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The Digital Divide and Smartphone Reliance for Disadvantaged Students in Higher Education

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ABSTRACT[1]

The digital divide as it pertains to information inequality among disadvantaged student populations in higher education is a pertinent problem, and has been further exacerbated by the increase in online learning due to COVID-19. This study explores Technological Access challenges of students at a small public midwestern university in the US that serves a disproportionately higher number of underserved and underrepresented students. Survey data from 535 undergraduate students indicate that a critical subset (n=61) of the sample who were first generation, low income, and nonwhite had significantly lower levels of Technological Access with respect to access to devices and Internet access, when compared to the larger sample. Additionally, nearly half of the sample used smartphones to access courses online. Educational implications of smartphone dependence among disadvantaged students and the consequent digital divide are discussed. As technology induced online learning proliferates, addressing such gaps will be a step toward mitigating inequities plaguing higher education.

Keywords: Technological Access, smartphone, digital divide, Internet, underserved, disadvantaged

1. INTRODUCTION

The diffusion of information and communication technologies is having a profound effect on education with technology stretching the educational boundaries. Online learning has increased manifold and enrollment in online courses has grown exponentially [1, 8, 12]. As a result, students from disadvantaged backgrounds such as minority and low-income groups, previously unable to pursue a post-secondary education for work or family related obligations, can now realize their aspirations of attending college. However, despite the popularity of technology induced e-learning, the digital divide in terms of access to computers and the Internet remains a case of concern for such student groups [20, 31]. Furthermore, the COVID-19 pandemic has underscored the importance of exploring a hidden form of social inequality, namely digital inequalities that are hindering the educational attainment of disadvantaged students [17, 22].

A rising share of students entering open admission post-secondary institutions come from minority and low-income backgrounds [9]. Research indicates the existence of a positive correlation between technology related access and academic outcomes [2, 18]. Additionally, research also indicates a negative relationship between smartphone dependence and academic achievement [16]. Given that the author's institution caters to a disproportionately higher number of disadvantaged student groups, the concerns about levels of Technological Access acquire specific relevance. Accordingly, the purpose of this study is to explore Technological Access and smartphone usage among students within the context of academic learning.

2. LITERATURE REVIEW

Disadvantaged Students

Disadvantaged students refer to those who may possess one or more of several at risk characteristics, such as belonging to low income groups (LI), first generation college (FG) attendee status, nonwhite (NW), academically underprepared, under credited, and not on track to graduate [11, 15, 32]. These groups have been traditionally underserved and underrepresented in higher education and have been academically at-risk of lower achievement.

The Digital Divide

The digital divide may be defined as a social inequity between individuals regarding (1) access to information and communication technology (ICT), (2) frequency of use of technology, and (3) the ability to use computing technology for different purposes [14]. Digital inequalities are defined as differences in actual access to technology and digital literacy – the extent to which individuals have the knowledge and competence to access digital technologies such as computers, Internet, mobile devices and applications, and utilize the same to obtain benefits from the use of such technologies [5]. As per the authors, such inequities in access and skills are deeply embedded in social, economic, and cultural contexts, which are likely to place socioeconomically challenged populations at a greater disadvantage with

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respect to obtaining benefits from use of technology. There is a vast amount of research on the digital divide based on low income or minority status, variables relevant to the demographics of this study. Accordingly, students with access to less reliable computer devices and or unstable Internet access are likely to come from low-income families, ethnic minorities, and residents of rural areas, small towns, and high poverty zip codes in inner cities.

Technological Access and Smartphone Reliance

In this study, Technological Access refers to access to ICT – access to and use of computers, mobile devices such as smartphones, and access to the Internet. Low Income and minority families in the US have been identified as being less likely to have access to computer device(s) and broadband Internet connection at home and less likely to have the necessary skills and knowledge to meaningfully use these resources [4, 7, 25, 26]. The digital divide, in terms of ownership of and access to computer devices as well as access to high speed Internet Services, is stratified by family annual income, and this differential access acts as an impediment to completion of homework assignments for those on the lower end of the income scale [30]. This disparity is particularly pronounced in African American and Hispanic households [2].

A national study on undergraduate students' (n = 64,536) use of technology in 114 doctorate granting institutions reported that minority, first generation, and low-income college students viewed smartphones as significantly contributory towards their academic success. These students saw their laptops and smartphones as significantly more important to their college success than did their demographic counterparts who were not first generation, low income, or minorities [10].

Results from a 2018 nationally representative survey sample of 1,500 exclusively online students (over 50% had annual household income of less than $40,000) indicated that 67% completed some or all of their coursework using a mobile device while 20% used only mobile devices for coursework completion [19] with a significant plurality reporting use of mobile devices to access educational materials online. The PEW Research Center reported similar findings with 19% of millennials and 17% of Gen Xers found to be smartphone-only Internet users in the absence of home broadband Internet access [30].

Anderson and Perrin [2] reported that 35% of teens often or sometimes completed homework on their smartphones. The authors noted that although this might have reflected a trend with younger generations, this was especially prevalent among lower income teens where 45% with annual household income less than $30,000 reported sometimes relying on their cell phones to complete homework.

Rubinstein-Avila and Sartori [26] in discussing the variety of issues that allow for a nuanced understanding of the digital divide that impacts access to and engagement with ICT, noted that "cell-mostly" users tend to come from demographics characterized by lower educational attainment. In a meta-analysis of research on the digital divide, Rowsell et al. (2017) found that students who used smartphones mostly or solely to complete coursework tended to belong to demographics characterized by lower educational attainment. The authors found this to be particularly troublesome as this put such students at greater risk of poorer educational outcomes despite the access provided for by smartphones. Tsetsi and Rains (2017) found lower income, younger, and minority adults in the US to be more dependent on smartphones to access the Internet, when compared to higher income and White adults.

Gonzales et al. [13] cites previous literature on the digital divide that reports physical access to ICT such as access to Internet, computers, and cellphones to have reached levels of near saturation amongst undergraduate college student populations. Despite the proliferation, digital inequalities may persist amongst low and middle income families who may suffer from periods of under connectedness due to periodic unpaid monthly bills, slow and broken hardware, and shared access (Rideout & Katz, 2016). Accordingly, using a technology maintenance lens that explores the stability of digital access, the authors examined how inequalities in the quality and stability of access impacted US college students' struggles to maintain technology access. The study reported that although ownership and use of both cellphones and laptops were nearly universal, roughly 20% of respondents experienced problems with broken hardware, data limits, and connectivity issues. Students of lower socioeconomic status and minority students disproportionately experienced technology access related hardships. Findings also revealed a link between the challenges of technology maintenance and students' academic performance.

African American and Hispanic adults in the United States remain less likely than White adults to own a traditional computer or have high-speed Internet at home. Eighty percent of White adults reported owning a desktop or laptop computer, compared with 69% of African American adults and 67% of Hispanic adults. Similarly, 80% of White adults reported having a broadband connection at home, while smaller shares of African American and Hispanic adults say the same – 71% and 65%, respectively [3].

The findings from the studies referenced above indicate that the disparity in Technological Access is stark along socioeconomic and racial lines, with individuals belonging to these groups lacking adequate computer and Internet access. A meta-analysis of the determinants of online course dropout rates in a community college

context found that access to technology (necessary hardware and software) were key factors that influenced success in online learning environments [18]. This further underscores the significance of such disparities and consequent debilitating effect of the Technological Effect gap on academic achievement.

During the ongoing pandemic, affluent students drew upon financial and material sources of support from their parents, partners, and employers to help mitigate the hurdles to learning posed by the emergency public health situation. Interviews conducted with less advantaged students at a university campus accentuated the digital divide and how much they typically rely on the physical infrastructure of the university – computers and reliable Internet services. The pandemic highlighted not only the wildly unequal resources available to students learning at home, but also just how much university campuses matter in reining in those inequalities – creating, through their shared spaces, a more level playing field for students of all backgrounds [22].

The pandemic impacted disadvantaged populations more acutely. The digital divide related to computer ownership, broadband adoption, and Internet use and affordability were highlighted by the pandemic and emerged in new ways as much of daily life moved online leaving families with lower incomes more likely to face obstacles in navigating this increasing digital environment. A majority of parents (59%) with lower incomes who had children in schools that were remote due to the pandemic said their children would likely face at least one of three digital obstacles to their schooling, such as a lack of reliable Internet at home, no computer at home, or needing to use a smartphone to complete schoolwork [29].

Smartphone ownership is highest among people aged 18–29 an age group commonly represented by college students [6]. Smartphones' mobility allows access to the Internet without a broadband subscription which can be cost prohibitive for individuals from lower income backgrounds. According to the Pew Research Center Mobile Factsheet, about 15% of American adults are "smartphone-only" Internet users, meaning they own a smartphone, but do not have traditional home broadband service. Reliance on smartphones for online access is especially common among younger adults aged 18 to 29 (28%), and those coming from nonwhite (17% of African Americans and 25% of Hispanics) and lower-income backgrounds (47% making less than 30K annually and 19% making between $30K and less than 50K annually), a demographic that closely represents the student population at the author's institution. A meta-analysis of studies (from 2008-2017) examining the influence of smartphone usage on academic achievement reported a small but negative effect on educational outcomes [16].

Higher education has long been touted as the great equalizer. As online learning becomes the norm and usage of multi-media platforms to facilitate learning becomes increasingly typical, the negative relationship between smartphone dependency and student academic performance becomes worrisome given that a substantial segment of the smartphone dependent student age population hail from disadvantaged communities.

3. METHODOLOGY

Research Questions

This study sought to explore device use and ownership characteristics of students for academic learning purposes. The major research questions for this study are:

1. What levels of Technological Access (ownership of, access to, and usage of computer devices as well as access to the Internet) do students have and use to complete coursework?
2. Are there group differences in Technological Access?
3. What is the extent of smartphone usage in accessing coursework?
4. Are there group differences in smartphone usage?

Design, Sample, Data Collection & Analysis

The study used a cross-sectional survey research design to investigate the research questions. The study was approved by the author's institutional human subjects review board. E-surveys were sent to all students who had completed at least one semester at the institution (n=2800). The survey was completed by 535 students at a response rate of 19.1%, fairly typical of online surveys. The survey consisted of a combination of dichotomous, multiple choice, Likert type, and open-ended questions. The data was exported to SPSS 28.0 to run descriptive and inferential statistics.

The Technological Access questionnaire included questions on computer device usage and ownership and Internet connectivity, arranged in four subsections. The first subsection had questions on the types and frequency of devices used to complete readings and assignments – laptop, desktop, tablet, and smartphone. The second subsection had questions on the types and frequency of use of public computers, such as school computer lab, borrowed devices from school, work device, community computer lab (Public Library, Workforce Development Center, or YMCA) to complete readings and assignments. The third subsection had questions on types and frequency of access to residential and public Internet services (Public Library, Workforce Development Center, commercial stores such as MacDonald's, Starbucks, or shopping mall) to complete readings and assignments. The last subsection had questions on ownership and access to technological devices (desktops, laptops, printers, etc.), availability and adequacy of

software resources, and access to resources outside of school for tech support.

Students were asked how commonly they used a smartphone to complete readings and assignments and based on their responses, were categorized as a) light users (never or rarely used) or b) frequent users (regularly or frequently used).

The student personal and demographic characteristics section contained questions pertaining to students' age, gender, cumulative GPA, race/ethnicity, income, Pell Grant recipiency, hours worked, first-generation college attendee status, transfer status, and independent or dependent status for financial aid purposes. They were categorized into groups to run Chi-square test of significance.

The Kolmogorov-Smirnov (K-S) test was used to check for non-normality. K-S test value of 0.05 or lower informs lack of fit and warrants non-parametric methods. Hence, non-parametric Chi-square tests of independence were employed to test group differences for Technological Access due to the non-normal nature of the distribution and the smaller sample size of the subgroup (FGLINW group; n = 61) being compared with the larger sample (n = 535).

Personal and Demographic Characteristics

The majority of the 535 respondents were 24 years or younger (72%), female (69%), White (67%), single (83%), and low income (47%). Low income was defined as either Pell recipient or having income of $30,000 or less. Almost half (46%) were Pell Grant recipients, another 38% identified as first generation, and 45% worked over twenty hours per week. For federal income tax purposes, students were asked to identify their status as independent (43%) or dependent (57%) and to report their individual or family income (if dependent status). Of those who reported independent status (n = 223), 72% were low income ($30,000 or less) and about 30% of dependent status (n=308) had family income $30,000 or less. For those students who reported independent status, almost 90% had income less than $50,000.

4. RESULTS

The digital divide with respect to Technological Access was apparent for this sample of disadvantaged students in several areas of usage, ownership, and access to computer devices, and usage and access to the Internet. This was observed within the FGLINW subset, which lagged the main group in several categories.

Tracking the type of devices used to complete coursework (Table 1) revealed that 90% of the respondents (n = 535) regularly or frequently used a laptop to complete readings and assignments. About 39% said they regularly or frequently used a desktop to complete readings and assignments. Chromebook or iPad usage was low. In comparison, 45% of the respondents for the entire sample reported using their smartphones regularly or frequently to complete readings and assignments. For the FGLINW group, half of the respondents (n = 61) used smartphones to complete their readings and assignments. The Chi-square test of significance did not detect significant difference in device use characteristics for completing coursework between the larger sample and the FGLINW group, due to the overwhelming similarity in usage ratio.

Table 1: Computer Devices Used to Complete Coursework

Table 1: Computer Devices Used to Access and Complete Coursework						
	N = 535		**N=61 (FGLINW*)**		**Significance**	**Effect Size**
Types of Devices	**Never/Rarely**	**Regularly/Frequently**	**Never/Rarely**	**Regularly/Frequently**	**Y / N**	**Cramer's V**
Laptop	56 (10.5%)	479 (89.5%)	5 (8.2%)	56 (91.8%)	N	-
Desktop	320 (61.1%)	204 (38.9%)	32 (54.2%)	27 (45.8%)	N	-
iPad	458 (87.7%)	64 (12.3%)	53 (86.9%)	8 (13.1%)	N	-
Chromebook/Android tablet	480 (91.6%)	44 (8.4%)	53 (93.0%)	4 (7.0%)	N	-
Smartphone	294 (55.5%)	236 (44.5%)	30 (50.0%)	30 (50.0%)	N	-
Use of Public Computer Devices to Complete Coursework						
Check out from school	497 (93.1%)	37 (6.9%)	50 (82.0%)	11 (18.0%)	Y (χ2=21.411*)	0.20
Use community computer device (Public library/Workforce Dev./The Y)	501 (93.8%)	33 (6.2%)	50 (82.0%)	11 (18.0%)	Y (χ2=10.989***)	0.19

*FGLINW = First Generation, Low Income, Nonwhite; *p <= .05, **p <= .01, ***p <= .001

Respondents' overall usage of public computers (Table 1) indicated that outcomes for the FGLINW group were worse than that of the main group across all categories. Significantly, for the FGLINW group, 18% checked out computers from school (main sample: 7%) while 18% availed of computer devices in community settings to access courses materials (main group: 6%). Group differences were significant, albeit with medium effect sizes [21]. Effect sizes based on four categories (Never, Rarely, Regularly, Frequently) were calculated using Cramer's V. This lends credibility to the importance of the findings.

Table 2: Internet Access

Table 2: Access to Internet Services to Access and Complete Coursework						
	N = 535		N=61 (FGLINW*)		Significance	Effect Size
	Never/Rarely	Regularly/Frequently	Never/Rarely	Regularly/Frequently	Y / N	Cramer's V
Home Internet	34 (6.4%)	500 (93.6%)	4 (6.6%)	57 (93.4%)	N	-
School Internet	66 (12.4%)	468 (87.6%)	3 (4.9%)	58 (95.1%)	N	-
Work Internet	371 (69.7%)	161 (30.3%)	33 (54.1%)	28 (45.9%)	Y (χ^2=7.450*)	0.14
Community Internet	459 (86.3%)	73 (13.7%)	40 (65.6%)	21 (34.4%)	Y (χ^2=14.698**)	0.27
Store Internet	448 (84.4%)	83 (15.6%)	43 (70.5%)	18 (29.5%)	Y (χ^2=12.990**)	0.18

*FGLINW = First Generation, Low Income, Nonwhite; *p <= .05, **p <= .01, ***p <= .001.

There were significant intergroup differences in access and usage of Internet resources outside of school and home (Table 2) with the FGLINW group using Internet resources at higher rates at work (46% vs 30% for the main group), in community settings (34% vs 14% for the main sample), and in store settings (30% vs 16% for the main sample). Medium effect sizes, based on four categories, were observed with respect to the above referenced group differences, underscoring the significance and meaningfulness of the results. In addition, 6% and 10% of respondents from the main sample and the FGLINW group, respectively, reported not having access to reliable Internet services at home (Table 3). These findings suggest uneven and differential access to residential Internet usage, which might help explain greater usage of work and community-based resources.

Table 3: Technological Access and Awareness

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	N = 535			N=61 (FGLINW*)			Significance	Effect Size
	Yes	No	DK	Yes	No	DK	Y / N	Cramer's V
Own a laptop/desktop	512 (95.7%)	23 (4.3%)	NA	53 (86.9%)	8 (13.1%)	NA	Y (χ^2=4.902*)	0.16
Share a laptop/desktop	123 (23.5%)	401 (76.5%)	NA	18 (30.0%)	42 (70.0%)	NA	N	-
Computer runs reliably on latest software	452 (84.6%)	36 (6.7%)	46 (8.6%)	49 (80.3%)	5 (8.2%)	7 (11.5%)	N	-
Own a printer	376 (70.4%)	152 (28.5%)	6 (1.1%)	31 (50.8%)	30 (49.2%)	-	Y (χ^2=24.799***)	0.17
Access to a printer	507 (94.9%)	23 (4.3%)	4 (0.7%)	56 (91.8%)	5 (8.2%)	-	Y (χ^2=18.106***)	0.08
Virus protection	393 (73.7%)	98 (18.4%)	42 (7.9%)	39 (63.9%)	15 (24.6%)	7 (11.5%)	Y (χ^2=9.165**)	0.08
Browser will play multimedia	463 (86.7%)	28 (5.2%)	43 (8.1%)	52 (85.2%)	5 (8.2%)	4 (6.6%)	Y (χ^2=8.338*)	0.05
Access to reliable Internet services at home	487 (91.4%)	32 (6.0%)	14 (2.6%)	52 (86.7%)	6 (10.0%)	2 (3.3%)	N	-
Know someone outside of school for tech help	388 (72.7%)	116 (21.7%)	30 (5.6%)	34 (55.7%)	26 (42.6%)	1 (1.6%)	Y (χ^2=14.233***)	0.19

*FGLINW = First Generation, Low Income, Nonwhite; *p <= .05, **p <= .01, ***p <= .001; NS = Not Significant

With respect to Technological Access and awareness (Table 3), while outcomes for the FGLINW group were worse across the board, crucially, there were statistically significant differences in outcomes between the FGLINW group and the main group with 13% not owning a computer (main sample: 4%), 49% not owning a printer (main sample: 29%), 8% not having access to a printer (main sample: 4%), 25% not having adequate virus protection (main sample: 18%), 8% not having browser capability to play multimedia (main sample: 5%), and 43% not having access to a resource that might assist with technical issues associated with device usage (main sample: 22%).

Amongst the categories with significant group differences, medium effect sizes (based on three categories - Yes, No, Don't Know) were noted with respect to ownership of computer devices, printer ownership, and access to technical help outside of school alluding to the meaningfulness of the results. While group differences were found to be significant for printer access, virus protection, and browsers that were able to access and handle multimedia content, effect sizes for these categories were found to be small.

Additionally, although intergroup differences were not significant, it is worth highlighting that within the main sample, almost a quarter shared a computer device with their family members, and 7% did not have a computer that reliably ran the latest software.

Table 4: Smartphone Usage

Table 4. Smartphone Usage by Demographic & Personal Characteristics			
Variables	**Pearson Chi-square**	**Significance**	**Effect Size (Cramer's V)**
College Cumulative GPA	10.341	.03*	0.14
Transfer Status	2.445	.07^{+}	0.07
Independent Status (For Financial Aid)	1.971	.09^{+}	0.06

$^{+}$p <= .1, *p <= .05

Group differences for smartphone usage to access and complete coursework was significant by GPA, transfer, and independent student status (Table 4). A Chi-square test of significance was employed to detect group differences in smartphone usage by academic performance measured by GPA and other disadvantaged characteristics (first generation, low income, nonwhite, transfer, and independent status).

Students with higher GPAs (3.1 and higher) were light users of smartphones (medium effect size). Transfer and independent students were light users at a marginally lower level of significance. Group differences by first generation, income, and nonwhite status were not significant and could be attributable to the homogenous nature of the sample. A possible reason of non-significance may be rooted in the fact that the sample itself is drawn from a population that is largely underserved (students mostly belonging to first generation and low income communities irrespective of race/ethnicity and academic under preparedness) thereby rendering it homogenous enough to preclude discovery of significant differences between groups (income, race/ethnicity, first generation status).

The results from this survey indicate substantial usage of smartphones to access course materials and complete assignments (Table 1), with 45% of the respondents in the larger sample and half of the respondents in the FGLINW group reporting usage of smartphones regularly or frequently to access course materials. Additionally, these results indicate that such usage of smartphones to meet academic needs is likely informed by the lack of adequate Technological Access (appropriately functioning desktops/laptops, shared access to devices, consistent Internet connectivity, etc.), as discussed earlier.

5. DISCUSSION

The above findings have resonance with national statistics aggregated by the PEW Research Center [6] that indicates that in American households, access to computer devices and Internet is differentially distributed based on socioeconomic status or annual family income, and that the relative lack of access to computer devices or Internet for students from lower economic backgrounds impedes their ability to complete academic coursework at a much higher rate than their counterparts from higher economic backgrounds [13, 30]. The access woes of the FGLINW subgroup mirrors national statistics reporting that these disparities are particularly pronounced in African American and Hispanic households, given the strong correlation between income and race/ethnicity [2, 3]. As access to ICT peaks, the digital divide is increasingly characterized by the inability to maintain access [13].

Additionally, survey results with respect to respondents' access to the latest software, virus protection, or a resource who could assist them with technology related problems were consistent with prior research indicating that disparities in access to devices alone is not the only problem facing students [28] and that a nuanced evaluation of the incidence of digital divide among disadvantaged groups should include consideration of issues related to Internet speed, software, and levels of technological maintenance and engagement [13, 26].

The significantly higher incidence of the FGLINW group's usage of work, community, and store Internet highlights the persistent digital divide prevalent in disadvantaged communities. The higher usage of devices borrowed from the school by the FGLINW sample alludes to the challenges pertaining to reliable device access within this group and underscores the importance of institutional programs geared towards improving access in ameliorating the digital inequality. This has wide implications with respect to narrowing the educational equity gap, especially since COVID-19 imposed near universal shift to remote learning was predicated on students having access to reliable computers and the Internet.

This study demonstrates how a subset of students who were first generation, low income, and of minority status encountered digital obstacles related to accessing and completing school related work due to lack of reliable or functioning devices or needed to use a smartphone to complete coursework, a finding consistent with Vogel's study [30] that states that the digital divide persists despite low income Americans making gains in technological adoption.

Higher smartphone usage in this population of disadvantaged students mirrored US national trends with first generation, low income, and minority students in primarily mid to large sized masters and doctoral universities (public and private) viewing smartphones as

significantly contributory towards their academic success [10]. This study's findings about smartphone usage are also consistent with higher usage of mobile phones to access digital media as evidenced in populations characterized by low income, minorities, and/or infrequent Internet users [13, 6, 26]. Another study [19] surveying exclusively online students reported two-thirds completing some or all of their coursework via smartphones, with 20% using smartphones entirely to complete all course related activities.

Additionally, the findings of this study have implications for a changed higher educational landscape in the wake of COVID-19. When classes went virtual and students were forced to leave college campuses and head home, multiple family members were under one roof, which increased the demand for bandwidth and further strained already unstable internet connections, and limited availability of computer devices, and this impacted disadvantaged students disproportionately. Research on the digital divide found that class and race shaped the realities of online learning during the pandemic [22]. According to the authors, affluent and White students were able to draw upon financial and material sources of support to help mitigate the hurdles to learning posed by the pandemic, while less advantaged students, hitherto dependent on the college infrastructure for technological access, fared worse with unreliable and inconsistent access to technology hampering adaptation to changed higher education landscape characterized by online learning.

In addition, further financial strains stemming from pandemic induced job losses, and resultant housing and food insecurity impeded allocation of scarce financial resources to adapt to the changed realities of online only learning, thereby further increasing student reliance on smartphones, especially amongst disadvantaged demographics. Given that minority group members, younger, and lower income individuals are likely to be "smartphone-dependent" [27], the pandemic served to exacerbate already existing educational differentials further.

Given the negative correlation between GPA and smartphone usage levels, the reliance on smartphones to access coursework must be reckoned with within the ambit of the effect of such on student academic attainment. Without dedicated efforts ensuring that underserved and disadvantaged students' particular technology related needs are met, universities may continue to reproduce the digital inequities they are supposed to diminish.

6. LIMITATION

This study was conducted on students attending a single institution whose student population exhibited underserved characteristics such as first generation, low income, or minority status. A more heterogeneous and diverse sample demographic across several institutions could have allowed for more diversity in findings and possibly different levels of group level differences. The design of the study was survey research using a self-report questionnaire, and thus is subject to the weaknesses related to self-reporting. Responses were limited to the honesty and accuracy with which respondents completed the questionnaire. Notwithstanding, the study sample represented the institution's student body stratification well in major demographic areas thus allowing for meaningful generalization.

7. RECOMMENDATIONS

In an educational milieu where reliable, consistent, and adequate access to technological devices and services is key to student success, not all students may have access to such. Some students contend with older devices that are hand-me-downs or are outdated, slow, unreliable, and/or incapable of meeting the needs of online instruction (multimedia, video-conferencing, etc.) while many others rely on smartphones to access coursework.

Exploring a range of purchase or loan options, as is common in many K-12 settings, might help remedy the digital inequity arising from uneven device ownership and access. Additionally, a robust tech support system that can troubleshoot computer issues could help ameliorate technology related problems that students lack competencies to solve on their own. Student support services must be dispensed with an equity lens, recognizing that our most disadvantaged collegiate populations have been disproportionately affected by the pandemic amidst already existing achievement gaps. Faculty need to be cognizant of disparate access issues to ensure not requiring sophisticated and high bandwidth course content at all times. When possible, course content should be mobile optimized given that disadvantaged students use smartphones heavily for accessing coursework. Such efforts can go a long way toward improving student success.

Future research could explore the extent of the digital divide at institutions serving a similar demographic as well as at institutions in general. A more in depth and targeted investigation of how smartphones are compensating for gaps in computer ownership and reliable internet access can offer more insights into how digital inequalities are hindering academic achievement.

8. CONCLUSION

This study is unique as it explores device ownership, access, and usage at a different level of granularity than

has been previously explored. The analysis highlights the incidence of digital divide pertaining to Technological Access among an already disadvantaged student demographic that is growing in higher education but on whose specific outcomes, there is limited research. An additional finding of this study is the likelihood that smartphone usage by the respondents is informed by the absence of adequate, consistent, and reliable access to devices and Internet services.

Even though this study shows high levels of ICT access, existing literature emphasizes the need to critically evaluate such higher levels of ICT access amongst American students against the backdrop of the qualitative characteristics of such access, namely, reliability, and consistency, factors that lead to students accessing course content increasingly via smartphones, especially as it pertains to students from disadvantaged backgrounds. The high rate of smartphone usage within this survey sample of predominantly disadvantaged students, therefore bears scrutiny, especially in light of significant and meaningful findings with respect to usage of public resources (devices and Internet) to complete coursework as the latter might point to the qualitative shortcomings in access that existing literature references. This is particularly troublesome, given that educational attainment has been found to be negatively correlated with "cell-mostly" users [26]. Gonzales et al. 13] reveals how "the insidious nature of under-connectedness may be associated with quality of life and academic achievement" (p.15).

Technological Access and consequently academic success remains an issue of concern for students coming from underserved and disadvantaged backgrounds, especially in the context of online learning environments. This matter is of particular importance given the higher incidence of online learning in the pandemic era. Higher education has undergone rapid change over the past two years. The COVID-19 pandemic has widened the educational equity gap [17, 22, 24]. With technological devices and Internet usage becoming a ubiquitous part of our lives, and an indispensable part of education, digital inequities are widening the educational equity gap. The digital divide with respect to Technological Access amongst underserved students must be addressed if the achievement gap is to be narrowed. Addressing such gaps will not only help disadvantaged students maximize their educational opportunities but will also prepare them to navigate the challenges of an increasingly technology driven society.

9. ACKNOWLEDGMENT

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