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DEVICE OWNERSHIP, DIGITAL EQUITY, AND POSTSECONDARY STUDENT SUCCESS

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Kate Berkley*
National Education Equity Lab
Joseph I. Castro
California Polytechnic State University, San Luis Obispo
Shadman Uddin
Crimson Education

ABSTRACT

In recent years, American universities have implemented many innovative strategies to enhance the academic success of students, especially those from underrepresented backgrounds. Yet first-generation and/or low-income (FLI) college students continue to encounter barriers to success because they do not have authentic access to digital technology needed to graduate and be career-ready in our rapidly changing economy. This paper analyzes the current state of digital inequity among FLI students at Stanford University. It also reviews existing programs to address digital inequity at California State University, Fresno (Fresno State), the University of Michigan and Bowdoin College and provides guidance on developing a device program. Finally, the paper recommends strategies to better understand digital inequity and to address it in a sustainable way.

Keywords: Digital Equity, Student Success, First-Generation, Low-Income (FLI), Stanford University, Fresno State

INTRODUCTION

At Stanford University, as at so many other colleges and universities, the Covid-19 pandemic laid bare what some administrators had already suspected to be true: a significant number of students did not have technology devices that adequately met the demands of a college education. When Stanford sent students home for remote learning in March of 2020, students came to the student Tech Desk – the

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**Kate Berkley is Senior Associate for Strategy and Policy at the National Education Equity Lab, Joseph I. Castro (corresponding author) is Professor of Leadership and Public Policy at Cal Poly Orfalea College of Business, and Shadman Uddin is General Manager at Crimson Education.* *The authors are grateful to Dr. Ann Jaquith, Stanford University; Silvia Herrero-Duvaras, Apple Inc.; Dr. Christopher Vieira, Apple Inc.; Mike Pronovost, Fresno County Superintendent of Schools Office; Richard Weber, Stanford University; Beth McCullough, Stanford University; Melissa Doernte, Stanford University; and Helen Chu, Stanford University. The three authors are equal co-authors.* *Please direct all inquiries to jcastromv@gmail.com.*

Stanford technology library where students can temporarily check-out laptops and tablets for academic use – to inquire if they could take laptops home with them. Having relied upon loan devices and computer lab desktops during their time at Stanford, these students would not have access to personal computers while learning remotely. Without hesitation, the Tech Desk loaned students devices, asking them to bring them back whenever they returned to campus. In total, the Tech Desk sent students nearly 400 devices - laptops and tablets - during the university's period of remote learning.

While Stanford's Learning Technologies and Spaces (LTS) division – the campus office which operates the Tech Desk as part of its work to support the learning technology infrastructure on Stanford's campus – was able to rely on its supply of loaner devices to address student requests promptly and adequately, the urgent demand revealed a clear student need that had gone unaddressed. Noting that the student population needing devices was disproportionately first-generation and/or low-income (FLI), LTS recognized a need for a more permanent solution to support device access for all students at Stanford.

The Digital Divide

Stanford was not alone in facing this challenge. Across the country, when schools and universities shuttered their doors at the beginning of the COVID-19 pandemic and teachers attempted to transition their instruction online, educational leaders across the country were made starkly aware of the disparate levels of access and familiarity to digital technology among their student populations. From kindergarten to postsecondary, students struggled to access the personal devices and reliable broadband internet that were now essential learning tools. While many educational institutions had generally been aware of this disparity prior to the start of the pandemic, the provocation for online education fueled by pandemic lockdowns raised a pressing question for educational leaders: how are we leaving some students behind in our broader ascent to technology-driven education?

This question stems from the historically invisible "digital divide" in the United States. The digital divide, as defined by the National Digital Inclusion Alliance, "is the gap between those who have affordable access, skills, and support to effectively engage online and those who do not" (Smith, 2022). As technology becomes more integral to modern civic, economic, and educational life, the digital divide prevents equal participation and opportunity in these core domains of our society, or digital equity: the "condition in which all individuals and communities have the information technology capacity needed for full participation in our society, democracy, and economy" (Smith, 2022). Research into the digital divide has shown that digital inequities typically map disproportionately onto communities of color, Indigenous peoples, low-income households, people with disabilities, people in rural areas, and older adults (Starr et. al, 2022).

In the classroom, the digital divide limits the possibility of creating equitable opportunity through education. Fortunately, pandemic-era efforts to provide students learning remotely with devices and internet access made a significant stride in closing the digital divide in some states. In California, the proportion of K-12 households with reliable access to a computer rose from 68% to 82% between spring and fall of 2020 (Starr et al., 2022). Moreover, the recent spotlight on the digital divide has led the U.S. Department of Education to produce guidance on how educational leaders can take advantage of new federal investment opportunities from the Biden administration's Jobs Act to further digital equity in the classroom (US DOE, 2022). However, even with these significant strides, much of the national focus on digital equity in education has centered around learners in the K-12 education system.

Digital inequities undoubtedly persist in higher education. However, historically, most higher education institutions, Stanford among them, primarily place the onus on students to obtain their own personal devices to participate in college coursework, even though college coursework increasingly requires the use of technology for both participation in class and the completion of assignments. As students have varying levels of device ownership in the classroom, this paper argues that the ramifications of digital inequity can produce deleterious effects in an affected higher student's experience, particularly for FLI students, who are disproportionately impacted by the digital divide.

Focusing on First-Generation College Students

Paying attention to the needs of first-generation college students is critical. Not only do first-generation students, who are disproportionately low-income, face more challenges in applying to college, but once on campus, are also less likely to complete their degrees than their peers with college-educated parents (Fry, 2021). Addressing the challenges faced by first-generation students is critical for designing the future of higher education, as over half of all undergraduate students are now first-generation college students. The number of first-generation college students grew by an average of 1.5% each year between 2016 until the pandemic in 2020. California, the state with the highest undergraduate student enrollment, is also home to the most first-generation college students (Hamilton, 2023).

At Stanford University, a private university which enrolls over 16,000 undergraduate and graduate students, the number of FLI students has been increasing each year. For instance, FLI students made up 18.5% of the class of 2023, and 21% of the most recent class of 2026 identifies as first-generation (Office of the Provost, 2020; Cu, 2023). FLI students are also a defined affinity group at Stanford, with a dedicated First Generation and/or Low-Income Student Success Center, which provides critical resources, networks, and services for FLI undergraduate and graduate students, as well as a student community group (First Generation and/or Low-Income Student Success Center, n.d.).

The basis from which these statistics are derived defines first-generation students as students whose parents do not have four-year college degrees, which is the definition employed by numerous higher-education institutions. Nonetheless, there is healthy debate around the scope of what defines a first-generation student, from Brown University's "any student who may self-identify as not having prior exposure to or knowledge of navigating higher institutions" to interpretations that include parents and/or siblings who have earned associate degrees but not bachelors (Hoover, 2023). Robert Toutkoushian published a paper in 2015 that estimated that depending on the definition of "first-generation" the percentage of students who qualify would range from 22% to 77% of all college students (A. A. Smith, 2015). No matter how broad the definition, Toutkoushian argues, these students were "still at a significant disadvantage" academically and less likely to go to college and graduate than students with two parents with bachelor's degrees. For the purposes of this paper's case studies, we accept the definitions used by the universities under study. Though these definitions may be incomplete or contested, the universities in question have definitions of first-generation college students that are akin or transitive to other peer universities, namely, students whose parents do not have four-year college degrees.

This paper serves to illuminate the academic experiences of FLI students at Stanford University and the ways in which those experiences are shaped by the digital divide, specifically through device ownership. This paper also serves as a case study for the development of a program to address digital inequities on college campuses. We accomplish this aim through discussion of the authors' process and learnings in developing a program at Stanford, while also later highlighting established programs on other college

campuses. In turn, the authors hope to shed light on an overlooked and under-researched challenge and compel higher education leaders to correct digital inequities.

Ultimately, our conversations with students and other stakeholders revealed a relationship between personal device access and FLI student success. Student success is a frequently-used term with many definitions. Most broadly, student success is commonly defined as degree attainment (Kuh et al., 2006). In this paper, we define student success as a student's ability to successfully complete college coursework and complete their degree. We also expand our definition of student success to include a student's ability to feel a sense of *academic belonging*, which Lewis and colleagues define as "the extent to which individuals feel like a valued, accepted, and legitimate member in their academic domain" (2016). The authors further define academic belonging as the personal belief that one is equally academically qualified and capable as their peers.

As Hurtado and colleagues have found, for all students, "managing the academic environment is essential to feeling a part of campus life" (2007). In order to ensure that students of all backgrounds across campus have equal opportunity to participate fully in academic life, to belong academically, and in turn to feel fully integrated into their campuses, inequities around device ownership must be understood and addressed.

METHODOLOGY

This paper is a culminating product of the work completed in a six-month course project for the Policy, Organization, and Leadership Studies seminar at the Stanford Graduate School of Education in Spring 2023. The project, which served in fulfillment of two of the authors' master's degree requirements (with guidance from the third author), aimed to build a device-ownership program that would address digital inequities for undergraduate FLI students at Stanford. Prompted by the unexpectedly high number of device requests at the start of the pandemic, the project was initiated prior to the authors' involvement by members of LTS as well as members of Apple Inc.'s Higher Education Team. Initial research was conducted by an undergraduate FLI student, who collected dozens of student testimonials regarding the lack of device ownership in the Fall and Winter of 2022. Stanford's Office of Institutional Research & Decision Support further corroborated the issue of device ownership through a survey to students during the pandemic lockdowns, the results of which informed our research purpose.

Once the authors joined the project in December 2022, the research began with in-depth conversations with eleven FLI undergraduate student volunteers who had personally struggled with device ownership while at Stanford University. We continued our investigation by interviewing over thirty Stanford University faculty and senior administrative leaders who had previously seen examples of students struggling in the classroom due to a lack of device ownership.

To build our proposals for a device ownership program, our team spoke with administrators at other universities, specifically at California State University, Fresno (Fresno State) and the University of Michigan, who had successfully implemented similar programs at their institutions. Finally, the Higher Education Team at Apple Inc. and Stanford University's Chief Information Officer Council provided other university case studies, including from Bowdoin College, and secondary literature resources that informed our device ownership proposal.

Because the authors' involvement with the project was limited to a six-month course, and because their primary purpose during the course of the project was to elucidate this problem to administrative leaders

through student stories and data around device access itself, the team did not produce or procure access to sensitive data around the target group of students and the respective metrics relevant to student success, such as academic performance, major choice, extracurricular participation, and graduation rate. In the recommendations section of the paper, we elaborate the importance of collecting and analyzing this data in dictating high-impact solutions to the device ownership problem at any institution looking to address their own gaps.

TECHNOLOGY ACCESS AT STANFORD UNIVERSITY

Prior to the Spring Quarter of 2020, some Stanford University administrators knew that some students lacked personal devices, but the pandemic revealed the extent of the problem. In a 2022 Stanford University IT survey, 5% of the student body (approximately 400 students) reported that they did not have reliable device access (Stanford University IT, 2022). While 400 is numerically significant on its own, it likely understates a larger problem. Asking a student if they have reliable access to a device does not answer whether that device is a personal device, nor if that device is adequate to support the learning demands of a college student. For example, while a student may have access to a Chromebook, that Chromebook might not support the Bluebook software a student needs for their midterm exam, forcing the student to see if they can borrow a device from a classmate or check one out from the Tech Desk.

Throughout the course of our project, our interviews with FLI students revealed their struggles with not having adequate devices to meet their academic needs. While these students generally received significant financial aid to cover tuition, room and board, and additional expenses, this aid did not necessarily cover a laptop. Stanford does not technically require students to have laptops to participate in courses, even though practically all courses require computer-based work. We spoke with some FLI students who did not have personal computers but instead relied on desktop computers in the libraries and computer labs, which were fully equipped with relevant software. Many students we spoke with, however, did have some kind of device, but stated that these devices–whether older, used, or less high-powered–did not always support their academic needs. Other students spoke about how they struggled to pay for needed repairs for devices when their old laptops no longer functioned.

One poignant story came from a student enrolled in a popular introductory computer science course. Her aging computer, which had been passed down to her from a sibling, crashed every time that she ran code required for her assignments. Embarrassed by the situation, the student chose not to go to office hours, as she didn’t want her teaching assistant to see her computer, and she dropped out of the course. This story and others like it reveal that lack of access to adequate devices impedes Stanford students' experiences in courses and have implications for how students choose courses and persist in their studies.

Technology challenges experienced by students can further impact their sense of academic self-efficacy and belonging. As one student described:

> Throughout my life I have always been on the receiving end of shocked looks at the government phones I had, or the heavy and older laptops I carried. My family and I just can't afford anything better or more efficient. My current laptop weighs at least two pounds while most students have paper-thin MacBooks. That not only feels slightly alienating (I've gotten used to it), but my bulky laptop has charging issues. I always have to be plugged in for it to turn on, and that's challenging while in the middle of a lecture room. So I don't get to use my laptop and can't take all the notes I want due to them

> having to be handwritten. This significantly affects my academic performance since I am always worrying about the inefficiency of my technology.

Stanford, as with so many other colleges and universities, recognizes that FLI students are likely to struggle with having adequate technology to allow them to thrive academically and has provided various solutions. However, our conversations with students further revealed how these existing solutions are insufficient to support FLI students' needs, particularly when it comes to their sense of academic belonging.

Stanford's most prominent device program is the Tech Desk's loaner program, which enables students to check out devices temporarily (Borrow Equipment, n.d.). However, while the Learning Technology & Spaces team has endeavored to grow the loaner program with the number of devices available and longer check-out periods, this program still only provides students with a temporary solution. The loaner program was designed to support students if their personal device needed a repair or if they needed a special device for a particular class project, not to support a student for an entire academic year.

Moreover, students expressed frustration at the "stigma" associated with using a device with a university barcode across its front. While this aspect of borrowing a device may seem insignificant, these experiences – shared by many of the students we spoke with – further evince the feelings of marginalization and "otherness" that FLI students experience on campus. One sophomore described how students made comments about his lack of technology: "When people realized I didn't have an iPad, I heard the phrase 'you need to get an iPad' a hundred times. It seemed like there was information I did not have and was therefore at a disadvantage."

Stanford also makes technology funding available specifically for FLI and other low-income (or high aid receiving) students. Stanford's Opportunity Fund provides a one-time grant of up to $1000 to FLI students "who are experiencing an unexpected financial challenge or seeking funds for an opportunity related to their academic and/or professional development" (Opportunity Fund, n.d.). While students can use these funds to purchase a laptop, $1000 is generally insufficient to purchase a high-powered laptop. Students meeting a similar financial aid requirement can also access funds through the Office of Financial Aid's Computer Expense Request, which offers students one-time funding through their financial aid package to purchase a laptop or other technology-related items, such as an external monitor or software (Financial Aid Office at Stanford University, n.d.).

While both funding options support students in purchasing technologies, these programs have serious limitations. Both programs require students to purchase the device, fronting the cost themselves, and wait to be reimbursed, which can make this option untenable for students with limited cash. Some students who were able to front the cost described having to wait until several months into the school year to be able to afford a new adequate device; they further noted how much their new laptops improved their academic experiences.

Each of these programs - the Tech Desk, Opportunity Fund, and Computer Expense Request - also creates what students described as *high-friction processes* that can sometimes overwhelm and confuse students. The programs require substantial paperwork and other back-and-forth communications with students and administrators, which FLI students described as particularly frustrating when their financial aid status often requires them to fill out more paperwork and bureaucratic processes than their more affluent peers. In turn, these additional steps cost students extra time and effort which is taken from their academic, extracurricular, and social capacities. Strikingly, we also spoke with students who simply did not know these options existed. Without an easily accessed, permanent solution, we learned, too many FLI students

at Stanford are falling through the cracks when it comes to having adequate technology to meet their academic needs.

REVIEW OF EXISTING MODELS

As the authors sought to understand what was happening at Stanford, it was also important to look at and learn from the existing landscape of programs at other institutions. Though on the whole digital inequities are not comprehensively addressed in higher education, in recent years, several institutions have instituted equity programs that provide free laptops and/or other devices directly to qualifying students. We reviewed three distinct and differently-scoped models from three diverse institutions to inform the design of the Stanford model: California State University, Fresno–a broad access comprehensive university; University of Michigan–a large public research university; and Bowdoin College–a small liberal arts college.

California State University, Fresno DISCOVERe Program

California State University, Fresno (Fresno State) is the largest university in Central California. The student body reflects the overall diversity of the region, as Fresno State is both a Hispanic-serving and an Asian American Native American Pacific Islander Serving Institution. Approximately 66% of the students are first-generation college students and 65% of the students are Pell Grant recipients (University Marketing and Communications at Fresno State, 2023).

The DISCOVERe Program was launched in 2014 to address a need for Fresno State students to have equitable access to mobile technology to help them graduate in a timely way and be ready for their careers. At the time, just 48.6% of Fresno State's students graduated within five years (California State University, Fresno Office of Institutional Effectiveness, 2013). Moreover, the region served by Fresno State includes rural areas that do not have the same level of digital connectivity as other parts of California (Hayes et al., 2023).

DISCOVERe started as a pilot program with 40 faculty members and 1,000 students to help ensure that Fresno State students had access to a quality mobile device and hotspot to do their work. A full-staffed technology hub was created in the Fresno State library, which provided technology support for faculty and students in the DISCOVERe Program. The faculty were invited to participate in professional development programs to help them better understand the many features of mobile devices such as iPads as well as suggestions for innovative ways to use them in the classroom to support their students' academic success. Fresno State provided stipends to faculty for participating in the professional development program. DISCOVERe inspired over 400 faculty members and 18,000 students to participate by 2020. The program was among the only large-scale student success initiatives implemented Fresno State prior to its six-year graduation rate increase from 49% to 58%, which led to consecutive years of Top-20 national rankings, including a Number 17 national ranking by *Washington Monthly* in 2017 (Hughes, 2017).

DISCOVERe also played a critically significant role in supporting students during the pandemic when they were required to take classes and study at home. The program also provided digital textbooks and helped to reduce textbook costs by 70% for Fresno State students, a critical benefit to FLI students (Lee, 2018).

Many students who shared written testimonials with Fresno State staff about why they participated in DISCOVERe, emphasized that they could not afford a quality mobile device required to complete their

schoolwork (California State University, Fresno, Testimonials from DISCOVERe students, 2019). This was vitally important as students were able to keep their mobile device through and after graduation as long as they participated in the program. The students also viewed the program as a way to save money on textbooks as many of the faculty involved in the program created or secured no or low-cost content in lieu of textbooks. Finally, students embraced DISCOVERe because it introduced them to a wide range of apps, which enhanced their overall learning experience at Fresno State.

DISCOVERe benefited from strong partnerships established with Apple and AT&T, among other entities. While Fresno State students had the option to use other mobile devices, the overwhelming majority chose to use Apple iPads because of their flexibility and reliability. AT&T was a key partner in providing Fresno State with high quality mobile wireless devices that the university provided to students free of charge.

Fresno State's leadership identified DISCOVERe as one of its highest student success program priorities. Funding for the program came from campus and private donor funds as well as in-kind contributions from partners like Apple and AT&T.

When Fresno State's President became Chancellor of the California State University in 2021, he established California State University Connectivity Contributing to Equity and Student Success (CSUCCESS), which aimed to provide access to mobile technology for students at all of CSU's 23 campuses. CSUCCESS was the largest initiative of its kind in the nation.

CSUCCESS launched in 2021 by serving students at eight CSU campuses. Apple was the primary corporate partner engaged in this new program. In a 2022 survey, 25% of CSU students said they did not have access to a reliable mobile device or internet access to do their work. 95% of the students served by CSUCCESS reported that the program made them feel supported by their campus and 93% of the students reported that the iPad bundle they received was always or mostly adequate to meet their academic needs (California State University Office of the Chancellor, CSUSUCCESS Program Year 1 Evaluation, 2022).

University of Michigan Undergraduate Laptop Program

University of Michigan (Michigan) began their Undergraduate Laptop Program in 2015 as a collaboration between the College of Literature, Science, and the Arts (LSA) and the Office of the Provost. The program was initiated after the University received survey feedback from students describing the stress of "not having similar resources as other students" (University of Michigan Undergraduate Laptop Program, 2023, p. 3). Moreover, the University had become aware of ways in which they lacked awareness of some student hardships, most prominently from a student tweet in 2013, "when a University of Michigan student using the hashtag #BBUM (Being Black at University Michigan) sent out the following Tweet: 'So everybody else can use their MacBook but I can't use my iPhone to look over a reading in class? I don't have a laptop #BBUM'" (University of Michigan Undergraduate Laptop Program, p. 4).

In response to this criticism, Michigan developed a digital equity program that directly addressed student need for adequate personal technology. Originally the program was framed as a laptop "loan" program, meaning that the students returned the laptop upon graduation, but owed no money to the university to have a laptop. In addition to addressing current student needs, the program sought to address recruiting and retention goals for low-income students. Funding came in part from two sizable alumni donations (~$125,000 total), and the expenses for the program were initially divided equally by LSA and the Provost for approximately 250 laptop packages, with the laptop package providing a current model year MacBook Air, a 4-year warranty, and protective case for the laptop.

The program is advertised upon admission to incoming students (first years and transfer students) who are identified by the Office of Financial Aid from the student's College Scholarship Service (CSS) profile. In an effort to make the program as frictionless as possible, students do not have to request to participate in the program but rather are asked if they would like to participate in the program two weeks after they are admitted to the University. After agreeing to the program and signing a contract, students are sent a voucher for purchasing the laptop approximately 10 days prior to the beginning of the semester. Students are then able to purchase the laptop at the campus Apple Store using their vouchers.

Over time, the program has gradually expanded to include qualifying students in all undergraduate programs and is now housed in the Office of Enrollment Management. Critically, administrators learned from the initial program that the term "loan" deterred students from taking advantage of the program due to concerns about owing money for the laptop. In response, in 2016, the program dropped the term "loan," which increased uptake in the program. After completing their first term, the laptop is fully owned by the student and is theirs to keep after graduation.

Bowdoin College Digital Excellence Commitment

Bowdoin College's (Bowdoin) Digital Excellence initiative began in 2016 under the leadership of their Chief Information Officer. As part of a broad institutional effort to increase student equity as more first generation and low-income students enrolled at Bowdoin, the school first provided free MacBook Pro computers to the inaugural group of Geoffrey Canada Scholars in Fall of 2018. The success of this early initiative led then-President Clayton Rose to launch a comprehensive fundraising campaign in February 2020 to support greater equity for students at Bowdoin, with digital access as a key component. Because Bowdoin, like Stanford, has a very high graduation rate for all students (96%), the scope of the initiative focused not so much on recruiting and retention but rather on leveling the playing field for all students at the College, specifically by providing MacBook Pros to incoming students (*Graduation and retention rates*, n.d.). This initiative, naturally, was disrupted somewhat by the onset of the Covid-19 pandemic a month later.

Concurrently, due to hybrid learning demands and feedback from faculty in Fall of 2020, Bowdoin provided iPad Pros and corresponding keyboards and Apple Pencils to all students at the college. By Fall of 2021, positive feedback from students and faculty on the value of universal student technology prompted the college to return to its original vision of MacBook Pros, now with an additional layer of value: as Bowdoin pushed for more sustainable energy usage across campus, they saw laptops as a means of reducing campus energy consumption while also freeing up valuable space formerly occupied by computer labs. In this way, the laptop program serves the college's equity goals as well as helps achieve its commitment to sustainability.

In February of 2022, Bowdoin launched its Digital Excellence Commitment to provide all students, regardless of ability to pay, a 13-inch MacBook Pro, iPad Mini, and Apple Pencil, beginning with its first-year class enrolling in Fall of 2022. In addition to the devices themselves, students were provided with access to a range of course-specific software "designed to advance learning, inspire innovative teaching, and create digital equity across the student body in the use of tools essential for success in the twenty-first century." Bowdoin also provided students with 4-years of AppleCare+ Coverage. After graduation, students are given the option to buy their devices for $1. Personal ownership of the devices, as opposed to a long term-loan, is a key feature of the program. As the College included in the announcement, "Students will be encouraged to treat the devices as their own during their time at the College (stickers

and unique cases are welcome)" (*Bowdoin Launches Groundbreaking Digital Excellence Commitment*, 2022).

MOVING TOWARDS DIGITAL EQUITY AT STANFORD

The authors' interviews and study of other schools made clear that Stanford required a more comprehensive device program and policy to ensure FLI students have the adequate technology needed to succeed and maintain a sense of academic belonging on campus. Learning from Fresno State, Michigan, and Bowdoin, as well as a few other cases, the team gleaned three major takeaways: (1) direct gifts of devices rather than grants or loans to purchase devices creates a more frictionless experience for students and encourages greater program participation, (2) loans and loan-related language deter students from taking advantage of programs, and (3) universal technology among students supports pedagogical innovation among faculty.

As the authors shared these findings and assessments with university leaders, we found that student stories resonated acutely with senior administrators and faculty, many of whom, despite best intentions, simply did not know the extent of the challenges FLI students faced when it came to technology access and academic success on campus. Through conversations with these leaders – including members of Student Affairs, Financial Aid, the FLI Office, the alumni community, as well as the Chief Information Officer (CIO) Council, the project team developed a proposal to support the needs of FLI students at Stanford. While the scope of the project initially focused on device ownership as the most direct route to addressing the needs of FLI students, the authors were encouraged by campus leaders to propose a larger, more comprehensive plan and policy that might more strongly resonate with campus leadership.

The project team then worked closely with the CIO Council to develop a long-term vision of digital equity at Stanford. This conception of digital equity was specifically upheld through four primary pillars put into place through universal institutional policy: *device access*, or the ability for students to have the sufficient devices to thrive on campus; *wireless access*, or the ability for students to go online wherever on campus and not need to rely on their own data plans or mobile hotspots; *digital literacy and usage*, or the ability for students to fully employ their devices and software to their full capabilities for learning; and *learning applications*, or the ability for students to have the necessary software applications to succeed on campus.

While all of these pillars play a critical role in a long-term vision of digital equity, our first recommendation was that Stanford institute a minimum learning technology provision outlining the hardware and software integral to the student learning experience at Stanford. The Stanford administration should convene a group of representative students, faculty, and staff to collaboratively determine what technology is needed for students to be successful at Stanford. A minimum learning technology requirement would consider tools such as laptops, tablets, and smartphones. By instituting a minimum device requirement, Stanford could then more clearly identify which students needed device provisioning and technology support.

Rather than prescribe a technology bundle, our study of various programs revealed that students, faculty, and staff within individual higher education institutions are best positioned to know what types of mobile technology devices are needed to be successful on that campus from a teaching and learning perspective. This can be articulated by the institution after a representative group of students, faculty and staff collaborates to develop minimum technology requirements. By being clear about the requirements and needs, higher education institutions can be empowered to pursue partnerships with those companies that are best equipped to serve those needs.

We proposed that Stanford address the already-identified need within the FLI community by providing options of learning technology bundles to incoming students already eligible for the Opportunity Fund. Students should be able to opt-in to the program in the spring prior to their campus arrival and receive a bundle of learning technology devices over the summer to start their time on campus ready and prepared.

Based on our conversations with financial aid staff, our team estimated that 400-500 students per year would qualify to receive a bundle comprising state-of-the-art technology as determined by the committee of representative students, faculty and staff referenced above. We explored two pathways of funding: (1) obtain funds from the development office to fund 1-2 years of implementation for this initiative, and (2) gain approval from the budgeting committee to approve long-term funding for this initiative as a part of financial aid. Once development funding has been approved, LTS will begin creating websites and processes as soon as they receive the funding. Depending on the timing of funding approval and disbursement, LTS is also considering expanding its loaner program to meet the needs of students currently on campus.

CONCLUSION AND RECOMMENDATIONS

As Stanford progresses towards a future with greater digital equity, adequate mobile devices for all students serve as an essential pillar and starting point. With a minimum learning technology provision, all Stanford students will be equipped with the tools they need for academic success and belonging. Moreover, with assurance that all students have universal devices, faculty may better incorporate technology into their courses and implement innovative pedagogy. Perhaps most importantly, through a device equity program, Stanford can ensure that access to adequate devices is no longer a hurdle that FLI students must face when they come to campus.

Stanford University's preliminary efforts to create a comprehensive device ownership program grew from a commitment to understand the role device ownership played in student success, specifically for FLI students. While we recognize that Stanford, as a private university with a very large endowment, is uniquely equipped to address the needs of FLI students, Stanford's case prominently highlights the ways in which – even in elite, well-resourced schools – the technology needs of first-generation students have fallen under the radar. Furthermore, we see the case of Stanford as fitting into a group of colleges and universities, who, though they vary in student population and level of resources, are charting a path towards a broadly accessible solution–namely, a multi-pronged approach to achieving digital equity, fortified by universal policy.

For public and private university leaders looking to further investigate the role device ownership may be playing in their students' outcomes, we recommend pursuing the following:

- Identify the students on campus who are struggling with device ownership as a research sample of your broader population. Based on our research, these students will be disproportionately first-generation and/or low-income students.

- Based on the characteristics of these existing students on campus, determine the overall population of students who have attended the university in the past for future analysis and outreach.

- Conduct qualitative research into how these students' collegiate experiences are or were affected by their lack of device ownership. This process will not only produce new and valuable insight, but also ensure that student voices are actively heard and included through this process.

- Based on the insights generated from listening to students, analyze the overall research populations' academic records to identify any patterns amongst various student success metrics, such as academic performance, major choice and persistence, extracurricular activity, and/or retention.

- After determining the needs of the students, propose the requisite device ownership and broader digital equity initiatives needed to make a demonstrable impact on the target student success metrics.

- Share the findings and proposals so that both internal stakeholders – faculty, administration, and students – and external stakeholders – private companies, individual donors and foundations, and government officials – can be convened and inspired to provide program financing and implementation. The university will need to demonstrate their commitment to such an effort by investing some of its own funding to launch such initiatives.

Throughout each case, it was pivotal that university leaders engage with student voices. It was only because we had a collection of powerful student stories at Stanford University was our team able to demonstrate that there existed some measurable impact that the lack of device ownership played in a student's college experience. Student stories not only helped capture the hearts and minds of university leadership, but student stories also helped direct our attention to what data would be needed to make a sufficient cost-benefit analysis for the university.

Furthermore, to develop and sustain a successful program that serves the technology needs of FLI and other students, higher education institutions must be intentional about recruiting and retaining qualified staff to support and administer programs. The staff need to have both the technical expertise to advise on and support minimum technology requirements established by the institution and a professional commitment to support the teaching and learning needs of students and faculty.

We recognize that many colleges and universities are facing post-pandemic challenges related to enrollment reductions and lower public investments by states, like California, that are facing budget challenges. For universities that cannot support an initiative to address digital inequities from their operating budget, we recommend they implement a technology fee that would be paid by all students and include revenue for a program to address digital inequities. The fee could have a substantial return-to-aid component, so that it does not create further inequities for students with significant financial need. Another option would be to establish partnerships with private individuals, foundations and corporations that have an interest in addressing digital inequities. This is the option that Fresno State pursued when it established DISCOVERe in 2014. Colleges and universities that aggressively address digital inequities among their students have an excellent opportunity to improve graduation rates for their FLI and other students and career readiness by all of their graduates.

The stories our team collected from students suggest that there exists a measurable impact that lack of device ownership plays in a student's baccalaureate experience, from academic performance, undergraduate major choice, and participation in extracurricular activities. However, due to the limitations of our project research methodology and scope, our team was not able to gain access to the

relevant datasets necessary to identify such patterns for our target groups within Stanford University. If more universities step in and begin engaging with their students about their experiences with device access, the greater higher education system will benefit from the influx of data analysis and reporting on the role device ownership, and more broadly, digital equity, plays in students' academic experiences, shedding much-needed light on an oft-overlooked issue. Moreover, it would ensure that more students are provided with the resources and support they need to succeed in an increasingly digital world.

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