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Advancing Workforce Readiness through Digital Equity and Technical Training: Evidence from an NTIA-Funded Program at an HBCU

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Abstract

The post-pandemic era underscored the growing demand for entry-level information technology (IT) professionals and government funding for digital equity, making technical training at Historically Black Colleges and Universities (HBCUs) more crucial. Leveraging a systematic literature review on technical education and workforce readiness at Historically Black Colleges and Universities (HBCUs), the evaluation assesses an initiative funded by a federal agency that aims to bridge the digital divide by providing underrepresented students with high-performance hardware and industry-standard technical education.

The research adopts a mixed-methods approach across three cohorts (2024–2025). Quantitatively, a pre/post design is used to assess changes in digital skills, career readiness, and early economic outcomes. Qualitatively, focus groups and interviews provide insight into how participants experience the training and navigate structural barriers.

Findings from the first cohort show strong completion and certification outcomes, with all completers earning at least one industry-recognized credential and a portion securing immediate employment in technical roles. Overall, the results highlight the importance of combining infrastructure access, credential-based training, and institutional support in shaping workforce readiness. This study contributes to the literature by emphasizing outcome-based evaluation metrics and offering a practical framework for assessing the workforce impact of digital equity investments across HBCUs and other minority-serving institutions.

Keywords: Technical Training, Technical Education, Vocational Training, Career Readiness, Workforce Readiness, HBCUs

1 Introduction

1.1 Background

The unexpected phenomenon of the Covid-19 pandemic, which necessitated the switch to fully digital services such as education and telehealth, exposed a digital divide in broadband connectivity, digital education, and device availability to millions of people in underserved households and communities. The NTIA Internet Use Survey (2023) reported that 83% of people in the United States used the internet, up from 80% in 2021 and 79% in 2019. This shows steady improvement in the digital divide through the adoption of internet and broadband connectivity since 2019 [1,2].

In response to the digital divide revealed by the pandemic, the Digital Equity Act of 2021 was enacted to address the problem of Americans lacking the tools and technology to use the internet, by promoting diverse digital inclusion projects, especially for low-income households. The Act yielded two major Federal grants, totaling $2.75 million, administered by the National Telecommunications and Information Administration (NTIA) [3].

In the contemporary global economy, the transition toward a fully digitized labor market has redefined the parameters of professional success and socioeconomic mobility. Workforce readiness is no longer merely a function of degree attainment but increasingly depends on equitable access to advanced technology and mastery of technical skills aligned with rapidly shifting industrial demands. The ability to integrate artificial intelligence, cloud computing, and big data into the core of every sector has become a fundamental requirement for entry into high-growth career paths [4].

However, the digital divide continues to marginalize students from underrepresented and economically disadvantaged backgrounds. In bridging the digital divide, digital equity initiatives focus on affordability, digital education, and serviceability [5]. These federal infrastructure investments are not limited to broadband access, internet connectivity, or device availability, but also to strengthening the technical workforce for national engineering and technological competitiveness. [6, 7].

The NTIA Internet Use Survey (2019) underscores the gravity of this divide. While 82% (remained steady 82% in 2019 and increased to 84% in 2021) of white households have high-

speed internet, only about 75% (increased to 77% and 82% respectively in 2021 and 2023) of Black households do [1,2].

Historically Black Colleges and Universities (HBCUs) are uniquely positioned to bridge this gap. Despite representing only 3% of postsecondary institutions, HBCUs produce nearly 20% of all African American STEM graduates [8]. These institutions cultivate a nurturing, family-like atmosphere that specifically supports the academic and psychological success of traditionally underserved populations. By emphasizing a shared cultural identity and a sense of belonging, these institutions foster higher levels of academic motivation and persistence than predominantly white institutions [9]. Yet, the mission of HBCUs is frequently hampered by systemic underfunding and a lack of modern technical infrastructure, which limits their capacity to provide the high-level digital training required by today's employers [10,11,12].

Recognizing the strategic importance of these institutions in bridging the racial wealth and skills gap, a government agency launched significant initiatives to promote digital equity and expand technical training within minority-serving institutions. These federal programs are designed to move beyond mere hardware provision, focusing instead on ensuring that students possess both foundational digital literacy and the specialized, applied competencies required to thrive in a competitive, interconnected world. By equipping students with high-speed broadband infrastructure, industry-standard digital tools, and workforce-relevant training modules, these initiatives aim to create sustainable pathways for economic advancement [13].

This study examines the outcomes of an NTIA-funded program at a selected HBCU, investigating how these targeted investments influence student proficiency, confidence, and career trajectories. Through a mixed-methods analysis of program data, surveys, and participants' experiences, the research examines how digital equity interventions and structured technical training together strengthen workforce preparedness.

This study contributes to the literature on digital equity and workforce development by transitioning from input-based metrics, such as device distribution and connectivity, to output-based labor market outcomes, including certification attainment, job placement, and wage improvements. Moreover, it offers empirical evidence derived from an intervention conducted at a HBCU to inform policy formulation and evaluation frameworks.

1.2 Statement of the Problem

Despite the widespread integration of digital technologies across the U.S. economy, a significant "digital opportunity gap" persists among students at Historically Black Colleges and Universities (HBCUs) [1]. This gap reflects the intersection of systemic inequities in infrastructure, resource allocation, and workforce preparation, threatening the economic mobility of underrepresented learners. While digital access is often discussed in terms of device ownership, HBCU students usually face a more nuanced struggle with quality of access, characterized by disparities in bandwidth, software availability, and exposure to industry-standard learning environments [14]. These inequities impede students' ability to develop the advanced competencies required for a digital-first economy.

The problem is rooted in the reliability and relevance of access. Students at underfunded institutions frequently encounter aging campus networks and limited cloud computing infrastructure. Historical underfunding has produced tangible deficits that impact both the instructional environment and student opportunity structures [11]. Consequently, even when connectivity is present, HBCUs may lack the capacity to deliver experiential learning that mirrors the high-level platforms used by modern employers [15]. This creates a cumulative disadvantage, forcing students to compete in labor markets dominated by technical skills they were never positioned to acquire.

This gap is particularly consequential as industries pivot toward automation, artificial intelligence, and cloud-driven systems. The modern workforce demands fluency in networking, cybersecurity, and applied computing, competencies embedded in certification pathways such as CompTIA A+, Network+, and cloud vendor credentials [16]. Yet, there is a challenge of structural misalignment between student preparation and employer expectations.

While federal and philanthropic initiatives have expanded investments, there remains limited empirical evidence demonstrating long-term outcomes. Existing literature disproportionately emphasizes "input" metrics, such as funding levels or device distribution, rather than "output" measures tied to workforce transformation, such as certification attainment, job placement rates, and salary trajectories [17]. In the absence of rigorous evaluation, institutions risk deploying resources without identifying which interventions meaningfully strengthen employability [9].

The acceleration of technological change further exacerbates the problem. As generative artificial intelligence and data-driven automation reshape labor markets, the bar for readiness continues to rise. If training initiatives are not aligned with evolving trends, they risk becoming outdated, preparing students for declining roles rather than expanding ones [7].

Without intentional intervention, the digital divide becomes a mechanism for perpetuating socioeconomic inequality. Employers may overlook HBCU graduates due to reputation bias or limited recruiting relationships, even when graduates are competent [18]. If these students continue to lack structured access to high-quality training and employment pipelines, a critical segment of the workforce will remain underrepresented in sectors central to national innovation.

1.3 Research Questions

To address this gap, the study is guided by the following research questions:

1. How does participation in the government agency-funded digital equity and technical training program influence students' digital literacy and workforce readiness?
2. What institutional and structural factors facilitate or hinder the effectiveness of such programs within HBCU settings?
3. In what ways can lessons from this initiative inform broader strategies for promoting digital inclusion and sustainable workforce development across higher education institutions?

1.4 Objectives of the Study

This paper aims to:

1. Evaluate the outcomes associated with participation in government agency-funded digital equity and technical training programs on students' digital competencies and workforce readiness outcomes at Historically Black Colleges and Universities (HBCUs).
2. Examine institutional and structural factors within HBCU contexts that facilitate or impede the effective design, implementation, and sustainability of digital equity–focused technical training programs.
3. Synthesize evidence-based practices and lessons learned from the government agency-funded initiative to inform scalable strategies for advancing digital inclusion and strengthening technical workforce development pipelines across higher education institutions.

2 Methodological Framework

2.1 Research Design

This study adopts a mixed-methods research design to examine the association between digital equity and technical training initiatives and workforce readiness among students enrolled in a government-funded initiative implemented by a participating HBCU. The approach integrates both quantitative and qualitative methods to provide a comprehensive understanding of program outcomes and participant experiences.

Quantitative data were collected from institutional records and participant surveys across three program cohorts between 2024 and 2025. These data capture key measures, including digital literacy, program completion, career readiness, and post-training employment outcomes.

Qualitative data were gathered through semi-structured interviews and focus group discussions with program participants, instructors, and administrators. These narratives provide insights into the perceived value of curriculum content, barriers to digital access, and the contextual factors that shape skill development and employability outcomes.

Also, the pre/post evaluation is designed as a quasi-experimental study involving program participants to assess outcome associations, rather than as causal proof, due to operational limitations. This research examines the outcomes associated with participation in the program, taking into account the NTIA funding allocated to the participating institutions.

2.2 Data Sources

This study utilized three primary data streams to inform it, following the evaluation framework typically required for federal digital equity grants. Table 1 shows that the data were received from the participating HBCU that implemented the initiative.

Table 1: Data Sources

Data Sources	Data Stream
Program Administrative Records	Data on completion rates, industry certification attempts (e.g., CompTIA), and job placement metrics.
Survey Instruments	Pre/post indicators measuring digital skill confidence and technical competency growth
Qualitative Narratives	Participant and faculty interviews, focus group discussions, and program curriculum review.

2.3 Participants and Sampling

The target population consists of students enrolled in the NTIA-funded technical training program at the participating HBCU. Enrollment is voluntary and consists primarily of undergraduate and recent graduate students from academically and economically underserved populations. Across three pilot cohorts (Summer 2024–Spring 2025), the total program sample comprises 35 enrolled individuals, limiting the generalizability of the findings.

2.4 Participants Application

The participating HBCU established a partnership with a non-profit technical training institute to provide the technical training. The institute oversees the student application and enrollment process, as shown in Figure 1, which includes an online application, virtual interview, virtual information session, online classes, and possible job placement.

Figure 1: Participants Application Process

2.5 Data Collection Procedures

The data collection process was designed by the participating HBCUs' implementation team to meet the federal agency's evaluation requirements, ensuring alignment between program

institutional reporting and student support goals. The procedure follows a structured, three-phase timeline that integrates assessment with the strategic provision of resources.

Phase I: Baseline Assessment and Resource Provision

During the initial intake, all enrolled participants complete a pre- intervention survey. This instrument captures baseline data on digital literacy, technical exposure, and workforce readiness. This ensures data integrity before the intervention and guarantees that every student has the necessary tools for the technical curriculum.

Phase II: Formative Program Monitoring

Throughout the training period, the implementation team maintains administrative records to monitor program fidelity. These "input" metrics track student engagement and the delivery of the program curriculum.

Phase III: Post-Program Evaluation and Completion

The final stage occurs upon completion of the instructional modules. Participants complete a post-intervention survey, which serves as a formal indicator of program completion.

3 Theoretical Framework

3.1 Human Capital Theory

Human Capital Theory (HCT) serves as the primary economic lens for this study, positing that education and training are deliberate investments that increase an individual's "stock" of knowledge and skills, thereby enhancing their productivity and lifetime earnings [19,20]. This is evidenced in Figure 2. Rather than treating education solely as personal advancement, the theory conceptualizes training inputs—such as access to industry-standard hardware and credential-aligned instruction—as capital investments intended to increase productivity and earnings potential within the broader labor market.

Figure 2: Human Capital Theory

In the context of HBCUs, HCT is used to analyze the skills gap and the rate of return on technical training. When HBCUs align their curricula with high-growth sectors like biomanufacturing or data science, they are effectively upgrading the human capital of a demographic that has historically been relegated to low-wage labor sectors [9]. This theory helps explain the 5.9% increase in demand for HBCU graduates, as employers increasingly view these institutions as vital sources of high-value, specialized human capital [18]. However, HCT also highlights the "depreciation" of capital that occurs when students lack access to the latest state-of-the-art equipment or industry-standard software due to institutional underfunding [15].

Recent workforce development scholarship extends this logic to non-degree credentials and short-term technical training, demonstrating that industry-recognized certifications can function

as labor market signals that improve employability and wage outcomes [21]. Within publicly funded digital equity initiatives, hardware provision represents a productive capital input, while certification attainment reflects formalized capital accumulation.

From this perspective, digital equity investments are evaluated not only by connectivity metrics but by their capacity to generate economically productive workforce outcomes.

3.2 Social Empowerment Theory

While HCT views the student as an economic actor, Social Empowerment Theory views the student as a member of a marginalized community gaining the agency to challenge systemic inequities. Empowerment is defined as a process by which individuals gain mastery over their lives and participate effectively in their community's life [22].

For HBCU students, technical training is not merely a path to paycheck; it is a process of Psychological Empowerment. The presence of Black faculty and mentors in technical fields helps students overcome "imposter syndrome" and build a resilient professional identity [23,24]. At the Organizational level, HBCUs act as empowering settings that provide social capital—networks, peer support, and institutional backing—that mitigate the "isolation" often felt by Black students at predominantly white institutions. Finally, SET suggests that by producing technical experts, HBCUs provide Community Empowerment, enabling graduates to address technical challenges within their own communities, such as digital deserts or healthcare disparities [15].

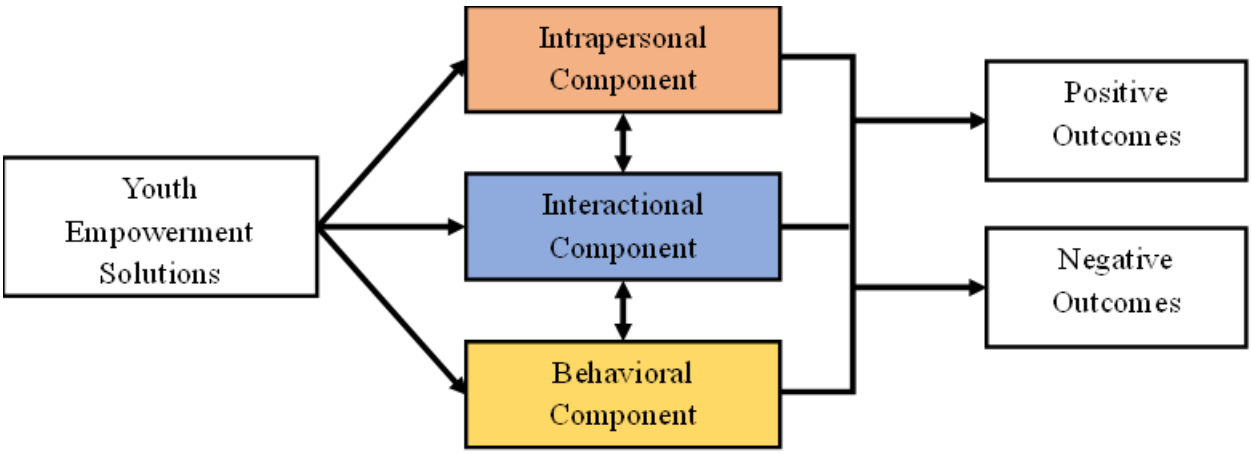

Figure 3: Social Empowerment Theory

4 Results and Discussion

4.1 Results

The following results present a comprehensive analysis of the NTIA-funded technical training initiative at a participating HBCU. By integrating quantitative metrics from program administrative records with qualitative insights from participant focus groups, this section examines the program's outcomes in bridging the digital divide and enhancing workforce readiness for HBCU students.

Table 2: Summary of Program Outcomes

Metric	Value
Total participants	35
Received laptops	19 (54%)
Completed program	28 (80%)
Certified	28 (100% of completers)
Job placement (Cohort 1)	44%

Program Overview and Curriculum

The technical training program utilizes a dual-certification strategy, which aims to align participant skills with industry-recognized standards. The program curriculum is primarily built around industry-recognized credentials that provide both foundational digital literacy and specialized technical proficiency. By integrating these certifications, the program ensures that participants meet the rigorous standards expected by top-tier employers.

Table 2 outlines the primary certifications offered through the technical training program, detailing the focus areas and the specific workforce roles they prepare students to occupy.

Table 3: Program Certification

Program Focus	Certification Name	Provider	Workforce Role/Outcome
Foundational IT	**CompTIA A+**	CompTIA	Entry-level IT Support, Help Desk Technician, and Field Service Technician.
Foundational IT	**IT Fundamentals+ (ITF+)**	CompTIA	Pre-career validation of basic IT knowledge and hardware/software troubleshooting.
Cybersecurity	**Security+**	CompTIA	Cybersecurity Analyst, SOC Tier 1, and Network Security Support.
Professional Skills	**Google IT Support Professional Certificate**	Google	Validates end-to-end IT support skills, including networking and OS management.
Digital Fluency	**CompTIA Tech+**	CompTIA	Validates the foundational technical literacy required for any modern professional role; industry successor to ITF+.

Impact on Student Digital Literacy and Technical Competency

The primary research question regarding the program's influence on technical proficiency is addressed through the "access-to-attainment" pipeline depicted in Figure 3. Data from the program's administrative records indicate that of the 35 participants enrolled, 19 (54%) received a new computer device to address infrastructure disparities.

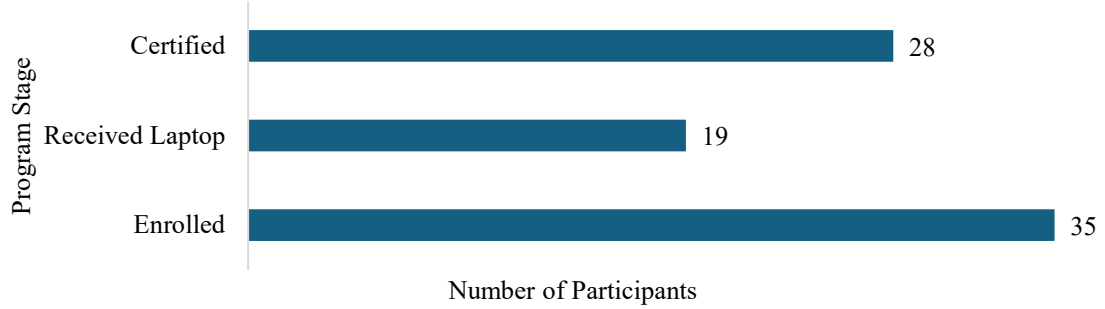

Figure 3: Participant Progression from Enrollment to Certification

This hardware provision appears to have supported skill development, as 28 students completed the program, all of whom earned at least one certification, including Google IT Support and CompTIA Tech+, shown in Figure 4. Over 6 students earned more than one certification, with all certified students completing Google IT Support.

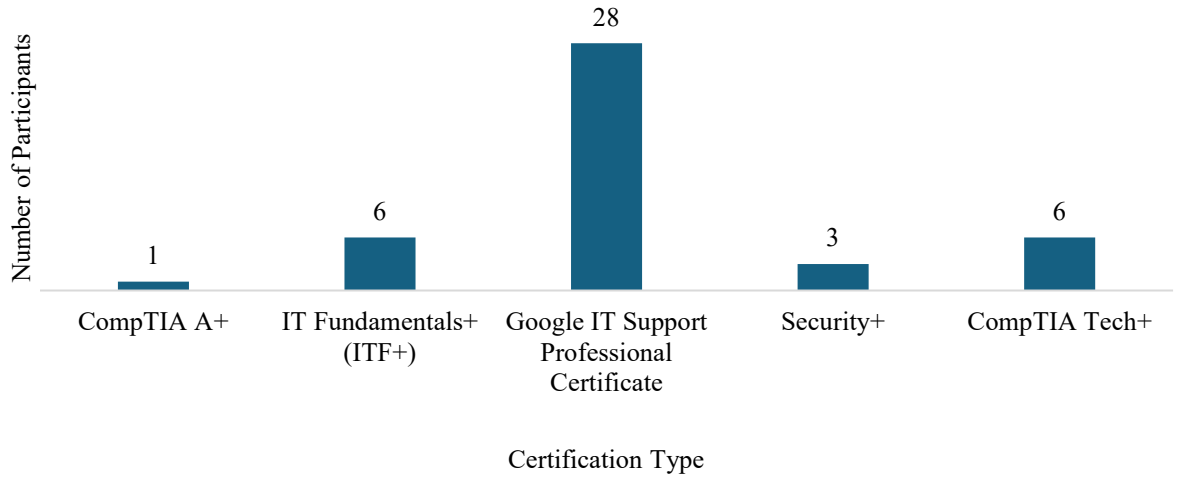

Figure 4: Distribution of Certifications Earned by Participants

Within this pool, seven students of the participating HBCU were specifically tracked, four of whom have already completed the program and achieved full certification. Qualitative feedback supports these metrics, as students expressed that the laptops' superior speed and features were essential for running the higher-standard software required for their technical assignments.

4.2 Workforce Readiness and Economic Outcomes

The transition from academic training to economic participation is illustrated in the performance and placement trends shown in Figure 5. This data reflects the practical application of Human Capital Theory, as participants converted their newly acquired credentials into tangible labor market value. In the first cohort alone, four out of nine graduates (44%) secured immediate job placements in technical roles at diverse organizations, including the IT Department and Gas and Electric.

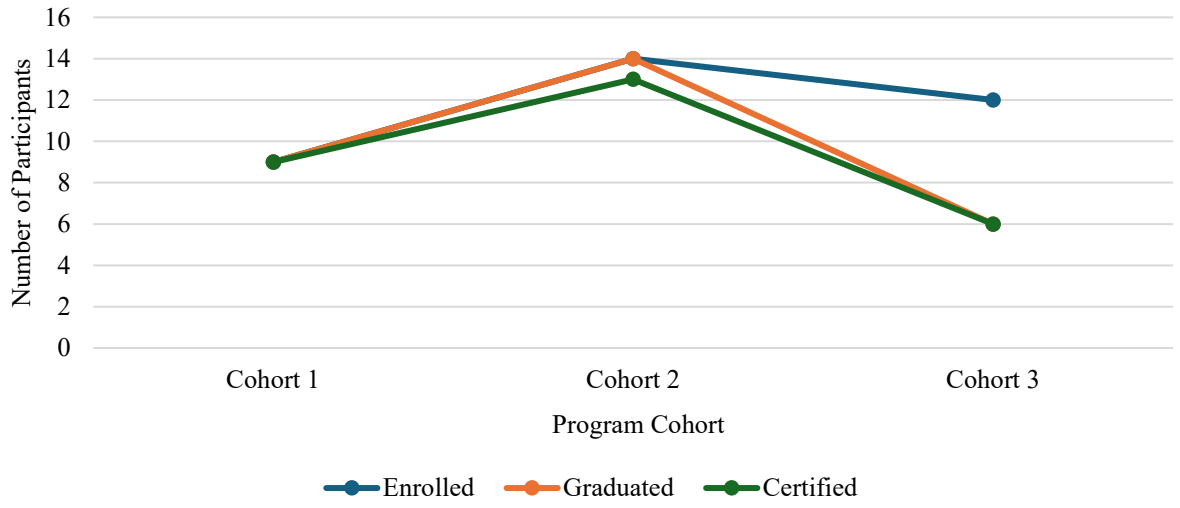

Figure 5: Cohort-Level Enrollment, Completion, and Certification Trends

The economic impact of program participation is notable, with program data showing an average salary increase of 336% for employed participants provided by the program directors, although this estimate may be influenced by a small sample size and outliers. This is consistent with the expected return on human capital investment, in which targeted skill acquisition increases labor market productivity and earnings. Participant interviews further highlight the psychological component of workforce readiness; individuals who previously had "no clear vision" of their career now maintain specific five-year goals, such as becoming cyber managers or executive directors of digital literacy programs. This evidence suggests that combining hardware access with industry-standard certification creates a sustainable pipeline for integrating HBCU talent into high-growth technical sectors.

4.3 Institutional Factors and Structural Support Mechanisms

The effectiveness of the program within the HBCU context is heavily influenced by "wrap-around" support services designed to mitigate the structural barriers identified in Figure 6. Analysis of the services provided reveals that technical training cannot succeed in a vacuum; the program addressed at least 6 unique types of structural hurdles, with resource referrals, food assistance, and financial assistance being the most frequent interventions.

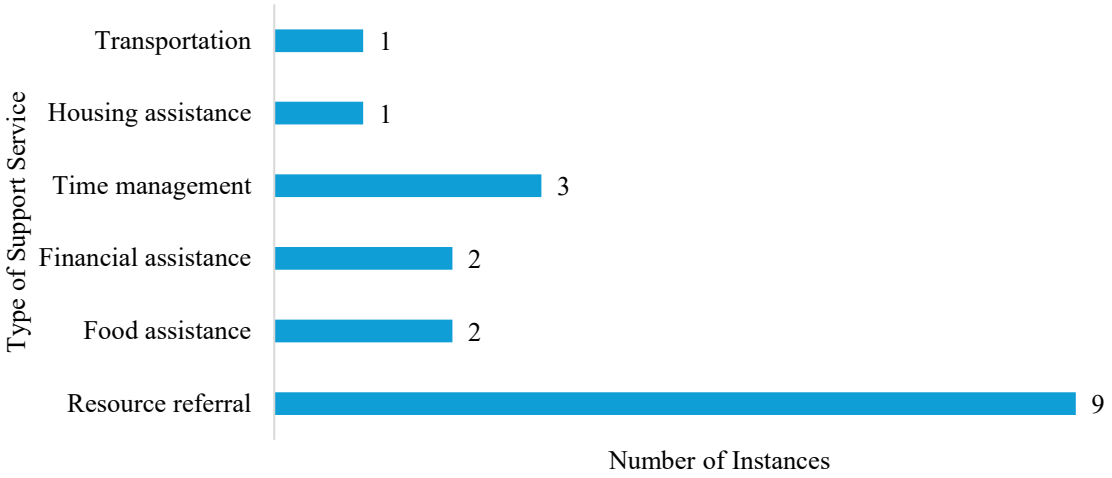

Figure 6: Types and Frequency of Structural Barriers Addressed

The social support manager for the technical program is typically tasked to meet with each trainee at least 3 times throughout the program to check-in and make sure any resources they need are provided and any barriers they have are addressed. The social support manager oversees accessing, collating, communicating, and providing access to the wraparound support services for the participants.

These supports align with Social Empowerment Theory, as they provide the stability necessary for students to transition from a state of being "humbled by poverty" or "stagnant" to a state of academic agency. Qualitative data from focus groups reinforces the importance of these institutional factors, with participants noting that the hardware made accessing resources like Canvas and Zoom significantly easier than using tablets or phones. While technical issues were minimal, the lack of awareness of secondary benefits, such as Comcast promo codes, suggests that institutional communication remains a factor that can hinder overall program effectiveness. Although poor communication occurred due to participants' lack of eligibility or the absence of prior email communication, the strategy will be to ensure that all participants receive an email with the eligibility criteria, regardless of eligibility, alongside constant reminders.

4.4 Discussion

The discussion of these findings suggests that digital equity at Historically Black Colleges and Universities (HBCUs) is a multifaceted achievement that requires addressing infrastructure, psychological, and economic barriers simultaneously. From the perspective of Human Capital

Theory, certification attainment signifies the formal acquisition of skills that augment labor market productivity and wage prospects [19,21]. The observed job placements and salary enhancements align with this theoretical framework. Concurrently, Social Empowerment Theory explains the observed qualitative outcomes, including increased confidence, career clarity, and persistence. The provision of wraparound support services and institutional resources serves as an enabling mechanism, facilitating participants' full realization of the benefits of technical training.

This investment in high-performance hardware provided the foundation for students to attain industry-recognized credentials, resulting in full certification among those who completed the program in Cohort 1. The subsequent average salary increase of 336% serves as a quantifiable return on educational capital investment, consistent with Human Capital Theory's assertion that targeted skill acquisition increases labor market productivity and earnings [19,21].

These findings extend beyond individual results, having wider implications for Engineering and Public Policy (EPP). Federal digital equity efforts, like those outlined in national broadband and workforce laws, serve as strategic investments in socio-technical infrastructure [6,13]. Traditionally, these initiatives are judged by input metrics such as the number of devices distributed, increases in broadband subscriptions, or the amount of grant funding spent. However, this research emphasizes the need to shift assessment focus toward output and performance metrics, such as certification achievements, job placements, and wage increases [17]. Framing hardware provision in terms of tangible labor market outcomes provides a potential framework for evaluating the return on public spending in technical workforce training [4].

From a policy perspective, workforce readiness can be conceptualized as a component of national infrastructure [4,7]. Like transportation or energy systems, it needs modernization to stay competitive. Developing the technical labor force requires targeted investments in credential-based training. The evidence indicates that effective policy must include three key elements: (1) access to high-quality hardware, (2) certifications validated by employers, and (3) institutional support to reduce structural obstacles [13,16]. Without combining these components, digital equity efforts may remain superficial access schemes instead of meaningful investments that boost productivity.

This economic perspective is complemented by the psychological change outlined in Social Empowerment Theory, where individuals transition from career stagnation to a sense of professional agency and mastery [22,23,24]. The focus group stories revealed an "identity shift" among participants who previously lacked a clear career direction or felt intimidated by the technology field. Providing a dedicated laptop eliminated the shared-resource barrier, enabling students to develop professional independence and a sense of belonging within the tech ecosystem. Also, wraparound services such as food and financial support, managed by a social support coordinator, demonstrate that engineering workforce policies must consider social stability as a foundation for technical success.

At the policy level, the study also tackles the challenge of aligning higher education with engineering labor market needs. It incorporates industry-recognized certifications like CompTIA Tech+ and Google IT Support into the program, creating a feedback loop between employer skill demands and curriculum development. This alignment enhances accountability in public spending by connecting funding directly to quantifiable improvements in workforce productivity [16,21].

Ultimately, these findings indicate that digital equity policy should be viewed not just as distributing devices, but as developing an engineered workforce system. When federal funding combines hardware access, industry-aligned credentialing, and structural support, underrepresented institutions can achieve swift economic mobility. In this approach, HBCUs become more than recipients of public funds; they play a vital role in enhancing national engineering competitiveness and fostering inclusive innovation.

4.5 Limitations of the Study and Recommendation for Future Research

While the findings offer promising evidence of workforce and economic advances, certain limitations should be considered and highlight areas for future Engineering and Public Policy research. First, the study uses a quasi-experimental pre/post design without a control or matched comparison group, which restricts the ability to draw causal conclusions [20]. Also, salary data only shows short-term results after the program and might not indicate long-term career growth or wage consistency. Even though analytically significant improvements and employment outcomes are reported, future studies could include randomized or matched comparison groups

across various institutions to improve causal inference and help develop evidence-based federal funding strategies.

Second, the sample size (n = 35) across three cohorts limits external validity. Conducting a multi-institutional study involving several HBCUs or minority-serving institutions would help policymakers evaluate scalability and differences in implementation success. This comparative analysis would offer more robust guidance for developing national digital equity funding and setting performance benchmarks.

Third, salary outcomes reflect early post-program employment data and do not capture long-term career mobility, wage persistence, or advancement trajectories. Longitudinal tracking over three to five years would enable future studies to assess whether initial certification gains translate into sustained economic mobility for evaluating the true return on public human capital investments.

Finally, because the initiative is embedded within a federally funded digital equity framework, replication may depend on sustained public investment and institutional capacity. This raises important questions regarding optimal grant design, accountability metrics, and cost-effectiveness thresholds for publicly funded technical workforce programs. Future research should explore cost–benefit analyses, funding allocation models, and comparative ROI across different digital equity interventions to inform more efficient engineering workforce policy design.

These limitations highlight the need for a more robust evaluation linking digital infrastructure funding to measurable labor market outcomes. By addressing these gaps, future Engineering and Public Policy scholarship can strengthen the empirical foundation for designing equity-centered workforce investments that advance both national competitiveness and inclusive economic mobility.

5 Conclusion

This study provides evidence that addressing the digital divide at Historically Black Colleges and Universities (HBCUs) requires more than expanding connectivity; it requires designing coordinated systems that link infrastructure access, industry-aligned credentialing, and structured institutional support. The government-funded initiative examined in this research illustrates how digital equity investments can function as productive human capital upgrades when intentionally aligned with workforce demand [19]. The documented certification attainment rates and substantial post-program salary gains provide measurable evidence that targeted technical training, supported by high-performance hardware, may contribute to economic mobility for underrepresented students.

Beyond institutional impact, the findings contribute to broader public policy discourse by reframing digital equity initiatives as strategic socio-technical investments. When evaluated through performance metrics such as certification conversion, job placement, and wage growth, publicly funded digital workforce programs can be assessed not merely as access interventions, but as mechanisms for strengthening national engineering competitiveness. This shift from input-based to outcome-based evaluation enhances accountability and provides policymakers with clearer signals regarding the return on public investment [17].

The integration of Human Capital Theory and Social Empowerment Theory further underscores that workforce development is both an economic and structural process [19,22]. Hardware access enables technical productivity, while wraparound support stabilizes the social conditions necessary for sustained participation. Together, these elements form an “access-to-agency” pipeline capable of translating federal digital equity funding into tangible labor market outcomes.

As digital technologies continue to reshape engineering and technical labor markets, the policy challenge is not only expanding access but ensuring that investments yield durable economic returns. The model presented in this study offers a scalable framework for minority-serving institutions seeking to align public funding with measurable workforce transformation.

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