betterment of society by recognizing the talent in our students and empowering them to reach their potential.

Keywords: student preparation, desire to learn, educational equity

Introduction

Students entering university come from diverse backgrounds shaped by unique experiences, significantly influencing their academic journeys. Among these students, first-generation college students represent a notable group, often arriving on campus without the familial guidance that can ease the transition to higher education. According to the National Center for Education Statistics [1], nearly one-third of undergraduate students in the United States are first-generation college students. Those with a family history of higher education typically enter college with a clearer understanding of academic demands and social integration, which enhances their confidence and adaptability [2]. In contrast, first-generation students may find themselves navigating college life with limited support, impacting their engagement and performance. Research indicates that these students often experience feelings of isolation and uncertainty, hindering their academic success [3]. They may struggle to access resources and services that are crucial for their development and persistence in higher education [4]. These hurdles not only affect their confidence but can also lead to difficulties in managing coursework, ultimately influencing their overall academic performance.

The challenges faced by first-generation college students are compounded by a lack of academic preparation. An underprepared student is generally defined as one who lacks the requisite academic skills, knowledge, or resources essential for success in postsecondary education. These deficiencies commonly manifest in foundational areas such as reading comprehension, technical writing, and mathematics, often stemming from prior educational experiences marked by academic underperformance, insufficient preparation, or limited exposure to rigorous academic standards [5]. In the context of engineering education, these gaps can be particularly detrimental, as engineering curricula place a heightened emphasis on advanced mathematics, technical communication, and critical analytical reasoning—skills integral to effective problem-solving and the successful application of engineering principles.

While issues of experience, confidence, resources, and preparation can impact any student, they disproportionately affect students of color due to systemic disparities in educational opportunities. Historical, social, and economic factors contribute to these disparities, including underfunded schools and societal stereotypes that complicate their experiences [6,7]. Professors and lecturers frequently voice concerns regarding the diverse levels of academic preparedness among students at the onset of their courses. This variability can be disheartening, potentially fostering a perception among students that their instructors lack confidence in their capacity to succeed. Such feelings of discouragement can significantly hinder the learning process [8,9]. Addressing these disparities is crucial, as they can contribute to a negative educational experience, undermine student motivation and can create a significant barrier to learning [10,11].

The erosion of trust between professors and students can lead to a substantial decline in educational quality, resulting in students exhibiting signs of disorientation and confusion while attempting to comprehend the course material. This sense of disconnection not only undermines

students' learning experiences but also reinforces professors' concerns and disillusionment regarding their students' engagement and success. Consequently, this dynamic creates a cyclical pattern of diminishing educational outcomes, where declining student comprehension further exacerbates faculty frustration and disengagement [12,13].

Engaging students that come from an underprepared background can pose a rather large challenge. Engaging unprepared students requires a multifaceted approach tailored to their unique needs. One effective method is the incorporation of active learning strategies, which promote student engagement through collaboration and participation in the learning process. Research has shown that techniques such as think-pair-share, problem-based learning, and interactive group activities can significantly enhance understanding and retention of material among underprepared students [14, 15]. Additionally, providing structured support, such as supplemental instruction and peer mentoring, can foster a more inclusive learning environment and empower students to take ownership of their learning [16,17]. Furthermore, the use of formative assessments allows instructors to identify gaps in understanding and adjust their teaching methods accordingly, ensuring that all students receive the support they need to succeed [18]. These strategies, when implemented effectively, can help bridge the gap for unprepared students and enhance their overall academic experience.

During our time at Lincoln University, we have observed that students, regardless of their initial academic readiness, exhibit a profound eagerness to learn and possess significant potential. This paper offers insights and reflections from our experiences working with students who, while often underprepared, demonstrate resilience and a deep commitment to their education. Building on these experiences, we propose strategies that can be adopted by other institutions to support student success in academic environments. By recognizing and nurturing the inherent talents of these students, we aim to contribute to a stronger engineering workforce and make a positive societal impact by empowering students to realize their full potential.

Lincoln University and our experience in working with underprepared students

Lincoln University mission

Lincoln University, a historically Black, land-grant institution, is deeply committed to fostering equitable access to high-quality education for a richly diverse student body and has the vision of “education and empowerment for all” [19]. With a proud tradition of open enrollment, Lincoln provides an academic environment where students from all educational backgrounds are welcomed, regardless of prior academic preparation. This inclusive policy not only embodies the university’s mission to broaden educational access but also creates a distinctive teaching environment that challenges faculty to engage meaningfully with a wide range of learners, including those who may not have had access to academic resources prior to college.

Experience at Lincoln University

At Lincoln University, we have observed that while many students enter engineering programs underprepared for rigorous academic content, they possess an extraordinary drive to learn and succeed. Despite facing significant initial challenges, these students exhibit a willingness to engage with material and actively seek growth opportunities. Their enthusiasm underscores the untapped potential within this demographic, reaffirming that with tailored support and resources, even students with weaker academic foundations can excel in demanding engineering curricula. To support this diverse student body, we have implemented targeted strategies designed to foster an inclusive and effective learning environment. These methods are tailored to accommodate varying academic preparedness levels while promoting skill development, confidence, and academic success. The techniques described here represent the ground-up efforts of faculty members in the engineering and technology areas to meet the needs of our students. These faculty-driven efforts are independent of, yet consistent with, University policies as well as a campus-wide initiative (since Fall 2023) to promote the use of high-impact practices [20]. Engineering faculty, in particular, are continually looking to improve upon these techniques to further student success, which serves as our lodestar.

Expanded accessibility through office hours

Recognizing that underprepared students often require additional one-on-one support, each faculty member is required to hold ten office hours per week. In our department, many faculty offer even greater availability through and open door policy to increase accessibility and allow students to seek guidance at their convenience. By creating a welcoming and judgment-free environment, students feel encouraged to ask questions, revisit complex concepts, and build a stronger understanding of course material. Additionally, students are invited to engage with instructors after class for further clarification and reinforcement, fostering a supportive relationship that enhances their learning experience. This building of rapport is essential for many of our students and helps to mitigate the extra issues faced by first-generation and underprepared students, bolstering their confidence and ability to overcome the academic challenges that are inherent to any engineering program.

Reinforcement of foundational knowledge

During lectures, we emphasize reiterating fundamental concepts to bridge gaps in prior learning. Key principles are revisited and contextualized through real-world applications, helping students solidify their understanding and relate theoretical knowledge to practical scenarios. This deliberate repetition ensures that critical ideas are not only memorized but also deeply comprehended. Further, the exposure to real-world applications helps to keep students motivated and to feed their internal desire to learn. Our goal is to provide the opposite of a "weed-out" class; instead, we strive to meet the students where they are while upholding the same rigor and learning objectives of any engineering program.

Hands-on active learning problem-solving activities

Interactive problem-solving exercises are central to our teaching approach. This technique resembles practice in industry where engineers work together within a team toward a common goal while not knowing in advance what the best approach to a problem may be, or if there is even a viable solution. These activities challenge students to apply their knowledge in real-time, fostering both confidence and independence in tackling complex engineering problems. Rather than presenting solutions outright, we guide students through each step of the process, encouraging them to think critically and collaboratively. This method strengthens their analytical capabilities while cultivating self-reliance, skills that are vital for academic and professional success.

Dynamic and inclusive teaching methods

The delivery of course content is designed to be engaging and interactive, capturing students' attention and making learning an active, enjoyable process. Through dynamic teaching strategies such as group discussions, peer collaboration, and active questioning, we aim to create an inclusive environment that motivates students to participate and connect with the material. This approach not only enhances comprehension but also builds a sense of community within the classroom.

Collaboration assignments

In Spring 2024 we introduced weekly "Collaboration Assignments" into our Circuit Analysis course. These assignments consisted of two major components:

1. Meet with a designated partner for at least 30 minutes to
    - discuss what makes sense from class
    - discuss what doesn't make sense from class
    - review your solutions to a variety of homework problems
    - identify which homework problems are challenging (and why), and
    - to help each other fully understand the material.
2. Individually submit a report from the collaboration meeting to include
    - with whom you met, and when
    - what you discussed
    - which homework problems you reviewed
    - any problems or challenges identified, and
    - any challenges/misunderstandings you were able to overcome.

The collaboration assignments encouraged students to complete their homework earlier (because it is most effective to attempt homework before meeting with a partner), to engage in deeper understanding through the intentional discussion of problems with one another, and provided meaningful feedback to the instructor on what topics were unclear a) after the lecture, and b) after the collaboration meeting. The strategy also encouraged students to think through

challenges collectively, promoting self-efficacy and empowering students to contribute to their own success.

These approaches have collectively appeared effective in supporting underprepared students. By meeting students at their current level and offering structured pathways for growth, these strategies empower learners to build confidence and competence. Our experience shows that with the right support and guidance, every student has the potential to thrive in engineering education, regardless of their starting point.

Fig. 1 illustrates a flowchart summarizing the strategies employed to support underprepared students. This visual representation highlights the interconnectedness of these methods and their role in fostering academic achievement.

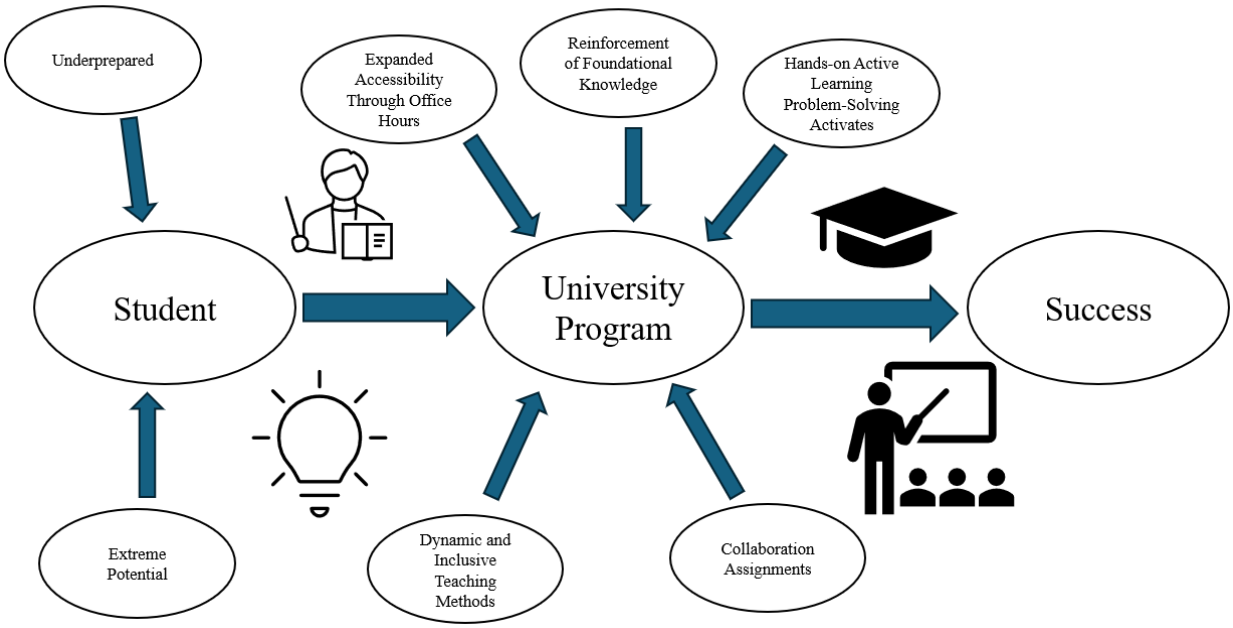

Fig. 1. Strategies flowchart.

Contrast with traditional approaches at large engineering institutions

At larger, research-intensive engineering universities, the educational environment often emphasizes academic rigor and a competitive atmosphere, catering primarily to students with strong foundational preparation. While these institutions frequently boast state-of-the-art facilities, abundant research opportunities, and extensive faculty expertise, their pedagogical models are not always designed to address the needs of underprepared students [21].

For instance, large lecture classes at such institutions often focus on delivering dense theoretical material at a rapid pace, leaving little room for the individualized attention necessary for bridging foundational gaps. Office hours may be limited or poorly attended, as students may feel

intimidated, unwelcome or overlooked [22]. Furthermore, assessments at these universities frequently prioritize summative evaluations, such as midterms and finals, over formative approaches that provide ongoing feedback and opportunities for improvement [23].

In contrast, Lincoln University's open-enrollment policy and mission to serve a diverse population necessitate a fundamentally different approach to education. The strategies implemented here, such as extended and flexible office hours, the reinforcement of foundational knowledge during lectures, and structured collaboration assignments, are tailored specifically to meet students where they are and guide them toward academic success. These methods emphasize inclusivity and support rather than competition and exclusivity, fostering a learning environment where every student has the opportunity to thrive.

This contrast highlights the importance of adaptability in educational practices, particularly in institutions serving populations with diverse academic readiness. By addressing the unique challenges faced by underprepared students, Lincoln University not only improves individual outcomes but also contributes to diversifying the engineering workforce, ensuring that talent is recognized and nurtured regardless of its starting point.

Discussion

Our work with underprepared students has revealed critical insights into the transformative power of understanding, support, and adaptive teaching practices. These students, often underestimated due to their initial lack of preparation, consistently demonstrate an extraordinary capacity for growth when met with patience, encouragement, and the right resources. Their perseverance and resilience underscore the importance of creating a learning environment that acknowledges their challenges while leveraging their potential.

One key takeaway from our experience is the need to reframe how we, as educators, perceive and address the struggles of underprepared students. Their difficulties are not indicative of a lack of effort or aptitude but rather a reflection of systemic inequities in educational access and preparedness. By shifting our focus from deficits to opportunities, we can adapt our teaching strategies to better meet students at their current level and guide them toward academic success. The instructional strategies we employed—active learning, formative assessments, and individualized feedback—emerged as highly effective tools in supporting these students. Active learning techniques, such as collaborative problem-solving and in-class exercises, engage students in realistic engineering tasks that foster both technical proficiency and critical thinking. These activities also build confidence, encouraging students to approach challenges with a problem-solving mindset.

Based on feedback from students and performance evaluations, our implemented teaching practices appear to have led to a student improvement in both material comprehension and retention. Assessing student performance and knowledge retention is critical, serving as a measurable indicator of the effectiveness of instructional strategies. Ongoing evaluations

continue to refine these approaches, ensuring their effectiveness in fostering long-term understanding and academic success. These teaching methods remain an evolving effort, subject to continuous assessment and improvement [24].

Formative assessments played a pivotal role in monitoring student progress, allowing instructors to identify and address areas of difficulty early in the learning process. This timely intervention not only helps students stay on track but also fosters a sense of accountability and partnership in their education. Additionally, individualized feedback proved invaluable in reinforcing a growth mindset, offering students clear, actionable steps to improve their performance while mitigating feelings of inadequacy.

While the strategies outlined in this paper have demonstrated effectiveness at Lincoln University, it is crucial to recognize certain limitations and areas for further refinement. First, the observations presented are based on a specific institutional setting—a historically Black, land-grant public university with an open-enrollment policy. The transferability of these methods to institutions with differing student demographics, resource availability, and academic structures warrants further investigation. Deeper examination of environmental factors within educational institutions may reaffirm the unique contributions of HBCUs to engineering education [25].

This study primarily relies on qualitative observations and anecdotal student feedback, limiting the ability to quantitatively assess the long-term impact of these interventions on academic performance, retention rates, and student progression. Future work will focus on the collection of robust empirical data, including longitudinal studies tracking student outcomes and comparative analyses across different institutional settings. Establishing clear performance metrics and leveraging data analytics will be critical in evaluating both the efficacy and scalability of these approaches.

A key challenge in sustaining these interventions is their resource-intensive nature. On one hand, the described interventions do not require any direct financial outlay — they require only a dedicated faculty willing to invest in their students. This should not, however, be taken to mean that these approaches do not come without cost. Extended office hours and individualized support can be taxing on faculty members, especially when facing (for example) staffing shortages and many competing responsibilities. The most important component contributing to sustainability is the support of leadership to allow appropriate balancing of responsibilities, recognition of the value provided by the investment in students, and a commitment to address and respond to faculty needs.

Finally, while these interventions aim to address academic preparedness gaps, they cannot on their own comprehensively mitigate the broader socioeconomic and systemic challenges that contribute to student struggles, such as disparities in pre-college educational access, financial constraints, and external obligations. The literature is replete with approaches that address these important issues, but the focus of this experience report is to share techniques that may be

immediately incorporated into the culture of a department, just as they were at Lincoln University.

Conclusions

Our experience demonstrates that the described strategies are effective as a catalyst for student success, ultimately expanding the pool of engineering talent amongst demographics that might otherwise be left in the margins. These techniques have been implemented in the context of Lincoln University, which provides an environment that is welcoming of students from all educational backgrounds. The ideas shared here, though, should be adaptable and scalable to diverse educational settings. Community colleges, other Historically Black Colleges and Universities (HBCUs), and large public institutions serving students with academic preparation gaps can readily tailor these approaches to fit their unique contexts. The flexibility of these methods ensures that they can be implemented effectively, even in resource-constrained environments, with significant benefits for student engagement, retention, and success.

Future work will focus on enhancing the evidence base for these strategies by collecting and analyzing comprehensive data, including qualitative student feedback, academic performance trends, and retention metrics. Such data will not only validate the impact of our interventions but also provide actionable insights for refining and scaling these practices. By contributing to the broader conversation around equitable teaching practices, we hope to inspire a wider adoption of these strategies across institutions.

While this paper focuses on classroom-level interventions, broader policy solutions are necessary to address educational inequities at scale. Institutional policies that fund structured bridge programs, summer readiness courses, and proactive academic advising can help mitigate preparation gaps before students enter engineering programs. Additionally, integrating equity-focused teaching strategies into faculty development programs can ensure that these approaches are applied consistently across departments.

The broader implications of this work extend beyond individual classrooms and institutions. By supporting underprepared students and helping them succeed, we expand the pipeline of future engineers and contribute to creating a more diverse and resilient STEM workforce. This work addresses systemic challenges of equity and access in higher education, ensuring that talented students from all backgrounds have the opportunity to thrive and make meaningful contributions to the field of engineering.

In conclusion, our findings reaffirm that with thoughtful, targeted support, underprepared students can not only meet but exceed academic expectations. We urge educators to recognize the potential within these students and to view their struggles as opportunities for impactful intervention. We hope to transform the common question from “why aren’t my students prepared?” to “how can I help my students reach their potential?”. By embracing these strategies and refining them through practice, we can unlock the potential of underprepared students,

transforming challenges into triumphs and creating a more inclusive, equitable, and thriving educational landscape.

Conflict of interest statement

The authors confirm that there are no commercial or financial relationships that could be seen as a potential conflict of interest related to this work. This study was conducted independently, without any external financial or commercial influences.

References

[1] National Center for Education Statistics, *Digest of Education Statistics 2020,* U.S. Department of Education, 2020.

[2] E. T. Pascarella and P. T. Terenzini, *How College Affects Students: A Third Decade of Research,* Jossey-Bass, 2005.

[3] T. T. Ishitani, T. T., "Studying Attrition and Degree Completion Behavior among First-Generation College Students in the United States", in *Journal of Higher Education*, vol. 77, no. 5, 2006, pp. 861-885.

[4] J. Engle and V. Tinto, *Moving Beyond Access: The Importance of Student Retention*, The Pell Institute for the Study of Opportunity in Higher Education, 2008.

[5] M. A. Miller and C. Murray, *Advising Academically Underprepared Students*, NACADA: The Global Community for Academic Advising, Academic Advising Recourses, 2005.

[6] G. Orfield and C. Lee, *Racial Transformation and the Changing Nature of the Public School*, The Civil Rights Project, 2005.

[7] C. M. Steele, "A Threat in the Air: How Stereotypes Shape Intellectual Identity and Performance:", in *American Psychologist*, vol. 52, no. 6, 1997, pp. 613-629.

[8] K. Burch, "The Impact of Student Preparedness on Academic Achievement: A Study of Undergraduate Students", in *Journal of Education and Practice*, vol. 10, no. 2, 2019, pp. 13-19.

[9] J. Hattie and H. Timperley, "The Power of Feedback", in *Review of Educational Research*, vol. 77, no. 1, 2007, pp. 81-112.

[10] C. S. Dweck, *Mindset: The New Psychology of Success.* Random House, 2006.

[11] D. H. Schunk and B. J. Zimmerman, *Motivation and Self-Regulated Learning: Theory, Research, and Applications*, Routledge, 2008.

[12] P. Brusilovsky and E. Millán, "User Models for Adaptive Hypermedia and Adaptive Educational Systems", in *The Adaptive Web*, in Lecture Notes in Computer Science, vol. 4321, Springer, 2007, pp. 3-53.

[13] V. Tinto, "Reflections on Student Persistence", in *Student Success*, vol. 1, no. 1, 2017, pp.1-5.

[14] M. Prince, "Does Active Learning Work? A Review of the Research", in *Journal of Engineering Education*, vol. 93, no. 3, 2004, pp. 223-231.

[15] S. Freeman, S. L. Eddy, M. McDonough, M. K. Smith, and M. P. Wenderoth, "Active Learning Increases Student Performance in Science, Engineering, and Mathematics", in *Proceedings of the National Academy of Sciences*, vol. 111, no. 23, 2014, pp. 8410-8415.
[16] V. Tinto, *Leaving College: Rethinking the Causes and Cures of Student Attrition*, University of Chicago Press, 1993.
[17] H. Wenglinsky, *The Effect of Homework on Student Achievement*, Educational Testing Service, 2004.
[18] P. Black and D. Wiliam, "Assessment and Classroom Learning", in *Assessment in Education: Principles, Policies, and Practices*, vol. 5, no. 1, 1998, pp. 7-74.
[19] Office of the President of Lincoln University, *Mission and Vision*, Lincoln University, 2022. [Online]. Available: https://www.lincolnu.edu/about-lincoln/presidents-office/mission.html
[20] G. D. Kuh, *High-impact educational practices: what they are, who has access to them, and why they matter*, Association of American Colleges and Universities, 2008.
[21] E. P. Bettinger and B. T. Long, "Addressing the Needs of Underprepared Students in Higher Education: Does College Remediation Work?", in *Journal of Human Resources*, vol. 44, no. 3, 2009, pp. 736-771.
[22] D. Perin and J. P. Holschuh, "Teaching Academically Underprepared Postsecondary Students", in *Review of Research in Education*, vol. 43, no. 1, 2019, pp. 363-393.
[23] D. Parmigiani, E. Nicchia, E. Murgia, and M. Ingersoll, "Formative assessment in higher education: an exploratory study within programs for professionals in education", in *Frontiers in Education*, vol. 9, no. 1366215, 2024.
[24] C. Rusnak, D. Heise, and Z. Alfawaer, "WIP – Building a Stronger Curriculum: A Comprehensive Model for Enhanced Evaluation", in *Proceedings of the 2025 ASEE Annual Conference*, in press.
[25] T. Ransom, "Clarifying the Contributions of Historically Black Colleges and Universities in Engineering Education", in *Changing the Face of Engineering: The African American Experience*, Hopkins Press, 2015, pp. 120-148.