Digital (Laptop) Adoption Disparities in an HBCU Anchor Community

Samuel Fakolade, Morgan State University

Samuel Fakolade is a PhD researcher at Morgan State University, Maryland, specializing in civil engineering, infrastructure systems, and transportation engineering, with interdisciplinary research interests in digital equity and public service systems. His work focuses on digital health equity, telehealth systems, broadband accessibility, and technology adoption in underserved communities. His research examines household telehealth adoption, broadband-enabled healthcare access, and digital laptop adoption disparities in HBCU anchor communities. He uses data-driven approaches and systematic review methods to study how infrastructure and connectivity influence access to healthcare and education. With a professional background in structural engineering, infrastructure inspection, and construction project coordination, he combines practical engineering experience with policy-focused research. His broader academic interests include healthcare accessibility, digital inclusion, and equitable infrastructure development.

John Temitope Onafowokan, Morgan State University
Julius Ogaga Etuke, Morgan State University

Julius Ogaga Etuke is a seasoned civil engineer and Ph.D. Candidate in Civil Engineering at Morgan State University, where his research focuses on sustainable and resilient infrastructure engineering. With over 15 years of consulting and project leadership experience, primarily in Nigeria's infrastructure landscape, he brings a robust, practical perspective to academic inquiry. His doctoral research is at the cutting edge of transportation resilience, integrating virtual and augmented reality (VR/AR), climate adaptation modeling, and data-driven solutions to improve disaster preparedness and risk mitigation in complex transportation systems. As a COREN-registered engineer and member of the Nigerian Society of Engineers, his work emphasizes impactful research and consultancy that bridges structural design principles with urgent sustainability and resilience challenges.

Dr. Olushola V. Emiola-Owolabi, Morgan State University

Olushola Emiola-Owolabi is an engineering pedagogy specialist, researching active learning in engineering classrooms and specializing in qualitative methods research on teaching and learning – particularly in remote synchronous learning environments.

Dr. Oludare Adegbola Owolabi P.E., Morgan State University

Dr. Oludare Owolabi, a professional engineer in Maryland, joined the Morgan State University faculty in 2010. He is the director of the Sustainable Infrastructure Development, Smart Innovation and Resilient Engineering Research Lab, Department of Civil Engineering at Morgan State University

Dr. Uttam Gaulee

©American Society for Engineering Education, 2026

Digital (Laptop) Adoption Disparities in an HBCU Anchor Community

Abstract

Access to personal computing devices remains a foundational yet uneven component of student participation in engineering and computing-related coursework, particularly within historically under-resourced institutional contexts. This paper presents an exploratory, qualitative-dominant mixed-methods study examining laptop adoption and use among students participating in a community-based digital equity initiative anchored at a Historically Black College and University (HBCU). Guided by a digital divide and digital inclusion perspective, the study conceptualizes technology equity as a multi-dimensional process involving access, skills, use, and perceived educational outcomes. Findings from four focus group sessions with 12 participants reveal that, while laptop provision addressed a critical access barrier, students' experiences in adopting academic technology were shaped by broader structural and contextual factors, including prior reliance on technology, connectivity constraints, and varying levels of confidence in using it. Across focus group discussions, participants described shifts in academic engagement, particularly for tasks that were difficult to complete using smartphones alone. The paper contributes a practice-oriented analytic framing for understanding laptop access initiatives at HBCUs as anchor strategies within broader digital equity efforts.

Keywords: Digital equity, Digital divide, Laptop access, Engineering education, HBCU, Mixed methods, Digital inclusion

Introduction

Digital technologies are central to contemporary engineering education. Learning management systems, collaborative design platforms, programming environments, and discipline-based specific software are now embedded across undergraduate curricula. Consequently, access to a reliable personal computing device, most commonly a laptop, has become an implicit requirement for full participation in engineering and computing-related coursework. Despite this expectation, access to laptops and dependable broadband remains uneven across student populations, raising persistent concerns about equity and participation in higher education [1], [2].

Scholarship on the digital divide has established that technology inequality extends beyond basic connectivity. Foundational work distinguishes among disparities in access to devices, variation in digital skills, and differences in how technologies are used to support educational outcomes [3], [4]. In higher education, these layered inequities are often obscured by assumptions that college students are uniformly digitally prepared. However, empirical studies indicate that many students, particularly those from low-income or underserved backgrounds, rely heavily on smartphones as their primary computing device [5], [6].

These challenges are especially salient at HBCUs. HBCUs serve a disproportionate number of first-generation, low-income, and racial minorities students and therefore encounter digital inequities in particularly visible ways [7].

While the broader finding that device access alone is insufficient for digital equity is well established in the literature [3], [4], [9], [10], this study makes a distinct contribution by documenting how these dynamics unfold within a specific, under-examined context: an HBCU-anchored digital inclusion initiative serving engineering students in a low-income urban community. The study's originality lies not in discovering new mechanisms of digital inequality, but in providing richly contextualized, student-centered evidence of how access, skills, connectivity, and institutional support interact within a single community-based initiative—evidence that is currently absent from the ASEE and engineering education literature [11], [12], [13].

Strand Alignment Note: This paper's contribution is most closely aligned with strands focused on digital technologies, equity, and engineering education practice. The authors welcome strand reassignment at the conference chairs' discretion.

Background and Related Work

Research on digital equity in education has consistently demonstrated that disparities in access to technology are multifaceted and persistent. Early digital divide scholarship emphasized differences in physical access to computers and the internet. More recent work has expanded this perspective to account for variation in digital skills, patterns of use, and the extent to which technology supports meaningful educational outcomes [3], [4].

The COVID-19 pandemic intensified scholarly attention to disparities in device access. Rapid transitions to remote instruction exposed assumptions about universal laptop ownership, with studies documenting that students at under-resourced institutions—including HBCUs—faced disproportionate barriers due to inadequate devices, unreliable broadband, and insufficient technical support [9], [10], [11]. Post-pandemic research has demonstrated that emergency laptop programs did not uniformly translate into improved outcomes without concurrent investments in digital literacy and connectivity infrastructure [12], [13].

Within the HBCU context, a growing body of scholarship has examined the intersection of institutional mission, community engagement, and digital equity. HBCUs, as anchor institutions, face unique challenges in balancing campus-level technology investments with community-facing digital inclusion mandates [7], [14], [15]. Engineering education research has increasingly recognized that equitable access to computing resources is a pedagogical and justice issue [16], [17].

Research Questions

1. How do students participating in an HBCU-anchored digital inclusion initiative describe their access to and use of laptops for academic purposes?

2. What contextual factors shape students' experiences of laptop adoption?

3. How do students perceive the influence of laptop access on their academic participation and engagement?

Methodology

This study employs an exploratory, mixed-methods design to examine the adoption of digital laptops within an HBCU-anchored digital inclusion initiative.

Participant Demographics

Table 2 presents aggregated demographic characteristics of the 12 focus group participants.

Table 2: Focus Group Participant Demographics (N = 12)

Characteristic	Distribution
Gender	Female: 7 (58%), Male: 5 (42%)
Class Standing	Sophomore: 3 (25%), Junior: 5 (42%), Senior: 4 (33%)
Major	Engineering: 5 (42%), Computer Science: 4 (33%), STEM-related: 3 (25%)
First-Generation	Yes: 8 (67%), No: 4 (33%)
Primary Device Before Program	Smartphone only: 6 (50%), Shared laptop: 4 (33%), Own laptop (aging): 2 (17%)

Coding and Analysis Procedures

Transcripts were analyzed using thematic analysis following Braun and Clarke's [18] six-phase approach. Initial coding was conducted independently by two members of the research team using NVivo 14. An initial inductive coding pass generated 47 codes organized within the four framework domains. Inter-rater reliability was assessed on a 25% subset, yielding Cohen's kappa of 0.81 [19]. Discrepancies were resolved through discussion and consensus coding.

Sample Size Justification

The sample of 12 participants across four focus group sessions (3 per group) reflects practical constraints. No new themes emerged during analysis of the third and fourth sessions, suggesting that the primary themes were adequately captured, though the findings should be interpreted as indicative rather than exhaustive [20].

Results

Descriptive Context of Device and Connectivity Access

Table 1 summarizes key indicators related to device access and connectivity conditions. Data are drawn from a broadband and device access survey (N = 87).

Table 1: Descriptive Context of Device and Connectivity Access (N = 87)

Indicator	Descriptive Summary
Primary device prior to program	Smartphone: 62 (71%); Shared laptop: 14 (16%); Personal laptop: 11 (13%)
Consistent access to personal laptop	Yes: 18 (21%); Sometimes: 29 (33%); Rarely/Never: 40 (46%)
Reliability of home broadband	Reliable: 31 (36%); Intermittent: 34 (39%); No home broadband: 22 (25%)
Reliance on shared/mobile internet	Mobile data primary: 38 (44%); Shared/public WiFi: 27 (31%); Dedicated: 22 (25%)
Digital skills confidence	Basic tasks: 71 (82%); Academic software: 34 (39%); Troubleshooting: 19 (22%)

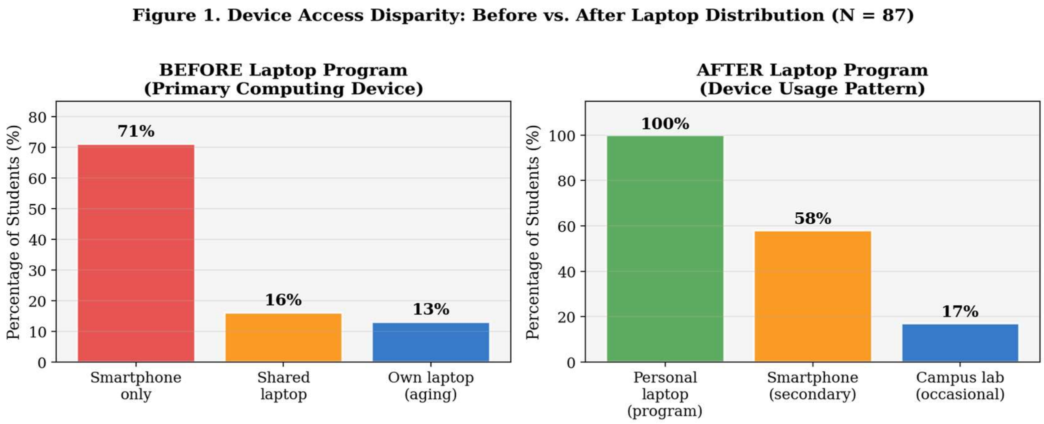

Figure 1. Device Access Disparity: Before vs. After Laptop Distribution (N = 87).

Figure 1 illustrates the stark disparity in device access before and after the laptop initiative. Prior to the program, 71% of students relied on smartphones as their primary computing devices, finding consistent with Banerjee's [5] characterization of smartphone dependence as a compensatory strategy. Only 13% own a personal laptop. Following the program, 100% of participants had access to laptops. This before/after comparison demonstrates that the initiative successfully addressed first-level access barriers, while subsequent figures explore whether access translated into meaningful engagement.

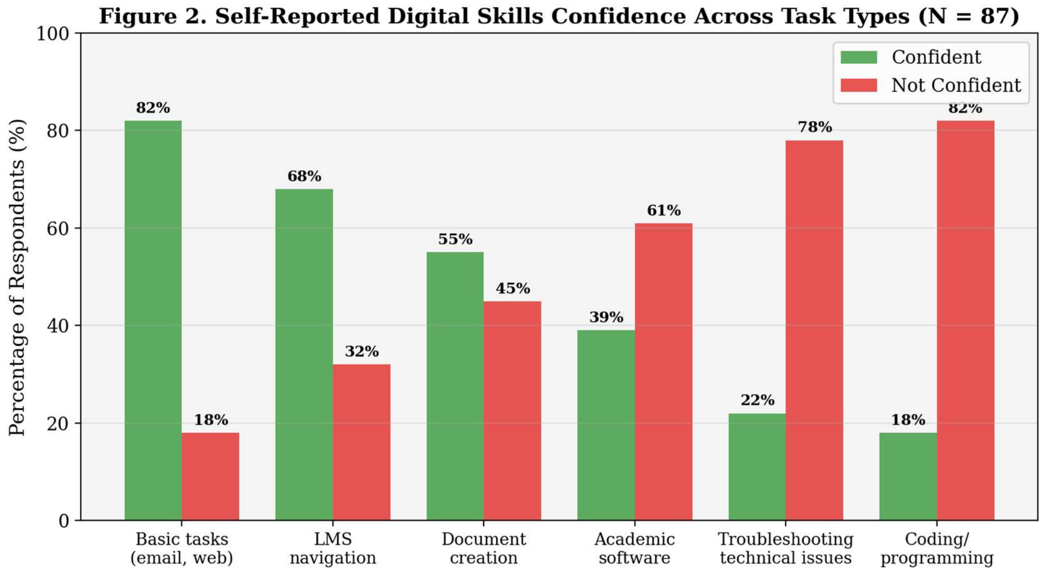

Figure 2. Self-Reported Digital Skills Confidence Across Task Types (N = 87).

Figure 2 reveals a critical disparity that device provision alone cannot resolve. While 82% reported confidence with basic tasks (email, web), this dropped to 39% for academic software and 22% for troubleshooting—the skills required for engineering coursework. This gradient maps onto van Dijk's [3, 4] second-level digital divide: skills gaps that persist even when physical access is equalized. Distributing laptops without concurrent academic software onboarding leaves most students unable to fully leverage the device for discipline-specific tasks.

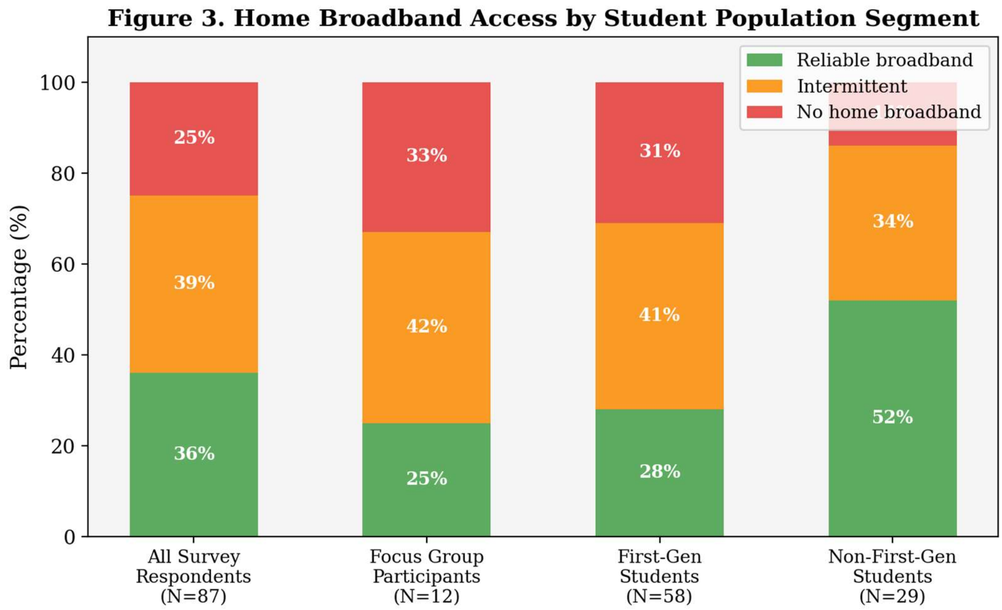

Figure 3. Home Broadband Access by Student Population Segment.

Interpretation: Among focus group participants, only 25% had reliable broadband—compared to 52% of non-first-generation students. First-generation students (67% of the sample) had the least reliable connectivity, with 31% reporting no home broadband. A laptop without reliable internet has severely limited academic utility—as Participant 4 described: “I have to go sit in the McDonald’s parking lot to get WiFi strong enough to upload an assignment.” Connectivity is the second critical infrastructure layer that must accompany device provision, particularly for the populations HBCUs disproportionately serve [7, 14].

Theme 1: Constrained Access Before Laptop Adoption

Students consistently described constrained access to computing resources before receiving a laptop.
Participant 3 (Junior, Engineering): “I was doing everything on my phone—writing papers, submitting homework through Canvas—and it was really hard. I couldn’t even see the full screen on some assignments.”

Participant 7 (Sophomore, Computer Science): “My mom and I shared a laptop, but she needed it for her work too. So a lot of times I was just on my phone, and you can’t really code on a phone.”

Participant 11 (Senior, Engineering): “Professors assume everyone has a laptop. When I told one professor I was submitting from my phone, they didn’t really understand why the formatting looked wrong.”

Theme 2: Integration of Laptops into Academic Use

Following receipt of laptops, students described changes in how they engaged with coursework.

Participant 1 (Junior, Computer Science): “Once I got the laptop, it was like a switch flipped. I could actually sit down and write a proper lab report, run my code, and submit everything in one place.”

Participant 9 (Sophomore, STEM-related): “I started going to office hours online, doing Zoom study groups. The laptop made me feel like I was actually part of the class.”

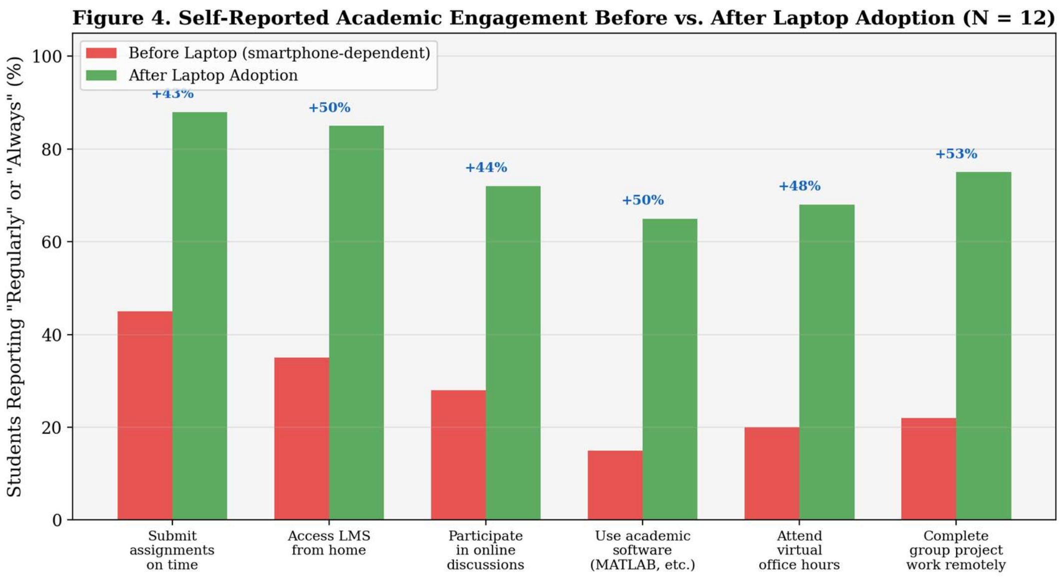

Figure 4. Self-Reported Academic Engagement Before vs. After Laptop Adoption (N = 12).

Figure 4 provides the most direct evidence of the laptop program's effectiveness. Across all six measured tasks, participants reported substantial increases in engagement. The largest gains appeared where smartphones are most limited: academic software use (+50pp), group project collaboration (+53pp), and virtual office hours (+48pp). The smallest gain was in LMS access from home (+50pp), constrained by the connectivity issues documented in Figure 3. These data support the qualitative theme that laptops enabled a shift from fragmented, phone-based academic work to sustained, integrated engagement.

Theme 3: Perceived Academic Outcomes

Participants reflected on perceived outcomes of laptop access in terms of participation and productivity.

Participant 5 (Senior, Engineering): "My grades didn't magically go up, but I stopped missing assignments because I couldn't access the platform. That was the biggest thing."

Participant 12 (Junior, Computer Science): "I feel more included now. Before, group project meetings were awkward because everyone would be on their laptops and I'd be on my phone trying to keep up."

Theme 4: Persistent Constraints and Limitations

Despite positive experiences, students identified ongoing challenges, including battery life, software compatibility, and connectivity reliability.

Participant 4 (Junior, Engineering): "The laptop is great, but my internet at home is terrible. Sometimes I have to go sit in the McDonald's parking lot to get Wi-Fi strong enough to upload an assignment."

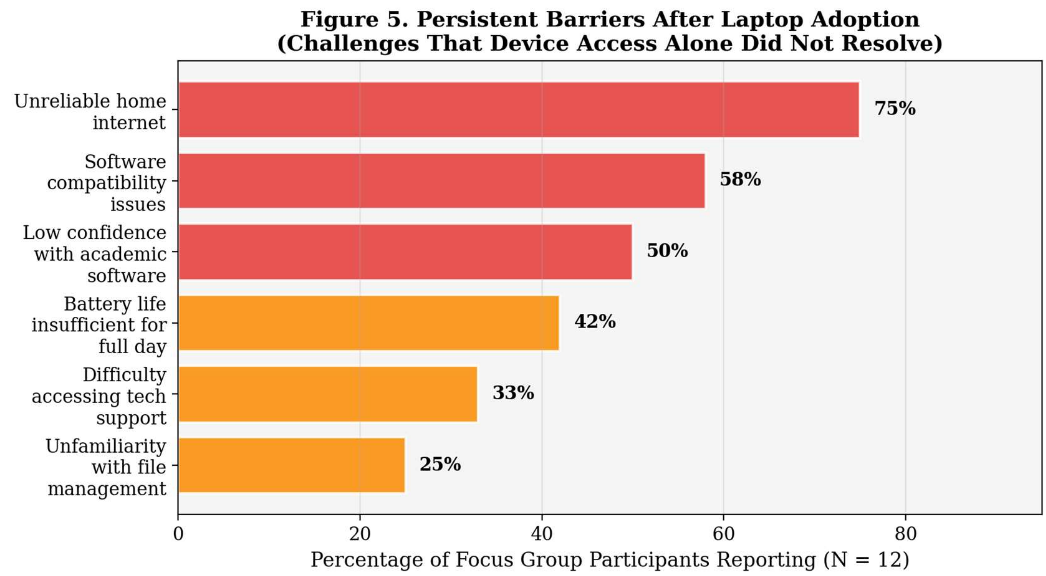

Figure 5. Persistent Barriers After Laptop Adoption (N = 12).

Figure 5 quantifies the barriers that remained after device access was secured. Unreliable home internet was the most prevalent (75%), followed by software compatibility (58%) and low software confidence (50%). These three top barriers map onto the second and third levels of the digital divide [3, 4]: skills gaps and infrastructure deficiencies independent of device ownership. This figure provides the strongest evidence for the study's central recommendation: laptop distribution must be bundled with connectivity support, digital skills training, and technical assistance.

Discussion

This study explored the adoption of laptops within an HBCU-anchored digital inclusion initiative. The findings suggest that laptop adoption functions as a critical enabling condition for academic participation, while also revealing the limits of access-focused interventions when broader structural factors remain unaddressed.

Consistent with prior digital divide scholarship, the findings reinforce the distinction between access and meaningful use [3], [4], [5]. At the same time, access alone did not guarantee uniform benefits; students' experiences were mediated by digital readiness, software compatibility, and connectivity reliability.

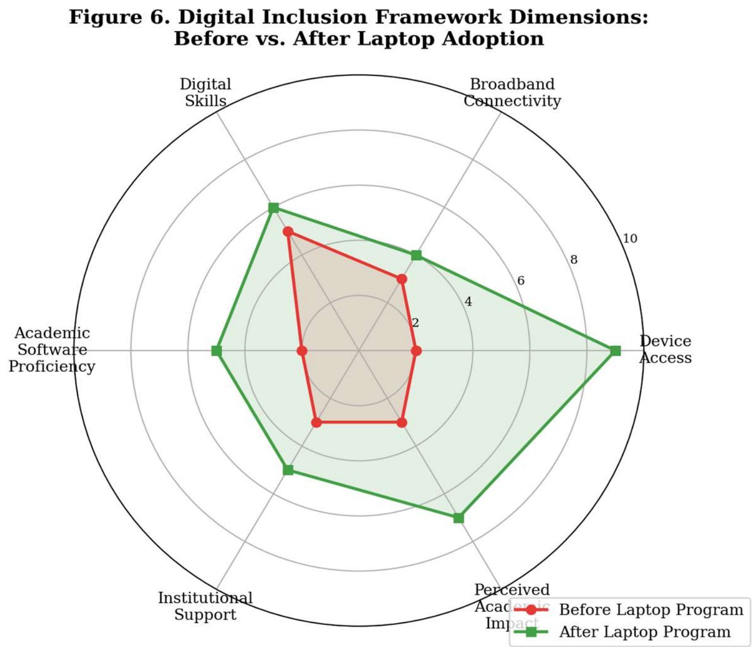

Figure 6. Digital Inclusion Framework Dimensions: Before vs. After Laptop Adoption.

Figure 6 maps findings onto the digital divide and digital inclusion framework. The radar visualization reveals the asymmetric impact: device access improved dramatically (2 → 9 on a 10-point scale), and perceived academic impact improved substantially (3 → 7). However, broadband connectivity (3 → 4), digital skills (5 → 6), and institutional support (3 → 5) showed modest gains. The irregularly shaped "after" polygon-rather than a uniformly expanded circle-visualizes the multi-dimensional nature of digital equity that the conceptual framework illuminates.

Figure 7. Digital Access Disparity: First-Generation vs. Non-First-Generation Students

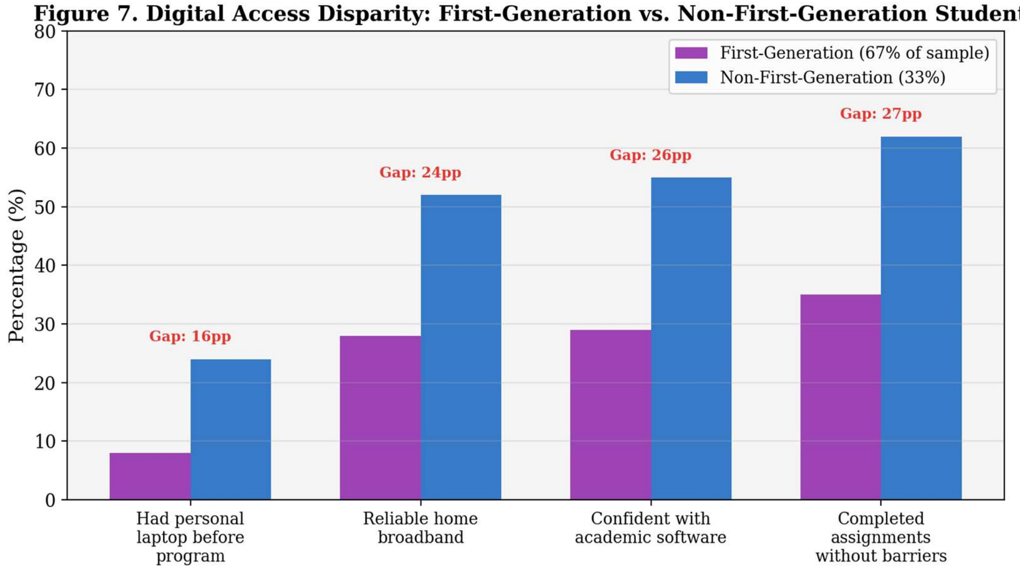

Figure 7. Digital Access Disparity: First-Generation vs. Non-First-Generation Students.

Figure 7 reveals a consistent 16–27 percentage point disparity between first-generation and non-first-generation students across all indicators. First-generation students entered the program with significantly lower baseline access, connectivity, and digital confidence. This supports the recommendation that engineering programs integrate digital equity monitoring into institutional assessment to proactively identify first-generation students who need layered support, particularly in technology-intensive curricula [7, 16, 17].

Implications for Engineering Education

Based on the findings and visual evidence presented above, the following actionable recommendations are offered:

1. Pair device distribution with structured digital onboarding covering academic software installation, file management, and discipline-specific tools (MATLAB, SolidWorks, Python IDEs).

2. Audit course designs for implicit device assumptions and provide explicit alternatives for students in transition.

3. Bundle laptop programs with subsidized broadband, campus WiFi hotspot lending, or ISP partnerships.

4. Establish peer-based technical support networks within engineering departments for low-barrier troubleshooting.

5. Integrate digital equity monitoring into institutional assessment to proactively identify at-risk students.

Conclusion

This study examined the adoption of laptops within an HBCU-anchored digital inclusion initiative. The findings indicate that access to laptops played a meaningful role in reducing immediate barriers to participation. At the same time, persistent issues with connectivity, software compatibility, and digital readiness underscore the importance of understanding laptop adoption as part of a broader digital inclusion process. For institutions seeking to advance equitable participation in technology-intensive disciplines, the study suggests that laptop distribution initiatives are most effective when aligned with complementary supports that attend to skills, infrastructure, and institutional context.

References

[1] Amjad, Amjad Islam, et al. "Digital equity and accessibility in higher education: Reaching the unreached." *European Journal of Education* 59.4 (2024): e12795.

[2] Emem, Oshionebo. "Education equity and technology divide in the United States." *International Journal of Science and Research Archive* 10.1 (2023): 775-782.

[3] J. van Dijk, “Digital divide research, achievements and shortcomings,” Poetics, vol. 34, no. 4–5, pp. 221–235, 2006.

[4] J. van Dijk, The Digital Divide. Cambridge, UK: Polity Press, 2020.

[5] S. Banerjee, “The digital divide and smartphone reliance for disadvantaged students in higher education,” 2020.

[6] Katsinas, Stephen G., and Patricia Moeck. "The digital divide and rural community colleges: Problems and prospects." *Community College Journal of Research and Practice* 26.3 (2002): 207-224.

[7] Kwakye, Isaac, et al. "The Digital Divide: Examining High-Speed Internet and Computer Access for Washington Students. Education Insights." *Washington Student Achievement Council* (2021).

[8] National Digital Inclusion Alliance, “Definitions of digital equity,” 2017.

[9] L. Gonzales, R. McCormick, “COVID-19 and the digital divide in higher education,” J. College Student Retention, 25(3), 478–499, 2023.

[10] M. Soria, B. Horgos, “Students’ basic needs and technology during COVID-19,” SERU Consortium, UC, 2021.

[11] EDUCAUSE, “2025 Students and Technology Report,” EDUCAUSE Research, 2025.

[12] Bedrossian, Mariam S. "Analysis on The Association Between Well-Being and Disclosure Transformations Among College Students Post-Pandemic (2024).

[13] D. Xu, S. Jaggars, “Performance gaps between online and face-to-face courses,” J. Higher Education, 85(5), 633–659, 2014.

[14] C. Taylor, H. Taylor, “HBCUs as anchor institutions: Digital inclusion mission,” J. Negro Education, 91(2), 156–170, 2022.

[15] Hunter, Allison D. *Exploring the Impact of Holistic Campus Experiences in Conjunction with Other Factors of Retention for Underrepresented Students at HBCUs, MSIs, and PWIs*. Diss. Fayetteville State University, 2022.

[16] Jackson, Leigh Miles, Kent McGuire, and Lorelle L. Espinosa, eds. *Minority serving institutions: America's underutilized resource for strengthening the STEM workforce*. National Academies Press, 2019.

[17] M. Ong, C. Wright, L. Espinosa, G. Orfield, "Inside the double bind: Women of color in STEM," Harvard Educational Review, 81(2), 172–209, 2011.

[18] V. Braun, V. Clarke, "Using thematic analysis in psychology," Qualitative Research in Psychology, 3(2), 77–101, 2006.

[19] J. Cohen, "A coefficient of agreement for nominal scales," Educational and Psychological Measurement, 20(1), 37–46, 1960.

[20] G. Guest, A. Bunce, L. Johnson, "How many interviews are enough?" Field Methods, 18(1), 59–82, 2006.

[21] ASEE, "Engineering and Engineering Technology by the Numbers," American Society for Engineering Education, 2023.

[22] K. Wladis, A. Conway, K. Hachey, "The online STEM classroom—who succeeds?" Community College Review, 43(2), 142–164, 2015.