

Microcredentials for Strategic Enrollment Growth: Removing Barriers to Graduate Degrees in Engineering

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Clay Gloster, Jr. is the Dean of the Graduate College at North Carolina A&T (N.C. A&T) State University. With more than 30 years of experience in higher education, Dr. Gloster has also served on the faculty of North Carolina State University and Howard University. He has a proven track record of strategic, results-oriented leadership that has shaped his strong reputation for establishing new programs that positively impact enrollment and national rankings.

Dr. Gloster received the B.S. and M.S. degrees in Electrical Engineering from North Carolina A&T State University and the Ph.D. in Computer Engineering from North Carolina State University. He has also been employed by IBM, the Department of Defense, and the Microelectronics Center of North Carolina.

Dr. Gloster has published numerous articles in peer-reviewed journals and conferences and has given presentations throughout the U.S., Europe, Africa, and China. He has served on the program committee for several international conferences and received best paper and presentation awards at an international conference. Under his leadership, the Master of Science in Information Technology degree program at N.C. A&T was ranked 16th in the country by U.S. News and World Report. He has received numerous fellowships and distinguished awards and holds two patents.

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Dr. Matt McCullough or "Dr. M." as he is referred to, currently serves as the associate dean of graduate enrollment in The Graduate College. He is also an associate professor in the department of Chemical, Biological, and Bioengineering, he has his B.S. in Industrial Engineering from North Carolina A&T and his Ph.D. in Biomedical Engineering from the University of Iowa. His research involves finite element modeling of the musculoskeletal system as well as kinematic analysis, especially the applications of machine learning to these data sets. He is also interested in engineering education, and in particular application experiences for engineering students. He is an advocate for DEI&B as well as graduate student well-being.

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Dr. Jenora Waterman is an Associate Professor of Biology and serves as Associate Dean for Academic Affairs in The Graduate College at North Carolina Agricultural and Technical State University. Her research examines the cellular and molecular mechanisms by which inhaled environmental and occupational pollutants injure the airway and contribute to respiratory diseases, including asthma and chronic bronchitis, with applications across agricultural, military, and clinical settings. Through interdisciplinary collaborations, her work has also advanced the evaluation of biocompatible metallic biomaterials to improve outcomes for individuals with airway injuries and congenital tracheal defects.

Dr. Waterman has secured more than \$7.6 million in external funding from agencies including the NIH, NSF, USDA, and Department of Defense to support research, education, and workforce development initiatives. A dedicated STEM educator, she has taught courses spanning toxicology, environmental health, cellular biology, and research ethics, emphasizing communication and critical thinking as essential skills for the modern STEM workforce. Her excellence in teaching was recognized with the UNC Board of Governors Award for Teaching Excellence, the highest faculty teaching honor in North Carolina.

Prior to her role in The Graduate College, Dr. Waterman led the Ph.D. in Applied Science and Technology Program, overseeing graduate admissions, curriculum management, student progress, and doctoral milestone processes while stewarding approximately \$3.5 million annually in graduate student support. She earned her B.S. Biology from Bennett College, M.S. Biology from North Carolina A&T, and Ph.D. in Functional Genomics (Biochemistry track) from North Carolina State University, followed by postdoctoral training in cell biology and pulmonary physiology.

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Abstract

Developing strategies to drive enrollment growth is more challenging in graduate programs than in undergraduate programs. Because of the significantly higher investment required to attract outstanding graduate students, as well as the barriers to graduate program admission, enrollment in graduate degree programs typically increases by the national average of 3-4% each year. However, many institutions set goals/targets for graduate enrollment that are well above 4% per year. Hence, graduate school deans and executive-level university administrators need to identify strategies to meet these lofty enrollment targets, especially when resources to attract graduate students are limited.

Our institution, the nation's largest Historically Black College or University (HBCU) with an enrollment of over 15,000 students, is intentionally using microcredentials to support strategic enrollment growth. We sought to address the enrollment growth challenge through the use of microcredentials, which have been used across private industry for some time and are becoming more common in higher education. The microcredential highlighted in this paper — a standalone graduate certificate program — aims to broaden access to graduate degrees in engineering and boost enrollment.

We demonstrate that introducing microcredentials in strategic areas of engineering significantly increased enrollment while expanding access. Over six years, we introduced 23 unique graduate certificate programs in engineering and other disciplines. During this period, the institution experienced a 33.03% increase in total graduate enrollment, averaging 5.51% per year. Graduate certificate programs contributed a net enrollment increase of 9300% (i.e., from one to 94 students) over the same six-year period and accounted for 6.46% of the total increase in graduate enrollment. Thus, enrollment in graduate certificate programs contributed to the institution's record graduate enrollment in each of the past two years.

Keywords: microcredentials, graduate certificate programs, strategic enrollment growth strategy for graduate engineering programs, expanding access to graduate engineering and other programs.

Introduction

Over the past few years, there has been increased interest in microcredentials of various types as evidence of competence in a particular field. Microcredentials come in many forms, including but not limited to digital badges, certifications sponsored by corporations or other organizations, and add-on and stand-alone undergraduate and graduate certificates, and provide a competitive advantage to individuals after completing a short course. These credentials can be used to quickly gain competence in rapidly changing or new technologies, customize an individual's education, stack to establish a new skill set, pursue another degree or credential, and span a multitude of industries and professions.

Because of the increasing interest in microcredentials, numerous studies have been published about the myriad of microcredentials, including digital badges, corporate certifications, and undergraduate and graduate certificate programs. Several reports describe digital badges [1,2,3,4], a type of microcredential awarded to individuals after completing a short course in fields such as healthcare and pharmaceuticals. These badges can be displayed on social media, in the signature of a person's email messages, and can be easily transmitted to others via the Internet. Another set of papers discusses the growth, demand, and topologies of corporate certifications and other general microcredentials [5,6,7]. The microcredentials of most interest to the authors of this paper are graduate certificate programs [8, 9], which are offered by many universities throughout the U.S. and the world.

A collection of recent publications reports on the effectiveness and the widespread use of digital badges throughout the country. In [10], the authors highlight the rapid growth in popularity of digital badges within the context of the new AI era. The paper points to rising interest in digital badges and microcredentials, noting the increase in publications on these topics. The popularity of microcredentials has been further enhanced by the recent COVID-19 pandemic, which caused a digital surge in higher education, leading to many rapid technological innovations and changes that were previously unthinkable. For institutions of higher education, the conceptualization and implementation of microcredentials to grow enrollment must be strategic to avoid the decoupling of traditional degrees and to engage stakeholders [1,11]. Post-pandemic needs among key stakeholders (e.g., students, educators, and employers) have increased the demand for accessible, flexible, and industry-aligned microcredential programs that offer alternative educational paths and enhance career readiness [12]. A study of employer perceptions of digital badges [13] was conducted among HR professionals to gather their opinions on digital badges as a method for authenticating employees' professional development. They noted that while digital badges offer opportunities to improve competency levels, the badge provider must be considered a credible source. Survey results demonstrated the badge's effectiveness in determining whether competencies were met.

Certifications offered by private corporations have long been popular, while other microcredentials are changing the nature of education. Many published reports, e.g., [5], include certifications in their systematic reviews of microcredentials, with some presenting analyses of the growth trajectories of popular microcredentials. One paper demonstrates the emergence of certifications and other microcredentials [6] at the very beginning of the post-pandemic era. Importantly, students were more positive in their evaluations of the benefits of microcredentials than employers were, which is probably why many corporations want to create their own certifications to ensure students are competent in using a particular new technology [7]. For students, certificates represent evidence of their achievement of employability skills and readiness for the job market [14].

Certificate programs in community colleges and at undergraduate and graduate schools are also being introduced to provide credentialing in various fields. For example, [13] presents stackable credentials in the context of postsecondary career education for community college students. A report published by the Council of Graduate Schools [15] concluded that graduate certificates are best understood as part of a larger ecosystem that includes graduate degrees. These credentials

are not alternatives to graduate degrees. These findings focused on graduate certificate programs, their relevance, and their comparison with master's degrees.

Taken together, the aforementioned reports provide solid evidence for the interest in and popularity of microcredentials for educational and professional advancement. However, a practical strategy for implementing microcredentials, specifically graduate certificate programs, for enrollment growth at HBCUs and other institutions of higher education in times of limited resources has not been addressed.

This paper builds upon work initially reported in publications by the Council of Graduate Schools [15,16] that demonstrates the advantages of using graduate certificate programs as microcredentials. The authors confirmed in these reports that graduate certificate programs can provide alternative pathways to graduate education for some students. They also found that these microcredentials can be used as tools for strategic enrollment growth in graduate programs. This paper validates the conjectures made in these previous reports.

Approach

Our structured and systematic approach to stand-alone graduate certificate programs grew organically from a practice piloted in the M.S. in Information Technology degree program—the largest master's program on campus at the time—which produced students with some of the highest grade point averages (GPAs) among graduate-level IT students. Instead of denying students admission to the master's degree program, students were advised to enroll at the university in post-baccalaureate studies (PBS, i.e., non-degree-seeking students) and to take two to three graduate courses offered by the master's program. The students were told that if they came back with A's in these courses, the grade point average from their enrollment in these courses would be the grade point average of record for their application for admission into the master's degree program. Their certificate GPA would supersede their undergraduate GPA. Because the admissions application process was used to determine whether students would be successful in a graduate program, and those PBS students demonstrated they could succeed at the master's level by earning A's, they were admitted to the master's degree program. We discovered that after several years of implementing this pilot approach, this population of students became accustomed to getting A's in their graduate courses. Students who entered the program through this approach had some of the highest GPAs in the master's degree program. The pilot program formed the basis for our stand-alone graduate certificate programs.

Historically, our institution primarily offered add-on graduate certificates available only to students enrolled in degree-seeking programs. However, in 2019, we shifted our program offerings to include post-baccalaureate certificates for non-degree-seeking students. Stand-alone graduate certificate programs were created to serve at least three populations of prospective graduate students:

1. Post-baccalaureate students seeking personal improvement in a specific area without enrolling in a degree-seeking program,
2. Prospective students who were not admissible to master's programs due to various reasons, including low cumulative GPA, and

3. Prospective students who did not have an earned bachelor's degree in the discipline of interest.

As summarized in Table 1, we used stand-alone graduate certificates as a pathway to increase the admissibility of applicants who might not otherwise have access to graduate education.

Certificate students are expected to complete 12 credit hours and are held to the same academic standards as master's students. Importantly, we ensured that the stand-alone graduate certificate programs aligned with relevant university policies, including those governing the use of credit hours taken while in non-degree-seeking status, GPA, and academic eligibility requirements.

Table 1. Summary of Admission Criteria and Requirements of Graduate Certificate Programs

Category	Requirement
Admission Criteria	Minimum cumulative GPA of 2.0 out of 4.0 in a completed bachelor's program
Total Credits Required	12 credit hours (4 courses, 3 credits each) • Core Courses: 2 courses (6 credit hours) • Technical Electives: 2 courses (6 credit hours)
Grade Requirement	Students are strongly encouraged to earn a grade of B or better in graduate courses. Otherwise, they run into challenges in being admitted to a master's program.
Graduation Requirement	Must earn a minimum GPA of 3.0 out of 4.0
Applicability to Master's Degree	Up to 12 credit hours may be applied toward a related master's degree program (subject to program approval)

Our graduate certificate programs are designed to be more affordable, as we are a public institution with lower tuition than private institutions, and domestic students enrolled in these programs can receive financial aid. For planning purposes, when each *stand-alone* graduate certificate program is about to be launched, we submit an application for program approval to the U.S. Department of Education. In our application to the Department of Education, we must demonstrate that students who earn these microcredentials can be gainfully employed. Once approved, domestic students enrolled in the graduate certificate program are eligible for financial aid. Recently, the Department of Education also began requiring universities to report the return on investment for these programs, so students are aware of the earning potential of these microcredentials before they enroll.

Our approach involved introducing stand-alone graduate certificate programs to grow enrollment, as they offer several advantages over add-on programs. Firstly, students submit applications to *stand-alone* programs via the standard graduate admissions portal (Figure 1). Rather than being turned away, students who do not meet the admission requirements are given the option to apply for and ultimately enroll in a stand-alone graduate certificate program in the same field. Hence, students enrolled in these programs are included in the institution's overall graduate enrollment reported on enrollment verification day each year. While an *add-on* certificate is a credential that benefits students, students enrolled in these programs do not

contribute to overall enrollment growth; they can be counted only once. Hence, our priority has been to introduce new *stand-alone* graduate certificate programs.

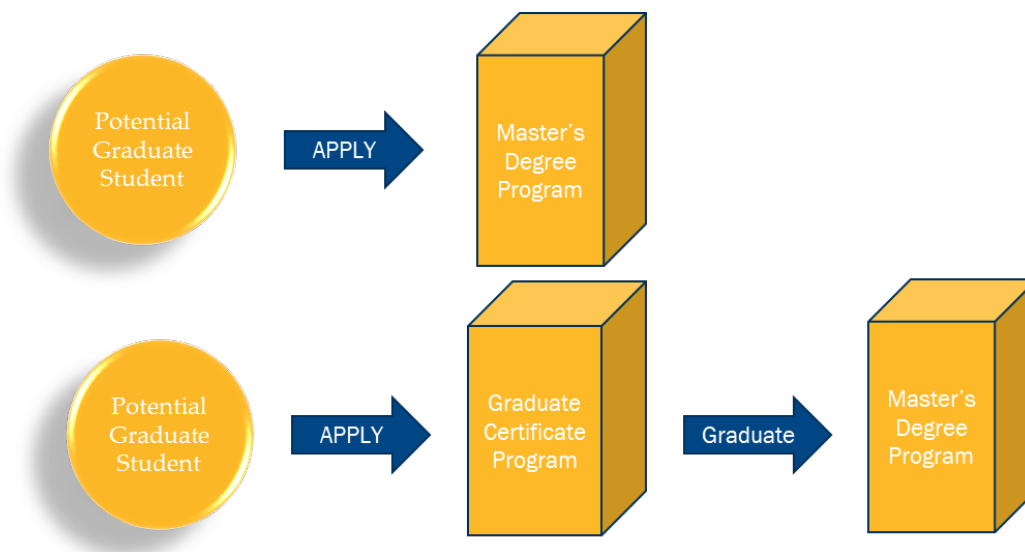


Figure 1: Graduate application process – from master’s to certificate program admission

After students complete the graduate certificate program, they can apply for admission to the master’s degree program using their most recent academic performance in the certificate program as an indicator of potential success in the master’s degree program. The vast majority of students who have earned one of our graduate certificates and apply typically gain admission to the master’s degree programs. Thus, our graduate certificate programs provide an alternative pathway to graduate education for students whose academic profiles do not initially meet the requirements for admission to a typical master’s degree program.

We designed the microcredential intentionally such that graduate certificate credits earned may count toward another master’s degree or even a doctorate, and may also contribute to industry-related skills that can enhance employability. For example, certificate credits earned in the graduate certificate in Cybersecurity can be applied toward the M.S. degree in Cybersecurity. Because this certificate requires 12 credit hours, students completing it need only 18 additional credit hours (approximately 6 more courses) to fulfill the 30-credit-hour requirement for the M.S. degree. Because all credits earned in the graduate certificate program in Cybersecurity count toward the M.S. degree, students who do not meet the requirements for admission to the M.S. degree program can enroll in the graduate certificate program. Graduate certificate programs do not extend the length of getting a graduate degree, per se. Students can complete certificate programs at their own pace. A motivated student could complete a non-thesis master’s program in a calendar year if they complete the graduate certificate coursework in one semester and complete the remaining 18 credit hours over the course of the next semester and summer term. Thus, such a student could ultimately earn a certificate and master’s degree in the same time it would take to earn a master’s degree.

Our strategy is to deploy a new graduate certificate program to serve as a feeder program for new master's degree programs yet to be approved for launch. For example, because our institution is part of the state university system, it can start a new graduate certificate program without going through the extensive approval process for a new master's degree, which takes approximately 26 weeks. Our approach is to enroll students in a graduate certificate program while the institution is in the planning phase for a master's degree program. Each graduate certificate program serves as a feeder program for a future master's degree program. For example, we launched two graduate certificate programs, Cybersecurity and Data Analytics, in Fall 2020. We then began planning for two new master's degrees in these areas. While these new programs were interdisciplinary, spanning two or more colleges, they required more time to plan than traditional graduate programs. In Fall 2023, when we began these two new master's degree programs, we already had 20-25 students enrolled in each graduate certificate program. These students were waiting for the new degree program to begin; hence, there was no lag in enrollment in the new master's degree programs. From the day the new programs began, student enrollment was at a sustainable level.

Results and Discussion

In this study, we used stand-alone graduate certificate programs to drive strategic enrollment growth. Specifically, the stand-alone graduate certificates were intended for students interested in self-improvement and those who may not otherwise have access to a master's or doctoral program because they may lack the credentials for admission (e.g., not admissible to a master's program due to low GPA or lack of a bachelor's degree in the discipline). While the scope of the work primarily focused on removing barriers to graduate degrees in engineering and other STEM disciplines at a public HBCU, stand-alone credentials are broadly applicable to a myriad of disciplines and strategic graduate enrollment growth at institutions of higher education that offer graduate programs. Over six years, we introduced 23 stand-alone graduate certificate programs in areas including: Advanced Manufacturing, Advanced Materials, Autonomy, Cybersecurity, Data Analytics, Geographic Information Systems (GIS), Environmental Engineering, Environmental Health and Safety, Environmental Justice, Environmental Science, Micro and Nano Devices, STEM Entrepreneurship, Systems Engineering, and Systems and Synthetic Biology. The success of these certificate programs spurred the launch of additional programs in education, health care, business, and supply chain management. We report the impact of stand-alone graduate certificate programs on graduate enrollment and increasing access to graduate degrees in engineering. We report the costs of introducing new graduate certificate programs and the benefits and challenges of our approach.

Graduate certificate programs were promoted to prospective students through a myriad of activities, including recruitment campaigns (in-person and virtual) and during admission application processing for applicants who were not admissible to degree-seeking programs. Certificate program enrollment and conferral data were tracked annually (from Summer II, Fall, Spring, and Summer I terms) and collected through our institutional and statewide university system records; data are de-identified and presented in aggregate.

Figure 2 shows total graduate enrollment at our institution from 2019 to 2025. In 2019, we had 1,517 students enrolled, which increased to 2,018 in 2025. We experienced record enrollment for

the past two years (2024 and 2025). These data represent a 33.03% increase in graduate enrollment over six years, an average annual increase of 5.51%. The introduction of graduate certificate programs accounted for 6.46% of the total enrollment gain.

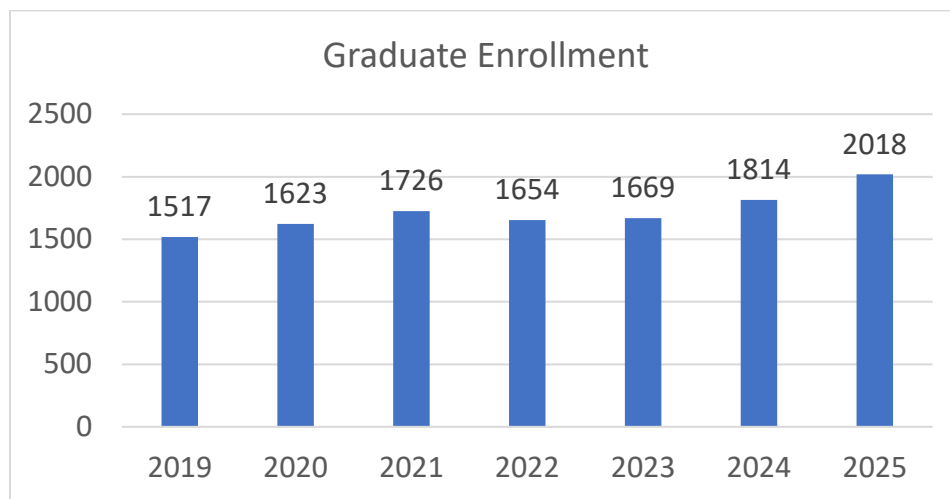


Figure 2: Total graduate student enrollment (2019 – 2025).

Figure 3 shows enrollment in *stand-alone* graduate certificate programs from 2019 to 2025. During that time, we introduced 23 new certificate programs. Enrollment grew from a single student in a certificate program in 2019 to 94 students in 2025, a net increase of 93 students over six years. This represents a 9300% increase in graduate certificate enrollment, averaging 1550% per year. The peak certificate enrollment over this timeframe was 98 students in 2024.

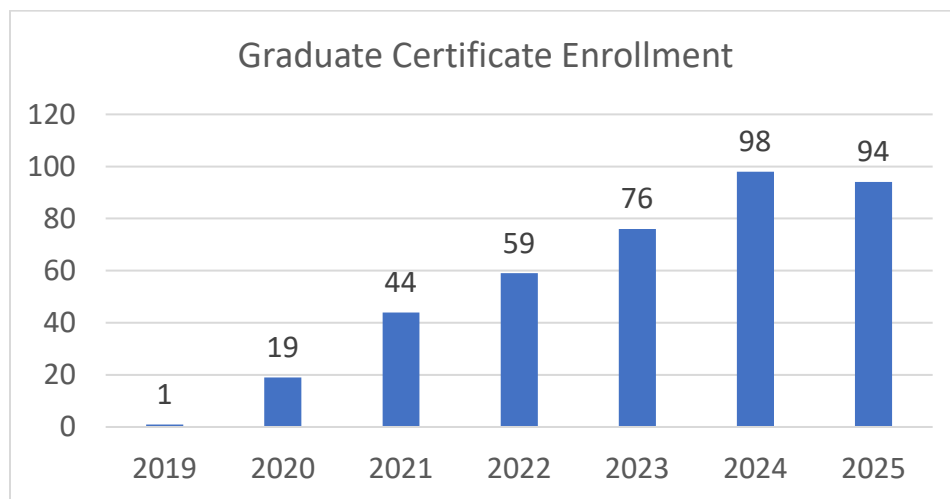


Figure 3: Stand-alone graduate certificate enrollment (2019 – 2025).

When we drill down to student demographics, our graduate certificate enrollment has been primarily in-state students (Figure 4). The financial cost of earning a stand-alone graduate certificate is modest because our institution is a public HBCU. To begin, the cost per credit hour for our graduate certificates is highly competitive, regardless of delivery mode, as our institution has been ranked the most affordable doctoral research university in the U.S.[17,18,19] for three

consecutive years (2023–2025) by Money magazine. As previously mentioned, our institution does not offer funding (i.e., graduate assistantships or fellowships, tuition, fees, or health insurance) to students enrolled in certificate programs. However, domestic students enrolled in these programs can receive financial aid from the federal government by submitting their Free Application for Federal Student Aid (FAFSA) form. Even though tuition at a public HBCU is affordable and the number of credit hours required to complete the certificate is about 40% of that in typical master's programs, at private institutions, costs associated with earning a graduate certificate can be excessive and prohibitive for many students. It is also important to note that funding to add faculty positions to teach program courses is typically not required, as certificate program students take the same courses as master's degree students.

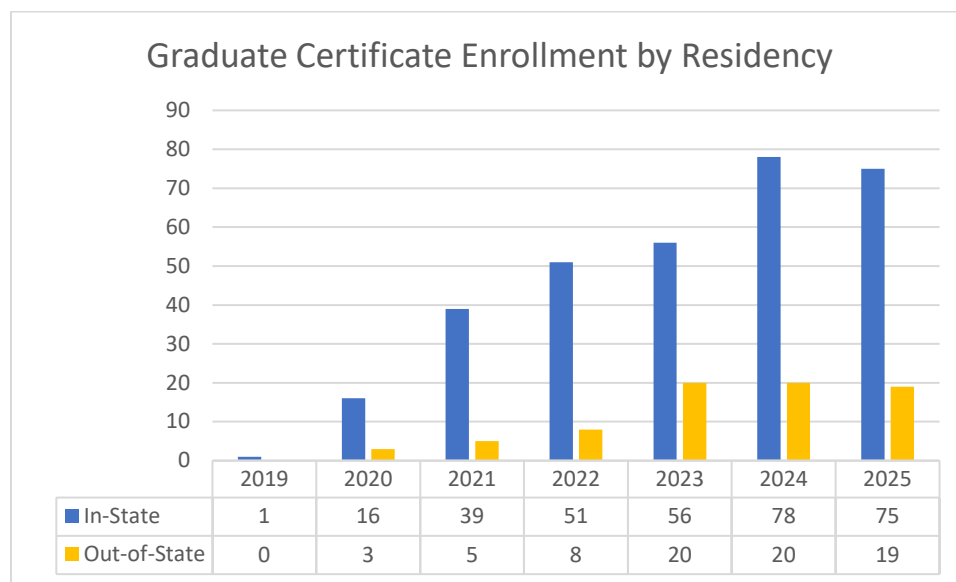


Figure 4. Stand-alone graduate certificate enrollment by residency (2019 – 2025).

Our microcredentials offer an option for student-athletes with additional years of eligibility to compete. A few years ago, the NCAA passed legislation allowing student-athletes to enroll in non-degree-seeking graduate programs during their years of eligibility. Previously, these student-athletes had to be enrolled in degree-seeking programs, posing challenges for institutions in identifying graduate programs in which each student-athlete met the admission requirements. Figure 5 depicts student-athlete enrollment since establishing our first stand-alone graduate certificate program in 2019. Now, students have access to a broader array of graduate degree options. For example, many student-athletes are attracted to our M.B.A. program, but some do not meet the admission requirements. Now, these students can enroll in a graduate certificate program in General Business Management, and as long as they maintain their grades, they can ultimately earn the M.B.A. they have dreamed of.

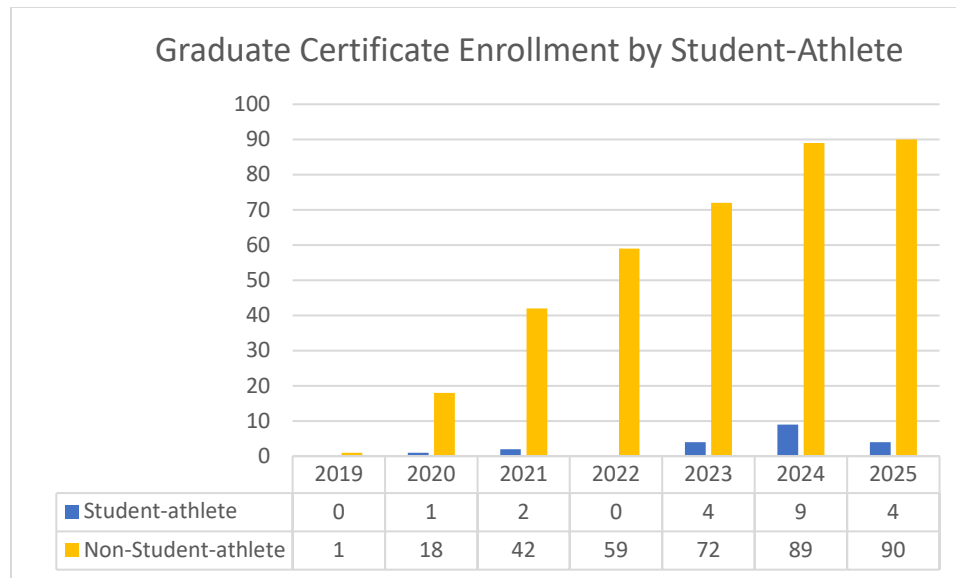


Figure 5. Graduate certificate enrollment by student-athlete (2019 – 2025).

Table 2 summarizes the STEM-related stand-alone graduate certificate programs established at our institution, the year each program enrolled its first cohort, the certificates conferred, and current enrollment. To maintain a relevant focus on engineering education and STEM-related disciplines, additional non-STEM graduate certificate programs, offered by the institution, are not included in the table.

Our focus on establishing graduate certificate programs was to expand access to graduate education for students from underserved groups or those underrepresented minoritized (URM) groups. As shown in Figure 6, the vast majority of students enrolled in our graduate certificate programs are from minoritized populations, with most of those students identifying as female (Figure 7). In light of the Supreme Court decision ruling that institutions cannot use race in admissions, universities can offer students who have been historically marginalized and students from underserved groups entry into graduate programs through graduate certificate programs. This use of a graduate certificate program as a mechanism to increase admissibility removes the need to lower program admission requirements or to make special accommodations for these students as a part of the application process. Minoritized students are given a chance to succeed in graduate school regardless of their previous academic performance in college, low standardized test scores, or other metrics used in traditional admissions processes. If these students demonstrate they can complete graduate-level courses and maintain the minimum grade point average required for graduation, they may continue their pursuit of graduate degrees.

Although the enrollment data are encouraging, it is important to acknowledge several limitations of the study. Although some students who were not initially eligible for a degree-seeking program enrolled in our graduate certificate programs, the study did not investigate the root causes of their enrollment. For instance, the establishment of our graduate certificate programs coincided with significant developments in our nation and around the world, including the U.S.

Table 2. Summary of STEM-related graduate certificate programs, certificates conferred and current enrollment

Certificate Program	In UNC System API	Year Established	Certificates Conferred (Fall 2019 - Spring 2025)	Current Enrollment (Fall 2025)
Advanced Manufacturing	Y	2026	0	0
Advanced Materials	Y	2023	0	1
Autonomy	Y	2022	2	0
Cybersecurity	Y	2020	108	24
Data Analytics	Y	2020	38	10
Data-Driven Modeling and Analysis of Complex Systems	Y	2023	2	0
Family and Consumer Sciences	Y	2019	1	1
Geographical Information Systems (GIS)	Y	2024	0	2
Human Lactation	Y	2020	37	13
Interdisciplinary Environmental Certificate (4 concentrations)	N	2020	8	3
• Environmental Health and Safety	Y	2020	3	1
• Environmental Engineering	Y	2025	0	1
• Environmental Justice	Y	2021	3	1
• Environmental Sciences	Y	2022	2	0
Micro and Nano Devices	Y	2024	0	1
STEM Entrepreneurship	Y	2024	1	0
Supply Chain Management	Y	2023	1	0
Systems and Synthetic Biology	Y	2022	1	2
Industrial Systems Engineering	Y	2024	0	3
Totals	--	--	207	63

UNC System Academic Program Summary: [Academic Program Inventory \(API\)](#)

Certificates Conferred Source: [NCAT Degrees Awarded: Trends by Major - Tableau Server](#)

Certificate Enrollment Source: [NCAT Enrollment: Major Trend - Tableau Server](#)

Supreme Court ruling that effectively ended affirmative action in higher education (in 2023) and the COVID-19 pandemic and post-pandemic era (2019-present). We also lack sufficient employment outcomes data for students who earned certificates. However, with time (e.g., 5- and 10-years post-award), we expect to be able to perform causal analysis to ascertain meaningful employment outcomes. Despite these limitations, the work presented herein demonstrates that stand-alone graduate certificate programs are a bona fide way to increase admissibility to degree-seeking programs, particularly for students classified as URM, and grow enrollment.

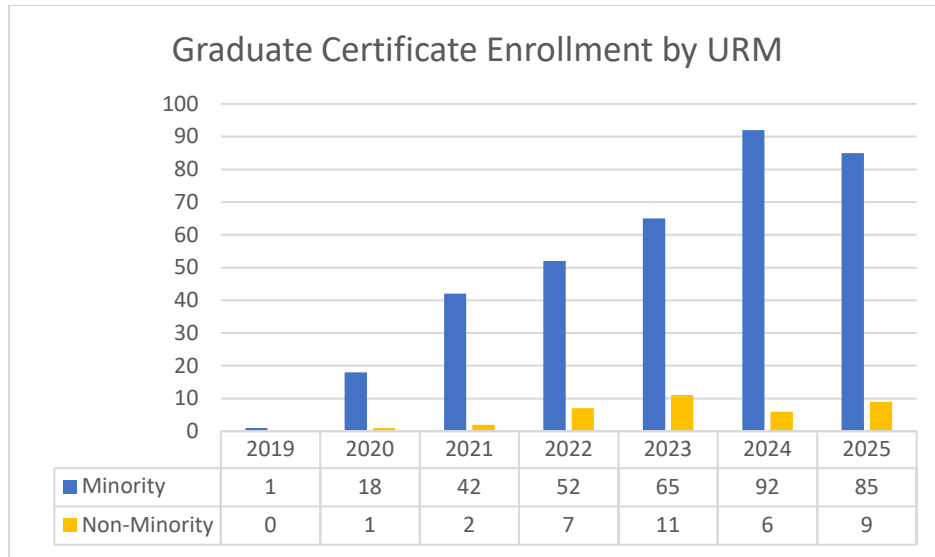


Figure 6. Graduate certificate enrollment by underrepresented minoritized populations (2019 – 2025).

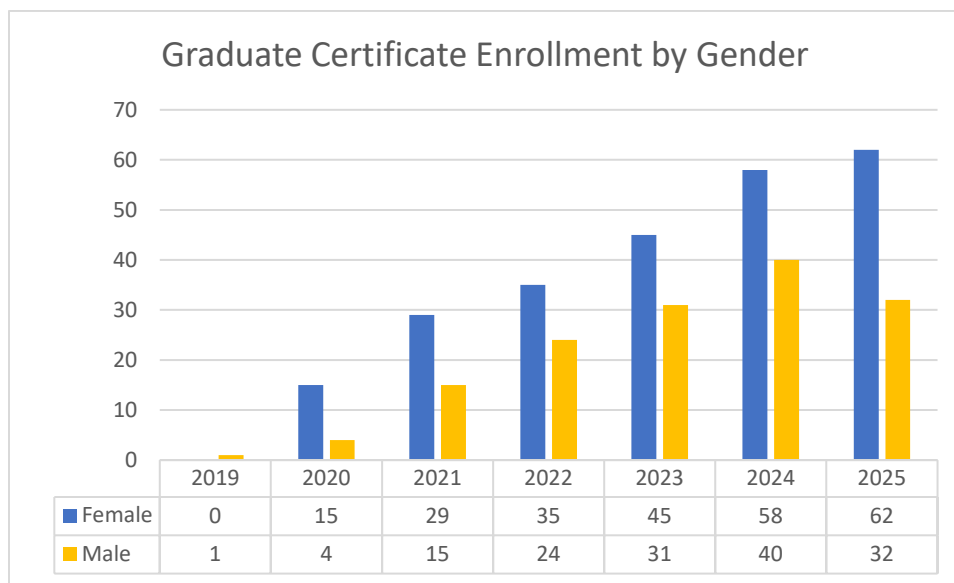


Figure 7. Graduate certificate enrollment by gender (2019 – 2025).

Conclusion

In conclusion, institutions of higher education that are interested in creating and using microcredentials, such as the stand-alone graduate certificates reported in this study, to grow enrollment must ensure that their certificate programs align with stakeholder needs, university policies, and meet accreditation standards, as applicable. Our strategic use of microcredentials, particularly stand-alone graduate certificates, has contributed to steady enrollment growth in engineering and related STEM fields, while making graduate education possible for underserved student populations without diminishing access to quality education. Evidence demonstrating how microcredentials directly contribute to employment outcomes, employer hiring decisions,

and learners' return on investment is still emerging. However, our institution plans to continue offering and expanding its portfolio of stand-alone certificate programs to meet the workforce-readiness needs of students and employers, while remaining cost-effective and fast-paced.

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