Tracing Black Transfer Students' Success in Engineering: A Comparative Insight into Transfer-Student Trends at Two State Minority-Serving Institutions

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Abstract
There is a pressing national concern about Black students' disproportionate underrepresentation and success rates in undergraduate engineering programs. Although, nationally, community colleges (CCs) serve as the primary pathways for Black students' making attempts to earn associate degrees. Fewer Black students achieve their transfer aspirations. For Blacks that transfer, there is a lack of detailed data tracking their enrollment, retention, and graduation rates, especially when transitioning to Minority-Serving Institutions (MSIs). In cases where national transfer data are available, they often lack comprehensive and adequate disaggregation by factors like the cohort entry type, race, ethnicity, or program of study. Exceptionally, the state of [redacted] education system's unique approach to tracking and publicizing data on transfer students from CCs provides an opportunity to glean insights. This paper is an offshoot of a larger funded research project that leverages the shared commitment of CCs and MSIs to optimize black engineering student pathways to success in higher education. Using a comparative case study design, the research team analyzes and synthesizes engineering transfer data of Black students who transitioned from [redacted] college system CCs to two prominent four-year MSIs in State [redacted]: one Hispanic serving institution (HSI) and one Historically Black Colleges and Universities (HBCU). We also collected data from faculty/administrative representatives from the four institutions through two focus group sessions. This study highlights the effectiveness of MSI's tracking system in capturing Black transfer engineering students' enrollment, retention, and graduation rates. Also, the findings hold the potential to serve as a benchmark for other MSIs nationwide seeking support and tracking of Black transfer students in engineering to promote their educational attainment.

Introduction
Upward transfer pathways, which facilitate students' movement from community colleges (CCs) to four-year colleges and universities, are of significant national importance [1]. In science, technology, engineering, and math (STEM) programs, the upward transfer pathways increase STEM graduates and the capacity of the workforce [2]. In particular, these pathways are pivotal for 1) Broadening participation in engineering, 2) Increasing the number of future engineers, and 3) Promoting educational equity and workforce development in the engineering sectors. [3], [4], [5], [6]. According to a recent report [7], although Black students are well-represented in CCs, their transition to four-year institutions and bachelor's completion remains around 9%, which is a lower rate compared to the overall community college students (16%) [3], [8], [9], [10], [11]. Moreover, transfer students' retention and graduation rates in engineering are not tracked nationally, so it is impossible to determine how students perform after leaving community colleges. Where national transfer data exist by racial/ethnic demographic groups, they are not disaggregated by field of study.

The State of [redacted] higher education system is one of the few in the country that consistently tracks transfer student enrollment, retention, and graduation for students at its public two and four-year institutions; the name of the system with which these public institutions are affiliated is the State College System (SCS). In addition, transfer student data in State [redacted] can be disaggregated by sending institution type (two vs. four years), race/ethnicity, and field of study.

This work-in-progress study is part of a larger funded research project that explores the shared commitment of CCs and four-year Minority Serving Institutions (MSI) to educate prospective and current Black engineering students. Centering on the purpose of the study for tracking Black

transfer students' success in engineering, we adopt a comparative case study approach that examines two sets of data: First, we examine the transfer data of Black engineering students transitioning from CCs in the State College System (SSCS) to two four-year MSIs in the state. Second, we present and analyze themes from interviews with four faculty and administrative staff members. from these institutions through a focus group to understand the components of their institutions' transfer pathways that facilitate or impact student transitions.

Specifically, our research questions are: (1) What do existing transfer enrollment, retention, and graduation data reveal about the current enrollment and student success trends for Black engineering students from Institutions 1 and 2? (2) What factors may contribute to the existing enrollment and student success trends for Black engineering students from State community colleges? For this study, we define "success" as students' retention and graduation in a four-year engineering program after transferring from a community college. The understanding gained from this study may offer valuable insights for other institutions [12], particularly those operating under similar educational policies and Carnegie classifications."

Literature Review

For Black and other minoritized populations to be successful, there must be a transfer-receptive culture at the receiving institution [13]. A transfer-receptive culture is defined as "an institutional commitment by a four-year college or university to provide the support needed for students to transfer successfully" (p. 253) [13]. This study specifies the transfer receptive culture in a four-year institution as the institutional commitment for supporting transfer students from minoritized backgrounds. Moreover, as Gelin [14] emphasizes, the effectiveness of student transfers hinges on the intertwined policies, practices, and cultural dynamics of both the sending and receiving institutions. For there to be effective transfer pathways, there must be a dedicated effort from both CCs and four-year universities to offer comprehensive support throughout the transfer process [15]. This support system needs to focus on guiding students through their program at the CC, assisting in course selection, managing application processes, facilitating enrollment, and ensuring academic and social integration at the university [15]. Additionally, support requires aiding the transfer students in completing their baccalaureate degrees in a timely and efficient manner [13], [16]. When transfer students enter specific programs earlier, they are more likely to transfer to enroll in a four-year institution or have degree completion [17].

The study conducted by Berhane [18], which identifies institutional factors that facilitate the transfer of Black engineering students from community colleges to four-year universities, revealed key elements crucial for a seamless transfer process in engineering education. Among these, the involvement of institutional stakeholders, including faculty and administrative staff, stands out as particularly impactful. Their roles in providing mentorship, fostering a welcoming and inclusive academic environment, and offering guidance to Black engineering students are highlighted as significant. Furthermore, the article points out the importance of institutional supports such as transfer assistance services, academic advising, tutoring programs, and research opportunities, emphasizing their essential role in ensuring the smooth transition of these students from CCs to four-year institutions [18]. In a related way, Smith [19] investigates the institutional factors that assist the transfer pathways of Black students entering engineering and other STEM programs at Historically Black Colleges and Universities (HBCUs), providing additional insights into this critical area of educational research [19]. This study found that Black undergraduates who

transferred to four-year HBCUs reported healthier institutional environments than those who transferred to four-year predominately White institutions (PWIs). Finally, we note that authentic partnerships and improved CC and four-year university communication can contribute to an effective transfer pathway [20]. Building on the insights provided by the existing literature, this study aims to fill a notable gap in understanding the nuances of some factors that impact Black transfer students' data within Minority-Serving Institutions (MSIs). We also present the current transfer enrollment and success trends for Black engineering collegians who initially enroll in State CCs.

Methodology

Merriam (1998) defines a case as a bounded and integrated system, seen as a thing, an entity, or a unit with boundaries [21]. We draw on multiple perspectives and data sources to understand the cases in-depth for contextually rich and meaningful interpretations [22]. These multiple data sources help to provide a richer and multifaceted understanding of the studied cases [21], [23], [24]. In this paper, we are considering Black engineering transfer in a particular state in the U.S.

We specifically considered two prominent four-year MSIs in the state. We refer to these institutions using pseudonyms to preserve their anonymity and the anonymity of the faculty/administrators we interviewed. The first one, referred to as Institution 1, is a Hispanic-serving institution (HSI), and the second one, Institution 2, is one of the 18 Historically Black Colleges and Universities (HBCUs) with undergraduate programs accredited by the Accreditation Board for Engineering and Technology. Institution 1 is a major four-year public research university in the State, with an undergraduate and undergraduate transfer-in enrollment of approximately 46,000 and 5,100 students in fall 2022. Hispanic students comprise 67% of the undergraduate student population, and Black (African American) students – the second largest demographic – comprise 12% of the undergraduate population, following Hispanic/Latino (67%). Institution 2 is a midsize four-year public HBCU in the State, with an undergraduate and undergraduate transfer-in enrollment of about 7,700 and 700 students, respectively, as of fall 2022. Black (African American) students are the largest racial/ethnic group, at 88% of the student body, followed by Hispanic/Latinx students at 5%. Institutions 1 and 2 are part of the State University System and contribute to the State's broad-based engineering education. The two institutions offer engineering programs in core engineering disciplines accredited by the Accreditation Board for Engineering and Technology (ABET).

Data Collection

This research combined quantitative and qualitative data to obtain a rich and comprehensive understanding of the case studies [24]. With the approval of the institutional gatekeepers, we derived quantitative data from institutional research databases, including interactive reporting tools and annual reports. These sources offered a detailed view of institutional metrics, which is essential for understanding the broader quantitative context of our study. The qualitative dimension of our research involved direct engagement with key stakeholders at both CCs and four-year institutions. A pivotal element in this process was a productive one-hour Zoom meeting with a senior member of an institutional research office at Institution 1. This interaction provided an in-depth walkthrough of the institution's data reporting platform and clarified various technical terminologies, which aligns well with robust qualitative research methods [25]. This engagement

was enhanced through continuous communication with institutional research representatives via Microsoft Teams chat. Furthermore, access to the Institution 1 data dictionary dashboard proved invaluable for interpreting specific terms in their data presentations. This tool provided clarity and enhanced the accuracy of our data interpretation. This process enabled us to gain nuanced insights and immediately clarify emerging questions.

We conducted two extensive virtual focus group sessions totaling 180 minutes. We facilitated one focus group with a senior university administrator at Institution 1 and an engineering professor at Institution 2. Our second focus group involved two STEM program directors, one affiliated with the feeder community college for Institution 2. The other program director is a science faculty member associated with the feeder community college for another university outside of the state; we do not reference findings associated with this second program director since those findings were associated with a different state context. This diversity in representation was crucial for presenting a wide range of perspectives [26], and through the online focus group sessions, we were able to bring all the participants together [27]. Following the focus group discussions, we engaged in follow-up correspondence through official emails due to time constraints and logistical challenges. This phase involved sharing institution-disaggregated data on Black transfer students with institutional representatives and soliciting their responses to specific questions. Among the types of questions we asked them, we queried them for insights related to the institutional data we provided. This step was vital for incorporating an insider view [28], [29].

This multifaceted data collection strategy was instrumental in ensuring the robustness and reliability of our findings. We achieved a comprehensive and nuanced understanding of this case study by integrating diverse data sources and leveraging direct communication with institutional research office experts. Our approach aligns with contemporary research methodologies that emphasize the synergistic value of combining quantitative and qualitative data for a holistic analysis [26].

Findings and Discussions

Research Question 1. What do existing transfer enrollment, retention, and graduation data reveal about the current enrollment and student success trends for Black engineering students from [State] community colleges?

A member of the research team with an existing account accessed an interactive reporting tools platform from the website at Institution 1. The platform provides a robust database with different data point options to select from. First, we downloaded the "enrolled Students by Admit Type" database. A unique feature of this platform was the "choose filter" option, from which we were able to disaggregate the data by time variables (e.g., academic year and semester), academic structure variables (e.g., college of engineering and degree plan (BA and BS)), degree and level variables (e.g., selecting only undergraduate students seeking a bachelor's degree), demographic variables (e.g., choosing Black or African American ethnicity/race as the subject of the study), and mode of admission type (e.g., focus on CC transfer students).

The transfer data presented pertains exclusively to State College System (SCS) students, encompassing students who started their education at a CC within the State and transitioned to

Institution 1. While an "other transfer" category exists in the database that accounts for students from non-State institutions or non-SCS schools, our work intentionally omits this segment. This is because the "other transfer" category includes transfers beyond community colleges. We suggested refining the "other transfer" designation to distinctly present data for Black students transferring from non-SCS community colleges. This would provide more accurate data tracking of the number of Black students transferring from CC to Institution 1. Institution 1 presented data for only six academic years, 2018-19 to 2023-24, including fall, spring, and summer semesters. Upon filtering, we extracted data for the total enrollment of Black engineering transfer students from SCS CCs. We also collected the total enrollment (including Black or African American, American Indian or Alaska Native, Asian, Hispanic, Nonresident Alien, White, Not reported, Two or more races) of engineering transfer students from SCS CCs. For each academic year, Institution 1 data shows the number of Black engineering transfer students who enrolled in fall, spring, and summer (See Table 1).

Similarly, for Institution 2, data were extracted from the publicly available interactive reporting tool, which provides a detailed data dashboard for the university. Fall enrollment data were available from 2008 to 2022. Spring enrollment data were available from 2009 to 2023. Summer enrollment data were available from 2008 to 2023. Through filtering of the last institution the student attended, we gathered data on students who transferred from SCS. See Table 2 for data from Institution 2. Because Institution 2 reported a broader period of data than Institution 1, the two tables appear separate rather than combined.

Navigating through the data platforms of institutions 1 and 2 was relatively straightforward, and filtering options offered the advantage of accessing disaggregated data of interest. However, without a data dictionary and consultation with representatives from the institutions' data offices, navigating these datasets could prove more challenging.

Table 1: Institution 1 Enrollment Data

		2023-24	2022-23	2021-22	2020-21	2019-20	2018-19
Fall	1	320	322	318	291	271	232
	2	2679	2645	2628	2530	2388	2168
	3	11.94	12.17	12.10	11.50	11.35	10.70
Spring	1	324	315	296	248	236	NP
	2	2627	2605	2526	2298	2189	NP
	3	12.33	12.09	11.72	10.79	10.78	
Summer	1	244	258	253	222	177	147
	2	2059	2074	2078	1929	1684	1507
	3	11.85	12.44	12.18	11.51	10.51	9.75

NP: Not provided, 1 = Total enrollment of Black engineering transfer students from SCS community colleges, 2 = Total enrollment (all race) of engineering transfer students from SCS community colleges, 3 = Percentage of Black engineering transfer students to the total engineering transfer students (all races/ethnicity) from community colleges represented at Institution 1.

Table 2: Institution 2 Enrollment Data

Fall	2022-23	2021-22	2020-21	2019-20	2018-19	2017-18	2016-17	2015-16	2014-15	2013-14	2012-13
A	61	44	28	51	56	46	21	16	13	20	24
B	74	63	39	67	69	54	24	21	18	23	30
C	82.43	69.84	71.79	76.11	81.16	85.19	87.5	76.19	72.22	86.96	80.00

A: Total enrollment of Black engineering transfer students from community colleges (only SCS Transfer), B: Total enrollment (all races) of engineering transfer students from community colleges, C: Percentage of Black engineering transfer students to the total engineering transfer students (all races/ethnicity) from community colleges represented at Institution 2.

Research Question 2. What factors may contribute to the existing enrollment and student success trends for Black engineering students from State community colleges?

Guidance and Knowledge Dissemination

Our findings indicate that engineering transfer students benefit significantly from having access to knowledgeable academic advisors about the transfer process. At a leading community college (CC) feeder to Institution 2, comprehensive programs on campus provide detailed guidance on the transfer process. For example, a focus group participant from this institution highlighted the effectiveness of these programs: “For our students who actively participate in this program [for prospective transfer students], they know the majors and schools they are transferring into.” This result aligns with existing research suggesting that clarity in the transfer process and understanding of academic pathways are important for successful transfers [30], [31], [32]. An informed

academic advisor has the potential to facilitate Black students' transition from CCs to four-year institutions in engineering and in other majors.

Building on this, the participant in a focus group from Institution 1 shared insights into their proactive approach toward facilitating transfer pathways. Institution 1 has implemented specialized advising systems like bridge advisors to guide students through their transfer and academic journey. These bridge advisors maintain a consistent partnership with the community college feeder institutions that send the most transfer students, often visiting the CCs to inform transfer advisors about transfer guidelines and resources. This collaborative approach has created a win-win situation with more successful transfers in the CCs and more reliable enrollment in the four-year institution. The participant noted, "We became focused and intentional about how we can improve their pathway." Proactive and collaborative advising between CCs and four-year institutions can significantly improve transfer rates and student success.

Furthermore, Institution 2 also engages in direct outreach to enhance students' transfer experiences. Representatives from Institution 2 frequently conduct advising days at their feeder community colleges. During these sessions, their advisors offer in-person opportunities for students to ask about the transfer process. This direct engagement exemplifies the institutions' commitment to facilitating a smoother transition for their transfer students, a strategy supported by research from Handel [33], which emphasizes the positive impact of direct communication and engagement on student transfer experiences. Proper guidance and knowledge dissemination can be instrumental in helping Black students navigate the complexities of the transfer process, ensuring they are well-informed about the requirements and expectations of their desired programs. These advising systems are vital in supporting students' academic progression and success by bridging the information gap between community colleges and universities. Comprehensive advising and institutional partnerships are key factors in supporting the transfer process.

Facilitating Connections

"It's like a lot of moving parts that the students have to kind of navigate, even before they really start their major on that campus." This comment from the CC participant in the State referenced how their roles as key institutional representatives have assisted in facilitating direct connections between their CC students and relevant engineering departments at Institution 2. This interaction which often involves liaising with specific individuals in engineering departments at Institution 2 and the transfer admission offices who help demystify the transfer process, a factor known to influence transfer success [34]. The efforts by these CC feeder representatives to provide comprehensive information and resources can empower students, allowing them to advocate for themselves effectively in transfer situations. A participant highlighted, "... it gives them a lot of agencies and [allows them] to advocate for themselves in transfer situations." Importantly, these representatives gather support from college leadership, including deans and provosts, which ensures their cohesive approach to transfer student assistance. Institutional support garnered by institutional representatives can help facilitate student transfer [35], [36]. Furthermore, our findings reveal a significant aspect that facilitates student transfer: the collaboration between Institution 2 and the CC feeder transfer offices. An annual event held at the feeder CC exemplifies this collaboration. During this event, representatives from various departments share transfer-related information. As one participant noted, "... in every spring, we have events called

‘Institution 2 day’ at the feeder CC where different department representatives set up stands to share information on student transfer.” This collaboration strengthens the institutional connections and encourages students to engage proactively with transfer offices. Such institutional partnerships facilitate student transfer success [37].

The Role of the Statewide Course Numbering System

Transfer credit processes present a significant barrier to STEM/engineering students transferring from community colleges to four-year institutions in many states across the United States, especially without a statewide course numbering system. Research has consistently identified this issue as a major obstacle in the transfer pathway [32], [38], [39], [40], [41]. The complexity and lack of transparency in credit transfer can deter students from pursuing transfer despite their aspirations. This barrier is particularly acute in states or universities without systems that ensure course equivalency and transferability, leading to uncertainty and potential credit loss for transferring students.

In contrast, the State Course Numbering System (SCNS) is a model for addressing these challenges, particularly for Black students transferring into engineering programs at Institutions 1 and 2. A focus group participant noted, “And in State, you know we do have [State Course Numbering System]. So, it makes it a lot easier for students to, you know, go from community college system to our university system.” Another participant stated: “SCNS plays a critical role in ensuring seamless transfer of credits between community colleges and universities. It helps aid their transfer students’ enrollments, avoid redundant coursework, and accelerates their progress towards degree completion.”

The SCNS provides a comprehensive database of higher education courses available at the target institutions and their respective community college (CC) feeder institutions. It lists and describes courses, ensuring their transferability and equivalence [42]. This system is integral in preventing duplication of coursework and in guaranteeing that transferred courses fulfill general education requirements. The first author examined the SCNS website, including filtering for specific majors and courses (State Department of Education, 2023), which revealed insightful examples. For instance, one lab-based course related to engineering graphics at a State CC has a direct transfer to another course with nearly the same number at four-year institutions in the state (there is one difference in the letter suffix for the lab). Without such a system, a transfer student might unnecessarily repeat the course, potentially leading to frustration and, potentially, attrition. The SCNS is a crucial part of the broader effort to streamline the transfer process from CCs to four-year universities in the state. Its effectiveness lies in its ability to provide clear, accessible information on course equivalency, thereby aiding transfer students in shortening their time to complete their bachelor’s degree and reducing excess credits. Institutions 1 and 2 also emphasized that their school websites provide detailed descriptions and information about courses and their respective transferability. Such transparent and efficient transfer processes can significantly impact transfer students' retention and success [16], [43].

Conclusion

These findings suggest that a statewide infrastructure and committed faculty/staff are extremely important for creating a robust engineering transfer ecosystem. At the state level, access to institutional data can help community colleges and four-year institutions understand trends with respect to enrollment. In future work, we will demonstrate the capacity of the statewide system to provide institutional data on retention and graduation. Combined, this will provide some of the

most comprehensive data on engineering transfer enrollment and the success of any study that we have seen in the literature to date. Beyond the institutional data, the SCNS creates transparency that can mitigate confusion and allow students to be the most efficient with their time as they prepare to transfer. For CC engineering students, particularly those from under-resourced backgrounds, ensuring maximum efficiency and transferability can potentially reduce the financial burden of attending college.

At the individual level, Black and other CC students must feel accepted and that they matter in the broader engineering environment. Faculty, advisors, and administrators play a major role in creating an environment of support, both pre- and post-transfer. Within a discipline like engineering, which is known to push away many students, this is especially important. Moreover, at a moment in which Black student transfer rates are alarmingly low, evidence of extensive faculty/staff support can create much-needed environments to foster success.

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