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AN EXPLORATORY STUDY OF ONLINE EQUITY: DIFFERENTIAL LEVELS OF TECHNOLOGICAL ACCESS AND TECHNOLOGICAL EFFICACY AMONG UNDERSERVED AND UNDERREPRESENTED STUDENT POPULATIONS IN HIGHER EDUCATION

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ABSTRACT

Aim/Purpose	This study aims to explore levels of Technological Access (ownership, access to, and usage of computer devices as well as access to Internet services) and levels of Technological Efficacy (technology related skills) as they pertain to underserved (UNS) and underrepresented (UNR) students.
Background	There exists a positive correlation between technology related access, technology related competence, and academic outcomes. An increasing emphasis on expanding online education at the author's institution, consistent with nationwide trends, means that it is unlikely that just an increase in online offerings alone will result in an improvement in the educational attainment of students, especially if such students lack access to technology and the technology related skills needed to take advantage of online learning. Most studies on levels of Technological Access and Technological Efficacy have dealt with either K-12 or minority populations with limited research on UNS and UNR populations who form the majority of students at the author's institution.
Methodology	This study used a cross-sectional survey research design to investigate the research questions. A web survey was sent to all students at the university except first semester new and first semester transfer students from various disciplines (n = 535). Descriptive and inferential statistics were used to analyze the survey data.
Contribution	This research provides insight on a population (UNS and UNR) that is expanding in higher education. However, there is limited information related to levels of Technological Access and Technological Efficacy for this group. This paper is timely and relevant as adequate access to technology and

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technological competence is critical for success in the expanding field of online learning, and the research findings can be used to guide and inform subsequent actions vital to bridging any educational equity gap that might exist.

Findings A critical subset of the sample who were first generation, low income, and non-White (FGLINW) had significantly lower levels of Technological Access. In addition, nearly half of the survey sample used smartphones to access online courses. Technological Efficacy scores were significantly lower for students who dropped out of or never enrolled in an online course. Transfer students had significantly higher Technological Efficacy scores while independent students (determined by tax status for federal financial aid purposes) reflected higher Technological Efficacy, but at a marginally lower level of significance.

Recommendations for Practitioners Higher education administrators and educators should take into consideration the gaps in technology related access and skills to devise institutional interventions as well as formulate pedagogical approaches that account for such gaps in educational equity. This will help ensure pathways to sustained student success given the rapidly growing landscape of online education.

Recommendation for Researchers Similar studies need to be conducted in other institutions serving UNS and UNR students in order to bolster findings and increase awareness.

Impact on Society The digital divide with respect to Technological Access and Technological Efficacy that impacts UNS and UNR student populations must be addressed to better prepare such groups for both academic and subsequent professional success. 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.

Future Research Given that it is more challenging to write papers and complete projects using a smartphone, is there a homework gap for UNS and UNR students that may impact their academic success? What is the impact of differing levels of Technological Efficacy on specific academic outcomes of UNS and UNR students?

Keywords underserved, underrepresented, technological access, technological efficacy, COVID-19, pandemic

INTRODUCTION

Over the past decade, institutions of higher education have been offering more online courses and programs, and the number of college students enrolled in at least one online course, as well as the proportion of all enrolled students who are studying online have been increasing (Allen et al., 2016; Cohen & Baruth, 2017; Ginder et al., 2017). In the US, online student enrollment has increased over 14 consecutive years (Seaman et al., 2018). Online learning has become mainstream (Allen et al., 2016) and has made learning accessible, convenient, and flexible (Parsad & Lewis, 2008).

While the institutional desire to increase student access to post-secondary education has resulted in the roll out of more online programs and course offerings, important questions to be considered with respect to uniformity of online educational access remain, given that the digital divide continues to be a persistent problem in the United States (Gonzales, 2016; Ritzhaupt et al., 2013; Rowsell et al., 2017; Warf, 2019). Online students also need to possess medium to high levels of confidence and skills with respect to utilizing the Internet for performing online tasks and interacting with others (Hauser et al., 2012; Kuo & Belland, 2016).

The share of minority students and students who are in poverty are on the rise at minimally selective and open admission post-secondary colleges and universities (Fry & Cilluffo, 2019). In light of this, questions exploring the extent of students' access to technology (Technological Access) and level of technological competence (Technological Efficacy), which together are essential for success in online educational endeavors at the post-secondary level, are pertinent. This is especially true for students whose demographic backgrounds are strongly suggestive of risk factors that impact academic achievement.

In keeping with national trends over the past decade, decreasing post-secondary enrollment coupled with continued declines in state funding have led to reduced enrollment at the author's institution, a small Midwestern public university. Recognizing the key role of tuition and fee revenue as a significant component of its sustenance, the institution has been growing its online courses and programs to attract more students. Consequently, the share of online courses as a percent of total courses offered has increased from 12.4% in 2017-18 to 18.1% in 2018-19 to 21.1% in 2019-20 (online course offerings - 2017-18: 421; 2018-19: 573; 2018-19: 699). While the uncertainty stemming from Covid-19 precludes an accurate projection of online course offerings for 2020-21, the general consensus in the institution is that online course offerings will remain constant at the very least, if not grow in response to the public health crisis.

As per university data, the author's institution caters to a demographic characterized by students who are first generation (55%), low income (40%), minority (35%), adult (25%), and academically underprepared (70%) with overall low post-secondary education completion outcomes (6 year graduation rate of 30.5% for first time, full time first year students; 39.6% for transfer students). The institution also draws students from inner city, high poverty zip codes. Given the increasing focus at the author's institution on expanding its online course offerings, the concerns about levels of Technological Access and Technological Efficacy acquire specific relevance as a significant part of the institution's student demographic may be characterized as underserved and underrepresented.

Underserved (UNS) students refer to those who may possess one or more of several at risk characteristics, such as belonging to lower economic status, first generation college attendees, minorities, academically unprepared, under credited and not on track to graduate (Zielezinski & Darling-Hammond, 2016). Underrepresented (UNR) students refer to those with one or more of the following characteristics: low income, first generation, minority background (Gershenfeld et al., 2016; Hurd et al., 2016).

Research indicates the existence of a positive correlation between technology related access and academic outcomes (Anderson & Perrin, 2018; Liu et al., 2007) as well between technology related competence and academic outcomes (Hauser et. al., 2012). In light of the above, the institution's student demographics, and its increased focus on expanding online education, it is unlikely that an increase in online offerings alone will result in an increase in the educational attainment of UNS and UNR students if such students lack the appropriate access to technology and the technology related skills needed to take advantage of online learning. In order for increased online course offerings to translate to improved access and sustained success, it is important to undertake a critical examination of whether there exists technology related access and efficacy barriers to online learning within the subject population. Such findings may then guide and inform subsequent actions vital to bridging any educational equity gap that might exist. The effect of the digital divide as it relates to Technological Access and Technological Efficacy needs to be examined closely for institutions serving a higher proportion of UNS and UNR demographics. This is an important topic of inquiry given the changing demographics of post-secondary enrollment (Fry & Cilluffo, 2019) and that student learning is taking place increasingly in digital environments (Seaman et al., 2018).

There is significant amount of research on both the existing gap in technological skills as it pertains to K-12 students, minority students, and the digital divide in American societies (Cotton et al., 2011, 2014; Gonzales, 2016; Huang et al., 2017; Kuo, 2018; Vigdor et al., 2014). However, there is limited research that delves into technology related access and efficacy woes of a mixed group of college students who may be of White or minority status but may also possess other characteristics such as lower economic status, first generation college attendee status, and academic under preparedness, all of which, standalone or in combination, may predispose them to underachievement, thereby classifying them as disadvantaged students (UNS and UNR). Additionally, given that the author's institution has had a recent uptick in online offerings and draws its students from primarily UNS and UNR communities, it is crucial to examine whether such students possess the necessary Technological Access and Technological Efficacy to take advantage of online learning.

The objective of this study was to explore and gain insights into levels of Technological Access and Technological Efficacy for UNS and UNR students, as this would help determine whether there exist gaps in access to technology and gaps between technology related competence and the skills needed to be successful in an online learning environment. The outcome of the study could reveal differences in either levels of Technological Access or levels of Technological Efficacy or both, or, alternatively, the absence of any meaningful differences. The findings are expected to help inform institutional and faculty outreach efforts, should the existence of differential levels of Technological Access and/or Technological Efficacy be confirmed. In order to do so, the following research questions were investigated:

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 in a small public Midwestern university that primarily serves underserved and underrepresented populations?
2. What is the Technological Efficacy level of students in a small public Midwestern university that primarily serves underserved and underrepresented populations?

These questions were examined using a cross sectional survey design. Data was collected via an online survey administered to the entire student population excluding all first semester students (new and transfer) to ensure that respondents had had the opportunity to complete an online course at the author's institution. A survey sample consisting of 535 student responses was analyzed using SPSS.

The paper details existing literature on Technological Access and Technological Efficacy. The survey instruments, sample, and types of statistical analysis performed are discussed, and discussions of results and consequent recommendations as well as topics for possible future research are provided.

LITERATURE REVIEW

UNDERSERVED AND UNDERREPRESENTED CHARACTERISTICS

Underserved (UNS) populations refer to a broad group of learners who may possess one or more of several at risk characteristics such as belonging to lower economic status, first generation college attendees, minorities, testing into remedial courses (academically unprepared), under credited (not full time status), and not on track to graduate (Zielezinski & Darling-Hammond, 2016). Other studies have included transfer students in this category as well (Finley & McNair, 2013). In the context of educational inequities, underserved students have been identified as those that lack access to high-quality educational and career planning opportunities and resources (Moore et al., 2018). Underrepresented (UNR) populations refer to students who are economically disadvantaged, and/or minorities (Gershenfeld et al., 2016), and/or first generation (Hurd et al., 2016).

In this study, the words underserved (UNS) and underrepresented (UNR) are used to describe disadvantaged students -- either low income, and/or first generation, and/or students of color, and/or academically at risk students where academically at risk refers to, singly or in combination, academically underprepared, and under-credited. First generation is defined as students whose parents' education is high school or less. Low income is synonymously used with Pell Grant eligibility. Students of color are those who identified their race/ethnicity anything other than White. Under-credited refers to students who carry an academic course load of less than 12 credit hours per semester. Academically under prepared refers to students who enter college needing remedial coursework. Students who are first generation, low income (Pell Grant eligible), and non-White, are designated as FGLINW. For the purposes of this research, use of the terms “underserved (UNS)” or “underrepresented (UNR)” is meant to refer to students with one or more of the aforementioned socio-demographic markers and is not intended to stand in for a comprehensive definition of the term. Rather, it is being used as the operational lens delineating the scope of the review.

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 (Hohlfeld et al., 2008). 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 (Beaunoyer et al., 2020). 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 respect to obtaining benefits from use of technology.

In the context of the changes in the higher education landscape with institutions offering more online courses and programs (Allen et al., 2016), and especially more so in the wake of a global pandemic, questions with respect to the existence of the digital divide and its impact on student learning outcomes acquire primacy. This is pertinent for UNS and UNR students who are liable to be particularly susceptible to the effects of the digital divide.

In this study, Technological Access refers to access to ICT – access to and use of computers, mobile devices, and access to Internet. Technological Efficacy refers to technology related skills and competence that, standalone or together, allow for utilization of digital technologies such as computers, mobile devices, and the Internet for the purposes of learning.

Technological Access

There is considerable amount of research, as discussed below, on unequal access to technology in the US in relation to UNS and UNR characteristics such as socioeconomic status and ethnicity, variables relevant to the demographics of this study. Accordingly, students coming from minority and lower income households are less likely to have access to reliable computer devices and Internet at home.

A PEW Research Center survey on how different demographic groups in the US have fared in the digital age reports that the digital divide persists even as lower income Americans have made gains in technology adoptions (Anderson & Kumar, 2019). According to this report, for households with annual income less than $30,000, approximately 29% do not own a smartphone, 46% do not own a computer, and 44% do not have home broadband services. In contrast, higher-income Americans are more likely to have multiple devices that enable them to access the Internet. Roughly two-thirds of adults living in high-earning households (64%) have home broadband services, a smartphone, a computer, and a tablet, compared with 18% of those living in lower-income households.

According to another PEW Research study (Anderson & Perrin, 2018), this stratification and differential access by annual household income acts as an impediment to completion of homework assignments, commonly known as the homework gap for those on the lower end of the income scale. Overall, about 15% of US households with school-age children (6 to 17 years) do not have broadband internet connection at home which constitutes about 35% of lower income households. The authors cited Horrigan’s (2015) findings to note that this disparity is particularly pronounced in

African American and Hispanic households. According to this report, lacking reliable Internet service at home, these teens seek out public Internet services to complete assignments. Teens whose family income is below $30,000 a year are far more likely to say that they use public Internet services to complete assignments than those whose annual household income is $30,000 or higher (21% vs. 9%). This facet of the digital divide is an additional burden on African American and Hispanic youth that contributes to the achievement gap.

A study by Vigdor et al. (2014) examined computer ownership and access to broadband Internet services among middle school students in North Carolina Public School system. Computer access was negatively associated with race and socioeconomic status (SES). While 90% of White students had a computer at home, computer ownership was 75% for African Americans. The study reported existence of significant differences in device ownership and frequency of computer use for school work based on race and socioeconomic status. Affluent and White students used computers to complete homework more frequently compared to students from lower income and minority populations.

In a national study, Mossberger et al. (2006) looked at home computer access and frequency of home Internet use in high poverty zip codes that comprised of White non-Hispanic populations (70%) as well as minorities, based on Census data from all 50 US states. The study found concentrated poverty to have a significant impact on lower access to technology. In zip codes where income levels were at least one standard deviation below that of the median poverty level, the study reported that Whites, Asians, African Americans, and Hispanics had lower access rates to home computers and the Internet. A second finding of the study was that within zip codes impacted by concentrated poverty, African Americans and Hispanics had relatively lower access outcomes than Whites. This was due to the fact that levels of racial segregation increased with increase in levels of poverty, and segregated communities, in turn, had differential levels of access to public infrastructure and facilities as well as social interactional dynamics that impede technological awareness and access.

A similar study by Mossberger et al. (2008) on patterns of computer use and Internet access in three disadvantaged Ohio communities that were poor and either White or African American reported work, school, friend/relative's residence, and libraries to be frequent destinations for computer and Internet access in the absence of such amenities at home. Respondents who were more affluent were statistically more likely to use the Internet at home than those who were poor. A subsample who did not have access to a computer at home or at work were mostly African American with lower incomes, even though income was not found to be a predictor of Internet use, perhaps because of the homogeneity of the subsample. Overall, African Americans were statistically less likely to have access to a computer and were less likely to use the Internet when compared to Whites.

In Gonzales' study (2016), qualitative interviews from 72 low-income urban US residents revealed the struggles that poor communities face to maintain stable Internet access. Respondents from impoverished communities experienced regular disruptions in access to and use of Internet, primarily due to the inability to pay monthly service bills, repair malfunctioning hardware, and constraints on public access (e.g., library hours, time-limits at terminals, distance to public resources and limitations of transportation options). Consequent to the absence of Internet services at home or restricted/intermittent access to the same, the study found that almost half of the respondents resorted to smartphones to access the Internet. According to the study, cost of acquisition and maintenance of device hardware as well as access to resources that might be able to provide technological assistance related to maintenance and repair of devices were other issues where lower income residents suffered in contrast to individuals with higher incomes.

Tsetsi and Rains (2017) analyzed smartphone dependence and usage patterns on a nationally representative sample of 2,254 adults. Topics covered in the phone interviews included Internet access, use, and perceptions of the importance of the Internet in respondents' lives. Whites were significantly less likely to be smartphone dependent and more likely to be owners of multiple devices than minorities. Economic status was a significant factor with individuals from lower income backgrounds reporting limited or no access to the Internet. Additionally, smartphone dependent users tended to belong to significantly lower income groups when compared to multimodal users.

A national study on undergraduate students' (n = 64,536) use of technology in 114 doctorate granting institutions by the non-profit agency Educause Center for Analysis and Research reported that minority, first generation, and low income college students viewed smartphones as significantly contributory towards their academic success (Galanek et al., 2018).

Results from a 2018 nationally representative survey of 1,500 exclusively online students in the US (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 (tablet or smartphone but not a laptop), 20% used mobile devices solely for coursework completion, and a significant plurality reported using mobile devices to access educational materials online (Magda & Aslanian, 2018).

These findings were corroborated by another PEW Research survey that reported 19% of millennials and 17% of Gen Xers in the US do not have home broadband and rely on smartphones only to access the Internet (Vogels, 2019). Anderson and Kumar (2019) also reported that the share of lower income Americans relying solely on smartphones to go online (effectively, respondents who owned a smartphone but did not have broadband internet at home) had doubled from 12% in 2013 to 26% in 2019.

Anderson and Perrin (2018) also reported that 35% of teens often or sometimes complete 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 (2016, p. 563), 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.

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. Liu et al.'s (2007) 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. This further underscores the significance of such disparities. This issue was also discussed by Rowsell et al. (2017) in noting that lack of adequate Technological Access is likely to impede student engagement in online educational activities and interaction thereof in ways that help foster critical thinking.

Therefore, gaps in Technological Access, if present, are likely to impede realization of learning outcomes despite the increase in access to education via increase in online offerings. This, then, gives rise to the need to evaluate levels of Technological Access in UNS and UNR students in higher education.

Technological Efficacy

Research on levels of technology skills possessed by undergraduate students in a minority serving US institution found that students did not possess the necessary technology skills needed to be successful in college and that there was a gap between the students' skill levels and the computer skills necessary for success (Buzzetto-Hollywood et al., 2018). The study found this gap to be more pronounced for underrepresented students. These findings support the concerns regarding the presence and impact of the digital divide in higher education, at least in the dimension that references student ability to use computing technology. This leads to the question of whether such a gap exists in student ability and skills as they relate to use of technology for a post-secondary student population in an institution that serves a higher proportion of UNS and UNR students.

Digital technologies are playing an increasing role in education due to the increase in online courses aimed at bridging the access gap to post-secondary learning (Allen et al., 2016; Parsad & Lewis, 2008). This observation leads to questions about whether there exists any gap between student ability/skills and computer skills necessary for success, and whether such gap is likely to act as an impediment to student learning in an online setting, thereby negating some, if not all of the gains in educational access that are sought to be achieved by moving to online course delivery mode.

In light of the above, Technological Efficacy, then, refers to skills related to use of computer devices and skills related to use of the Internet that, standalone or together, facilitate the use of technology for the purposes of learning. Technological self-efficacy, on the other hand, consists of a person's perception in his or her own capabilities to use computer skills in the accomplishment of a computer related task, also known as Computer self-efficacy (Compeau & Higgins, 1995b), and a person's "belief in one's capabilities to organize and execute courses of Internet actions required to produce given attainments," also known as Internet self-efficacy (Eastin & LaRose, 2000, p. 1).

Existing literature indicates that Technological self-efficacy and performance in technology related tasks are positively correlated (Compeau & Higgins, 1995a; Hauser et al., 2012), and that Technological self-efficacy contributes to development of technological skills that constitute Technological Efficacy (Compeau & Higgins, 1995a; Compeau et. al., 1999; Eastin & LaRose, 2000). As such, in the absence of tests examining actual levels of Technological Efficacy of a sample, self-assessment of technological skills or Technological self-efficacy is used to infer Technological Efficacy. The linkage between Technological self-efficacy and development of technological skills has been progressively established via the findings of several studies, which are discussed below.

Two related Canadian studies (Compeau and Higgins, 1995b; Compeau et al., 1999) conducted on managers and professionals found computer self-efficacy to exert a significant influence on individuals' expectations of the outcomes of using computers, their emotional reactions to computers (affect and anxiety), as well as their actual computer use. Together, the findings indicated that individuals with high levels of computer self-efficacy experienced less anxiety, had higher outcome expectations, perceived themselves to be able to accomplish difficult computer related tasks, judged themselves as capable of operating with less support and assistance, and used computers more. These findings were similar to Kuo's study (2018) of African American working adult undergraduate students at an US institution that found learner's levels of computer self-efficacy to be a good predictor for computer anxiety. The correlation between levels of computer self-efficacy and anxiety and attitude towards computers was echoed in another study of African American working adult undergraduate students (Kuo & Belland, 2019) that found that learners with lower levels of computer self-efficacy exhibited anxiety related negative attitudes towards computers while learners with higher levels of computer self-efficacy exhibited positive attitudes towards computers.

Such a relationship between levels of computer self-efficacy and anxiety and attitude towards computers appears to be reasonable given that negative emotions towards computers is likely to impact learners' confidence level in performing computer related tasks. This is supported by Saadé and Kira's study (2009) on first year undergraduate students at a Canadian university that found (1) computer anxiety had a significant effect on perceived ease of use of a learning management system (LMS), (2) computer self-efficacy acted as a significant mediator in reducing the strength and significance of the impact of computer anxiety on perceived ease of use of an LMS, and (3) the existence of a strong and significant relationship between computer self-efficacy and computer anxiety.

Additional research, as discussed below, indicates that higher levels of technology related self-efficacy are not just correlated to reduced levels of learner anxiety related to technology but also positively affect levels of learner confidence in adoption and use of technology. Gangadharbatla's study (2008) found Internet self-efficacy to be a significant predictor of willingness to join in and exhibit positive attitudes towards social networking sites among undergraduate college students at a large southwestern US university. The study cites Daugherty et al.'s (2005, p. 71) findings that usage and adoption of internet related technologies depends on the individual's "confidence in their ability to successfully understand, navigate, and evaluate content online" (p. 7). The study further surmises that the greater the ease with which an individual can perform tasks online, the greater should be the individual's ability to participate in online forums.

The findings from Gangadharbatla (2008) were consistent with another study (Eastin & LaRose, 2000) of undergraduate students enrolled in an introductory communication course at a large US university that found Internet self-efficacy and Internet use to be directly and significantly correlated. This was attributable to the fact that students were more likely to persist in behavior that they felt capable of performing (Oliver and Shapiro, 1993, as cited in Eastin & Larose, 2000). The study also found that Internet self-efficacy (1) directly influenced learner outcome expectancies, (2) was positively correlated to Internet usage, and (3) was strongly influenced by prior experience. The authors surmised that positive assessment of Internet self-efficacy directly influenced learners' outcome expectations, and such expectations along with lower stress and/or higher confidence associated with higher levels of Internet self-efficacy, promoted greater task persistence and influenced effort levels towards realizing such expectations. This, in turn, promoted greater use of technology and expanded technology related experience.

This assessment by Eastin and LaRose (2000) indicates that higher technology related self-efficacy leads to greater usage of technology that helps develop learner technology related skills, which then further bolsters technology related self-efficacy, thereby completing a positive feedback loop. Therefore, higher levels of Technological self-efficacy are likely to lead to higher levels of technology related skills or Technological Efficacy while lower levels of Technological self-efficacy are likely to lead to lower levels of Technological Efficacy. This is consistent with research conducted on 95 professionals and managers by Compeau and Higgins (1995a) that reported a significant positive relationship between prior experience and performance and between Technological self-efficacy and performance in technology related tasks. This study concluded that Technological self-efficacy strongly influences performance outcomes and that Technological self-efficacy represents a unique and important contribution to the development of technology related skills (Technological Efficacy).

The linkage between computer self-efficacy and online performance was also reported in a longitudinal study by Hauser et al. (2012) that examined the effect of computer self-efficacy, amongst other variables, on that of student performance. This study found that higher computer self-efficacy scores positively correlated to higher performance in online courses for undergraduate students at a midsized US university. Kuo and Belland's study (2016) of African American working adult undergraduate students found a similar linkage between Internet self-efficacy and performance. The study found higher Internet self-efficacy to be significantly and positively correlated with learner-content interaction, learner-learner interaction, and learner-instructor interaction in an online learning environment, which in turn, was positively correlated with satisfaction in online courses. Higher levels of satisfaction, in turn, was correlated with better academic performance.

The link between technology related efficacy and performance was also examined by Liu et al. (2007) in a meta-analysis of the determinants of online course dropout rates in a community college context. The authors noted that technology related efficacy, among other variables, was a key factor that influenced the decision to drop courses. The study found that the ability to use technology to achieve one's learning objectives was a significant factor influencing online success.

The literature shows that specific skills and knowledge related to technology (computer and Internet) are needed to perform tasks in an online learning environment, and that the ability to leverage such skills and use technology is a key factor that influences performance and success in online learning contexts. Therefore, lower levels of Technological Efficacy are likely not to lead to improvement in learning outcomes despite the increase in access to education via increase in online modes of instruction, which then gives rise to the need to evaluate levels of Technological Efficacy in UNS and UNR students in higher education.

The development of such skills (Technological Efficacy) needed to accomplish tasks is influenced by the learner's level of Technological self-efficacy. Technological self-efficacy determines level of anxiety, confidence, task persistence and effort, usage of technology, technology related experience, and development of skills eventually leading to Technological Efficacy. Technological Efficacy, in turn, leads to increase in Technological self-efficacy, thereby completing the learning reinforcement loop. In light of this, Technological self-efficacy is used as the appropriate construct for assessment of Technological Efficacy in a survey sample, in the absence of skills based tests for the latter.

METHODOLOGY

DESIGN, SAMPLE, AND DATA COLLECTION

Participants were 535 undergraduate students at University of Wisconsin-Parkside, a small public university in the Midwestern part of the United States, in the state of Wisconsin. The study used a cross-sectional survey research design to investigate the research questions. The author's institutional human subjects review board approved the study. Informed consent was obtained prior to participation in the survey and participants could discontinue at any time. Adequate steps were taken to protect participants' confidentiality.

Data was collected through a Qualtrics web survey. Email invitations to participate in the online survey were sent to the entire student body except for first semester new and first semester transfer students, thereby ensuring that the respondents had completed at least one semester at the institution – this was to ensure that the students had had the opportunity to complete online course(s). This yielded a student population of 2,800 students.

Procedures outlined by web survey experts to increase response rates, such as follow up contacts and incentives for survey completion, were employed. The initial email invite survey link was sent to all 2,800 students during the 7th week of the semester. Weekly reminder emails were sent to those who had not completed until the 14th week of the semester. Instructors were approached to announce the survey verbally in their face-to-face courses or in writing on their learning management system homepage. To increase response rate, the survey was incentivized. Students who completed the survey were placed in a draw to win Amazon gift cards.

The survey response rate of 19.1% was in line with the typical e-survey response rate range of 20-30% (Bosnjak & Tuten, 2001; Sheehan, 2001) and was consistent with general guidelines for descriptive research which deems a sample size of between 10-20% of population as acceptable (Gay, 1996).

RESEARCH QUESTIONS

The major research questions are outlined below:

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 in a small public Midwestern university that primarily serves underserved and underrepresented populations?
2. What is the Technological Efficacy level of students in a small public Midwestern university that primarily serves underserved and underrepresented populations?

INSTRUMENTATION

An online course was defined in the survey as a course where 100% of the course content was delivered online. The survey included a section to assess Technological Access and a section to assess Technological Efficacy. A third section gathered information on student personal and demographic characteristics.

The Technological Access questionnaire included questions on computer device usage and ownership and Internet connectivity, arranged in four subsections (Table 1). 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), availability and adequacy of software resources, and access to resources outside of school for tech support.

Table 1: Research Question 1 – Technological Access

Research Question	Independent Variable	Dependent Variable	Instrument	Scale	Analysis
Technological Access level of students	Group (Entire sample vs. FGLINW group)	Computer devices used to complete coursework	TA Questionnaire	1=Never 4=Frequently	Chi- Square analysis Table 5
	Group (Entire sample vs. FGLINW group)	Public computer devices used to complete coursework	TA Questionnaire	1=Never 4=Frequently	Chi- Square analysis Table 6
	Group (Entire sample vs. FGLINW group)	Access to Internet services to complete coursework	TA Questionnaire	1=Never 4=Frequently	Chi-Square analysis Table 7
	Group (Entire sample vs. FGLINW group)	Hardware and software access (Technological Access) characteristics	TA Questionnaire	1=Yes 2=No 3=Don't Know	Chi- Square analysis Table 8

The Technological Access questionnaire was developed by the researcher and was informed by a review of access characteristics investigated and reported in the literature as reported herein. The Pew Research Center analysis of 2015 and 2018 US Census Bureau data was based on questions that examined ownership of and reliable access to computer devices such as desktops, laptops, tablets, and smartphones, access to reliable Internet services at home, the use of public Internet services to complete coursework in the absence of access to the Internet at home, and use of cellphones to complete coursework (Anderson & Kumar, 2019; Anderson & Perrin, 2018).

Mossberger et al.'s study (2006) examined issues of computer access at home and frequency of home Internet use in high poverty zip codes that comprised of mostly White non-Hispanic populations based on 2000 Census data on all 50 US states. A similar study by Mossberger et al. (2008) examined patterns of computer use and Internet access in three Ohio communities that were poor and either White or African American. The survey asked questions about such usage at work, home, school, library, and friends/relatives' place. Vigdor et al.'s study (2014) examined computer ownership and access to broadband Internet service among secondary school students in North Carolina Public School system. A 2018 study (Galanek et al., 2018) surveying mostly 114 doctorate granting US institutions examined undergraduate students' computer and mobile device access and ownership attributes as well as residence/off campus Internet access features.

Questions on availability and adequacy of software resources and access to resources outside of school for tech support were developed by the author based on over ten years of personal experiences with students facing technology related hardships at the author's institution. Additional support for the survey question with respect to availability of tech support was found in Robles' study (2006) that examined, amongst other variables, the impact of support services on student satisfaction levels in online courses at an US undergraduate institution.

The Technological Efficacy questionnaire (Table 2) was based on a scale that required students to self-assess their skills and degree of comfort with respect to basic technological skills (Technological Efficacy). Technological Efficacy was an 8 item measure on a 5 point Likert scale with 1 = strongly disagree to 5 = strongly agree. The 8 items included perceptions of skillsets and preparedness related to using the computer and the Internet and to taking online courses.

The items included perceived comfortability with tasks related to typing, saving, and organizing files in a computer; surfing the Internet; finding Internet resources and setting bookmarks; uploading and downloading files; installing software and changing configuration settings; navigating a learning management software; and two items on perceived confidence related to taking and completing online courses.

Table 2: Research Question 2 – Technological Efficacy

Research Question	Independent Variable	Dependent Variable	Instrument	Scale	Cronbach's alpha	Analysis
Technological Efficacy level of students	Group Characteristics (Online course completion, Transfer, Federal Income Tax status – dependent / independent)	Mean TE Score	Felt comfortable typing, saving, and organizing files in a computer	1=Strongly disagree 5=Strongly agree (5 point Likert Scale)	0.82	Independent Samples T test; & ANOVA Table 9
			Felt comfortable surfing the Internet			
			Felt comfortable finding Internet resources (web search) and setting bookmarks			
			Felt comfortable uploading & downloading files			
			Felt comfortable installing software and changing configuration settings			
			Felt comfortable navigating a learning management software			
			Felt prepared to take an online course			
			Felt confident to complete an online course			

The Technological Efficacy questionnaire was developed based on a review of relevant literature and in consultation with faculty experienced in online teaching, and subject matter experts in the field of adult and distance education in the institution's Teaching and Learning Center.

The Technological Efficacy questionnaire was loosely based on review of three instruments: the Computer self-efficacy (CSE) questionnaire used by Santoso et al. (2014), the Internet self-efficacy questionnaire developed by Torkzadeh and Dyke (2001), and the Internet self-efficacy scale used by Robles (2006). The 29 item CSE questionnaire (Santoso et al., 2014) had three subsections on beginning skills (10 items), advanced skills (12 items), and file and software skills (7 items) with Cronbach's alpha scores of .93, .88, .90 respectively. The Internet self-efficacy questionnaire (Torkzadeh & Dyke, 2001) consisted of 17 items with three items representing confidence with browsing, another six items on encryption/decryption, and eight items on system manipulation. Cronbach's alpha reliability scores were .93, .98 and .94 for browsing, encryption/decryption and system manipulation, respectively. Overall reliability for the 17-item scale was .96. The 9 item Internet self-efficacy scale (Cronbach's alpha reliability score of .93) used by Robles (2006) consisted of student self-assessment of their abilities in browsing and navigating the Internet (7 items) and self-assessment of their abilities in taking and completing an online course (2 items).

Cronbach's alpha Reliability coefficient for the Technological Efficacy questionnaire used in this survey was .82 and can be considered reliable for perception related instruments (Wallen & Fraenkel, 2001). Construct validity for Technological Efficacy was established by pilot testing the instrument on a small sample (n = 50) at the author's institution.

The student personal and demographic characteristics section contained questions pertaining to students' gender, age, race/ethnicity, Pell Grant eligibility, independent/dependent tax status for financial aid, income, transfer student status, and first generation college attendee status.

According to Creswell (2008), content validity is typically established by researchers having a panel of judges or experts identify whether survey questions are valid. Content validity for the entire questionnaire was established as the instruments were developed based on a review of relevant literature and in consultation with subject matter experts in the field of adult and distance education in the institution's Teaching and Learning Center as well as faculty experienced in online teaching. Construct validity for the entire questionnaire was established by pilot testing the instrument on a small sample (n = 50) at the author's institution.

DATA ANALYSIS

Data were analyzed using quantitative methods. Tables 1 and 2 list the analysis methods used for each research question. The survey data was exported to SPSS 24.0 to run descriptive and inferential statistics. 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. Non-parametric (chi-square) test was employed while testing 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). However, if the sample size is sufficiently large, parametric tests (t-test and ANOVA) can be used to detect significance (Lumley et al., 2002), and as such parametric tests (t-test and ANOVA) were used to detect group differences with respect to Technological Efficacy.

Group differences between the main sample and the FGLINW subset with respect to Technological Access was measured using Chi-square test of significance. Group difference was the independent variable while types of computer devices used (desktop, laptop, tablet, and smartphone), types of public computer devices used (school lab, community computer lab, work computer), types of Internet access (home, school, work, community), and hardware/software access characteristics were dependent variables.

Technological Efficacy was the dependent variable used to discern if there were group differences (independent variable) among demographic variables such as race/ethnicity, low income, and first generation status and other personal characteristics such as independent or dependent status for financial aid purposes and transfer status. Independent sample t-test (for two categories in the independent variable) and analysis of variance (for three or more categories of the independent variable) were employed to check for significant group differences in mean Technological Efficacy scores.

SAMPLE DEMOGRAPHIC CHARACTERISTICS

There were a total of 535 respondents. A critical subset (n = 61) of the sample consisted of students who were first generation (FG), low income (LI), and non-White (NW), termed as FGLINW.

Females constituted 69% of the total sample and 72% of the FGLINW group. The majority of the sample (71.6%) and FGLINW group (73.8%) were 24 years or younger while non-traditional students comprised 28% and 26% of the sample and FGLINW group respectively (Table 3). A majority of respondents were White (66.6%) followed by Hispanic (15.1%), African American (8.3%) and Asian (5.1%). The FGLINW group comprised of Hispanic (50.8%), African American (24.6%), and Asian (14.8%) students.

For purposes of federal financial aid, students were asked to identify their federal tax status as independent (42.5%) or dependent (57.5%) and to report their individual or family income (if dependent status). A large majority (72.4%) of independent students (n = 221) in the total sample had incomes lower than $30,000 (official US poverty threshold in 2018 was $25,100 for a family of 4 and $29,420 for a family of 5) while the corresponding figure for the FGLINW group was 86%. For students who reported dependent status (n = 299), 30% had family incomes less than $30,000 while the corresponding figure for the FGLINW group was 58%. For those students who reported independent status, 88% had income less than $50,000 (below the US median income of $63,179 in 2018) while 93% of the FGLINW group had income less than $50,000.

For dependent students, 52% had family incomes lower than $50,000 compared to 79% in the FGLINW group who had family incomes lower than $50,000. Almost half (46.4%) of the respondents were Pell Grant recipients. Of the survey respondents, 38% were first generation college students, and 37% were transfer students (29.5% of the FGLINW group were transfer students).

Table 3: Demographics of Participants				
	Survey Sample		FGLINW Group	
Age	**N**	**%**	**N**	**%**
24 or younger	383	71.6	45	73.8
25-34	86	16.1	11	18.0
35-44	41	7.7	3	4.9
45-54	21	3.9	2	3.3
55+	4	0.7	0	0.0
Total	*535*	*100.0*	*61*	*100*
Gender	**N**	**%**	**N**	**%**
Female	367	68.9	44	72.1
Male	161	30.2	16	26.2
Other	5	0.9	1	1.6
Total	*533*	*100.0*	*61*	*100*
Race/Ethnicity	**N**	**%**	**N**	**%**
African American	44	8.3	15	24.6
Asian	27	5.1	9	14.8
Hispanic / Latinx	80	15.1	31	50.8
Native American	2	0.4	2	3.3
Native Hawaiian/Pacific Islander	1	0.2	1	1.6
White	353	66.6	0	0.0
Multiracial	23	4.3	3	4.9
Total	*530*	*100*	*61*	*100*
Income Status (Independent Students)	**N**	**%**	**N**	**%**
Less than $10,000	73	33.0	11	39.3
$10,001-$20,000	59	26.7	10	35.7
$20,001-$30,000	28	12.7	3	10.7
$30,001-$40,000	18	8.1	1	3.6
$40,001-$50,000	16	7.2	1	3.6
More than $50,000	27	12.2	2	7.1
Total	*221*	*100*	*28*	*100*
Income Status (Dependent Students)	**N**	**%**	**N**	**%**
Less than $10,000	28	9.4	11	39.3
$10,001-$20,000	20	6.7	10	35.7
$20,001-$30,000	38	12.7	3	10.7
$30,001-$40,000	31	10.4	1	3.6
$40,001-$50,000	37	12.4	1	3.6
More than $50,000	145	48.5	2	7.1
Total	*299*	*100*	*28*	*100*
Federal Pell Grant Recipient	**N**	**%**	**N**	**%**
Yes	248	46.4	61	100.0
No	286	53.6	0	0.0
Total	*534*	*100*	*61*	*100*
First Generation College	**N**	**%**	**N**	**%**
Yes	201	37.7	61	100.0
No	325	61.0	0	0.0
Don't know	7	1.3	0	0.0
Total	*533*	*100*	*61*	*100*
Transfer Student Status	**N**	**%**	**N**	**%**
Yes	196	37.0	18	29.5
No	334	63.0	43	70.5
Total	*530*	*100*	*61*	*100*

RESULTS

Of the 535 respondents, 233 (43.6%) had successfully completed an online course, another 225 (42.1%) never enrolled in an online course, and 77 (14.4%) had enrolled but dropped an online course (Table 4).

Table 4: Online Enrollment

	N	%
Enrolled and never dropped an online course	233	43.6
Enrolled but dropped an online course	77	14.4
Never enrolled in an online course	225	42.1
Total	*535*	*100*

TECHNOLOGICAL ACCESS

Due to the non-normal nature of the distribution, a chi-square test of significance was performed to discern if there were meaningful differences in device ownership as well as device and Internet usage characteristics between the whole sample (n = 535) and a critical subset of the sample who were first generation (FG), low income (LI = Pell Grant recipient), and non-White (NW), termed as the FGLINW group (n = 61).

Tracking the type of devices used to complete coursework (Table 5) 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. Comparatively, 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.

Table 5: Computer Devices Used to Complete Coursework

	N = 535		N = 61 (FGLINW*)		Significance
Types of Devices	**Never/Rarely**	**Regularly/Frequently**	**Never/Rarely**	**Regularly/Frequently**	**Y / N**
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

*FGLINW = First Generation, Low Income, non-White; $^{*}p <= .05$, $^{**}p <= .01$, $^{***}p <= .001$

Table 6: Use of Public Computer Devices to Complete Coursework

	N = 535		N = 61 (FGLINW*)		Significance
	Never/Rarely	**Regularly/Frequently**	**Never/Rarely**	**Regularly/Frequently**	**Y / N**
School Lab	386 (72.1%)	149 (27.9%)	40 (65.6%)	21 (34.4%)	N
Check out from school	497 (93.1%)	37 (6.9%)	50 (82.0%)	11 (18.0%)	Y (χ^2=21.411*)
Work computer	408 (76.3%)	127 (23.7%)	46 (75.4%)	15 (24.6%)	N
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***)

*FGLINW = First Generation, Low Income, non-White; $^{*}p <= .05$, $^{**}p <= .01$, $^{***}p <= .001$.

With regards to usage of public computers to complete coursework (Table 6), the FGLINW group differed significantly from the larger sample in two categories. The FGLINW group checked out computer devices from the institution at a higher rate than the rest of the sample (18.0% vs. 6.9%;

χ^2=21.41, p=.012) and utilized community computers at a higher rate compared to the rest (18.0% vs. 6.2%; χ2=10.99, p=.000).

When asked about how students accessed Internet services to complete coursework (Table 7), the majority in the larger sample (n = 535) reported using residential (93.6%) or campus Internet services (87.6%). In contrast, a small number used Internet services at work (30.3%), community (13.7%) or at a store (15.6%) to complete homework and assignments. A chi-square test of significance indicated significant intergroup differences with the FGLINW group reporting greater usage of work based Internet services (45.9%; χ^2=7.45, p=.05), community based Internet services (34.4%; χ^2=14.70, p=.002), and store based Internet services (29.5%; χ^2=12.99, p=.005).

Table 7: Access to Internet Services to Complete Coursework

	N = 535		N = 61 (FGLINW*)		Significance
	Never/Rarely	Regularly/Frequently	Never/Rarely	Regularly/Frequently	Y / N
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*)
Community Internet (Public Library/Workforce Dev./The Y)	459 (86.3%)	73 (13.7%)	40 (65.6%)	21 (34.4%)	Y (χ^2=14.698**)
Store Internet (MacDonald's, Starbucks, shopping mall, etc.)	448 (84.4%)	83 (15.6%)	43 (70.5%)	18 (29.5%)	Y (χ^2=12.990**)

*FGLINW = First Generation, Low Income, non-White; *p <= .05, **p <= .01, ***p <= .001.

In terms of computer device ownership, most everybody (95.7%) reported owning a laptop or desktop in the larger group (Table 8). The FGLINW group differed significantly in not owning a computer (13.1% vs. 4.3%; χ^2=4.90, p=.02). Almost a quarter of the respondents reported sharing their computer at home with family members compared to 30% in the FGLINW group. A chi-square test of significance detected a significant difference in printer ownership (χ^2=24.80, p=.000) and access to a printer (χ^2=18.11, p=.000) compared to the larger group. Within the larger group (n = 535), 85% reported having the latest software compared to 80% in the smaller subset, with no statistically significant difference observed between the two groups. Significant group differences were detected for having virus protection software (χ^2=9.17, p=.01) and the ability of devices to play multimedia content (χ^2=8.34, p=.015). Approximately 10% in the FGLINW group did not have access to reliable internet services at home compared to 6% in the larger group. When asked about access to resources in terms of knowing someone who might be able to provide help with computer/technology related matters, a larger majority (72.7%) in the sample reported availability of such a resource compared to 56% in the FGLINW group (χ^2=14.23, p=.001), a significant difference.

Table 8: Technological Access

	N = 535			N = 61 (FGLINW*)			Significance
	Yes	No	DK	Yes	No	DK	Y / N
Own a laptop/desktop	512 (95.7%)	23 (4.3%)	NA	53 (86.9%)	8 (13.1%)	NA	Y (χ^2=4.902*)
Share a laptop/desktop	123 (23.5%)	401 (76.5%)	NA	18 (30.0%)	42 (70.0%)	NA	N
My computer runs reliably on the 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***)
Access to a printer	507 (94.9%)	23 (4.3%)	4 (0.7%)	56 (91.8%)	5 (8.2%)	-	Y (χ^2=18.106***)
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**)
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*)
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***)

*FGLINW = First Generation, Low Income, non-White; *p <= .05, **p <= .01, ***p <= .001.

TECHNOLOGICAL EFFICACY

Even though the K-S test was significant for Technological Efficacy scores, indicating a non-normal distribution, the sufficiently large sample size allowed for the use of parametric tests (t-test and ANOVA) to detect significant group differences in Technological Efficacy scores (Lumley et. al., 2002).

Mean Technological Efficacy scores for the entire sample was 4.08 on a scale of 1 to 5. An analysis of variance (Table 9) showed that mean Technological Efficacy scores were significantly higher for online course completers (F=26.079, p=.00), compared to those who enrolled but dropped or never enrolled in an online course. Transfer students had significantly higher scores than their counterparts (t=2.41, p=.02). Students who identified as independents for federal financial aid purposes had higher scores compared to those who identified as dependents but at lower significance level (t=1.85, p=.06). Group differences for underserved characteristics of first generation, low income, and race/ethnicity were not significant.

Table 9: Technological Efficacy							
Mean Technological Efficacy Score - Overall							**N = 535**
	N	**%**	**Min**	**Max**	**Mean**	**SD**	**Test Stat**
All Survey respondents	535	100	1.00	5.00	4.08	0.62	NA
Mean Technological Efficacy Score by Online Course Enrollment							**N = 535**
	N	**%**	**Min**	**Max**	**Mean**	**SD**	**Test Stat**
Completed an online course	233	43.6	2.50	5.00	4.26	0.56	F=26.079***
Enrolled but dropped an online course	77	14.4	2.88	5.00	4.19	0.59	
Never enrolled in an online course	225	42.1	1.00	5.00	3.87	0.62	
Total	***535***	***100***	***1.00***	***5.00***	***4.08***	***0.62***	
Mean Technological Efficacy Score by Transfer Status							**N = 530**
	N	**%**	**Min**	**Max**	**Mean**	**SD**	**Test Stat**
Transfer	196	37	1.00	5.00	4.17	0.62	t=2.41*
Not Transfer	334	63	2.50	5.00	4.04	0.61	
Total	***530***	***100***	***1.00***	***5.00***	***4.09***	***0.62***	
Mean Technological Efficacy Score by Federal Income Tax Status							**N = 531**
	N	**%**	**Min**	**Max**	**Mean**	**SD**	**Test Stat**
Dependent	308	58	1.00	5.00	4.04	0.64	t=.1.85+
Independent	223	42	2.50	5.00	4.14	0.58	
Total	***531***	***100***	***1.00***	***5.00***	***4.08***	***0.62***	

+p <= .1, *p <= .05, **p <= .01, ***p <= .001.

DISCUSSION

TECHNOLOGICAL ACCESS

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

Respondents' overall usage of public computers (Table 6) 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%).

There were significant intergroup differences in access and usage of Internet resources outside of school and home (Table 7) with the FGLINW group using Internet resources at higher rates at work (46% vs 30% for the main sample), in community settings (34% vs 14% for the main sample), and in store settings (30% vs 16% for the main sample). 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 8). These findings underscore uneven and differential access to Internet resources at home, which in turn, explain greater usage of work and community based resources.

With respect to Technological Access (Table 8), 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%). 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. The corresponding figures for the FGLINW sub group were 30% and 8%, respectively.

The results from this survey also indicate noteworthy usage of smartphones to access course materials and complete assignments (Table 5), 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, Internet connectivity, etc.) as discussed earlier.

The access, ownership, and usage characteristics discussed above, especially in categories where intergroup differences (between the overall sample and the FGLINW group) were found to be statistically significant, further allude to the presence of the digital divide with respect to Technological Access. The worse outcomes for the FGLINW group as they relate to ownership of and access to technological devices (computer devices and printers), including incidence of shared device usage, ties in to the greater usage of public computers as discussed earlier with reference to Table 8.

The above findings have resonance with national statistics aggregated by the PEW Research Center (Anderson & Kumar, 2019) that indicate that, in American households, access to computer devices and Internet is differentially distributed based on annual family income. The study also reports that the relative lack of access to computer devices or Internet for students from lower economic backgrounds impedes their ability to complete academic coursework/homework at a much higher rate than their counterparts from higher economic backgrounds, thereby alluding to the possibility of the existence of a "homework gap" (Anderson & Perrin, 2018). This is a pertinent area of future investigation given that Anderson and Perrin (2018), citing Horrigan (2015), also note that these disparities are particularly pronounced in African American and Hispanic households, given the strong correlation between income and race/ethnicity.

The results from this study hew closely to the findings of past research that has reported differential access to technology being concentrated in minority and low income households (Gonzales, 2016; Vigdor et al., 2014), and demographics impacted by concentrated poverty (Mossberger et al., 2006). This is salient as the author's institution draws a section of its student population from communities that are low income, impoverished, and of minority status.

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 that indicates that disparities in access to devices alone is not the only problem facing students (Vigdor et al., 2014), and that a nuanced evaluation of the incidence of digital divide among disadvantaged groups should include consideration of issues related to Internet speed and software (Rubinstein-Avila & Sartori, 2016).

Mossberger et al. (2008) reported that the issue of differential access to technology for low income demographics results in increased usage of public resources to access computers and the Internet. Gonzales (2016) reported that the lack of adequate Technological Access impacting impoverished communities coupled with lack of accessible and reliable public resources led to significant numbers in such populations to resort to smartphones to access the Internet. Similar findings about higher usage of smartphones to access digital media as evidenced in populations characterized by low income and minorities were reported by Rubinstein-Ávila and Sartori (2016). Along the same lines, Magda and Aslanian (2018) reported that two-thirds of surveyed online students completed some or all of their coursework via smartphones, with 20% using smartphones entirely to complete all course related activities. The use of smartphones to access online content in lieu of reliable access to the Internet were also reported in other studies (Anderson and Kumar, 2019: lower income Americans; Anderson and Perrin, 2018: lower income youth; Vogels, 2019: millennials and Gen Xers). Tsetsi and Rains (2017) found low income and minority adults in the US to be more dependent on smartphones to access the Internet as compared to higher income and White adults. Such usage also mirrored US national trends (Galanek et al., 2018) with minority, first generation, and low income college students viewing smartphones as significantly contributory towards their academic success.

The findings of these studies resonate with results of the current study that indicates that the FGLINW group used public resources (devices and/or Internet) at a significantly higher rate than that of the main sample, and that nearly half of the survey respondents regularly or frequently used smartphones to complete coursework. Given that the survey sample consisted of UNS and UNR students characterized by one or more of at risk variables such as first generation, low income, and minority status, the consistency of the findings of this study to prior research is salient.

Previous studies pertaining to issues of Technological Access refer to findings limited to population specific subsets in the US (Anderson & Kumar, 2019: low income households nationally; Anderson & Perrin, 2018: minority households nationally; Vigdor et al., 2014: minority and low income middle school students in North Carolina; Mossberger et al., 2006: concentrated poverty nationally; Mossberger et al., 2008: low income households in Ohio; Gonzales, 2016: low income residents in mid to large sized Midwestern urban town; Rubinstein-Avila & Sartori, 2016: low income, minority, and/or infrequent Internet users in general population; Tsetsi & Rains, 2017: adults nationwide; Galanek et al., 2018: large private & public colleges nationwide; Magda & Aslanian, 2018: online only college students nationally). The results from this study not only corroborate the findings evident in the existing body of literature but extends the findings beyond the respective contextual subsets to a population of college students who are traditionally underserved and underrepresented.

This study is unique as it explores device ownership, access, and usage at a different level of granularity than has been previously explored, and in the way it highlights the incidence of digital divide pertaining to Technological Access among an already disadvantaged population of UNS and UNR students that is growing in higher education (Fry & Cilluffo, 2019), 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 ownership of and/or adequate access to suitable computer hardware such as desktops, laptops, and tablets.

Overall findings suggest that there are significant gaps in terms of access to technology in several aspects, and especially for a critical subset (FGLINW) of the survey sample. These findings acquire special significance not only due to the general trend of educational institutions increasing online courses in an effort to increase accessibility (Allen et al., 2016), but also due to the more extensive and far reaching impact of a global pandemic in COVID-19, the onset of which has led to a forced shift from face-to-face delivery to online delivery for most courses. This transition has been sudden and abrupt, and has left students already facing a technological equity gap with limited opportunity to adapt to the changed realities of higher education characterized by online delivery, and the consequent outsized role of Technological Access in the changed scenario.

Gonzales (2016) and Mossberger et al. (2008) discussed the types of existing digital inequities that individuals from socioeconomically challenged backgrounds encounter while Beaunoyer et al. (2020) discussed the potential impact of such existing digital inequities being further exacerbated by COVID-19. Given that 47% of the respondents from this study had annual household incomes less than $30,000 (57% had annual incomes less than $40,000), and that 33% of the sample was non-White (Table 3), pre-existing inequities in access are likely to be exacerbated with the impact of COVID-19, as discussed below.

With not just students but also the majority of the population confined to home due to the health-related restrictions imposed by COVID-19, the resultant increase in simultaneous use of the Internet by multiple members in the household makes reliable access to the Internet a major concern for students. This is likely to be especially true for those students who do not have the resources that allow for subscription to uninterrupted higher bandwidth Internet services. With additional pandemic related restrictions on visitation of public spaces such as libraries or stores as well as homes of relatives or friends and with traditional work spaces that otherwise provided a way to access the Internet being out of bounds, the barriers to access are likely to be exacerbated.

The effect of these events on student access outcomes should be considered against the backdrop of survey respondents, almost half of whom are economically challenged and, therefore, unlikely to be in a position to tap into resources needed to upgrade to reliable Internet service when confronted with pandemic related circumstances (home isolation for multiple household members and resultant use of bandwidth for entertainment and work from home scenarios). In this study, the survey sample reported (Table 8) lack of reliable access to Internet services at home (sample: 6%; FGLINW: 10%). Furthermore, a significant portion of the UNS and UNR survey sample and an even greater share of the smaller sub sample of FGLINW students reported regular to frequent use of Internet resources outside of home and school – work based Internet (sample: 30%; FGLINW: 46%), community based Internet (sample: 14%; FGLINW: 34%), and store based Internet (sample: 16%; FGLINW: 34%) to complete coursework (Table 7). These findings bring into stark relief the potential impact of COVID-19 on student access outcomes.

Resource strapped students, likely to be working with older devices and with limited financial resources available to repair hardware or upgrade the same in response to the demands placed on them by the pandemic induced circumstances, are also likely to suffer from the absence of opportunities to borrow computer devices from their institution to alleviate this issue. With lower income students more likely to share devices at home and with most, if not all, household members confined to home, the issue of shared device access is further likely to negatively impact the existing equity gap, as it relates to Technological Access. The respondents from this survey reported (Table 6) regular to frequent use of computer labs (sample: 28%; FGLINW: 34%), device checkout from school (sample: 7%; FGLINW: 18%), use of work computer (sample: 24%; FGLINW: 25%), and use of public computers (sample: 6%; FGLINW: 18%), all of which highlight the level and extent of dependence on external/public resources. Furthermore, survey responses (Table 8) indicated lack of computer device ownership (sample: 4%; FGLINW: 13%) and sharing of computer devices (sample: 24%; FGLINW: 30%) provide insight into how the pandemic related restrictions are likely to worsen pre-existing inequities related to Technological Access.

Survey respondents (Table 6) reported regular to frequent use of computer labs (sample: 28%; FGLINW: 34%), device checkout from school (sample: 7%; FGLINW: 18%), use of work computer (sample: 24%; FGLINW: 25%), and use of public computers (sample: 6%; FGLINW: 18%). Furthermore, survey responses (Table 8) indicated lack of computer device ownership (sample: 4%; FGLINW: 13%) and sharing of computer devices (sample: 24%; FGLINW: 30%). This provides insight into how the impact of COVID-19 related restrictions are likely to disproportionately impact UNS and UNR students and worsen pre-existing inequities related to Technological Access.

Students from disadvantaged backgrounds also tend to lack access to technologically savvy resources outside of school, and therefore, with the shift to online education, they are more likely to face deficits in technological support that would otherwise have been available at school and helped them troubleshoot technological problems related to devices and access to the Internet. This is evident from the fact that a remarkable number of survey respondents (Table 8) reported lacking access to technologically savvy resources outside of school who might be able to provide technical help needed to resolve problems related to devices and/or issues related to Internet access (sample: 22%; FGLINW: 43%). In light of the economic status of the sample, which impacts reliability of access to Internet, rate of device ownership and sharing, and constraints on acquisition and/or upgrade of devices, the lack of access to technological help further underscores the burdens encountered by students and how COVID -19 related circumstances can increase the barriers to Technological Access.

Finally, the issue of pre-existing resource deficiencies with respect to adequate access to the Internet and computer devices is likely to be further impacted by increased strains on allocation of household financial resources wrought by the unprecedented loss of employment and income as a result of the pandemic and the disproportionate impact of the same on households situated in lower economic strata to begin with.

These findings inform the recommendations, which in turn should help ameliorate the impact of barriers to Technological Access and facilitate better outcomes for students in an academic setting characterized by increased online course delivery.

Recommendations

In light of the survey finding that students faced various challenges related to Technological Access and the high prevalence of smartphone usage among respondents, it is important to consider whether such usage actually indicates closing of the Technology Access gap. Rubinstein-Avila and Sartori's (2016) report that mentions the correlation between lower educational attainment and cell-mostly usage should spur a more critical and nuanced evaluation about such students' prospects of academic success given the difficulty of completing assignments via smartphones as noted by Rowsell et al. (2017). In the absence of adequate access to computer devices (desktop/laptop) and broadband Internet services that can contribute to a homework gap, accessibility of course materials on mobile devices and the issue of assignment completion using such devices will remain critical factors impacting such students' success in an online learning environment.

With web content becoming more graphic based and involving the transmission of large data files, broadband Internet access has become more of a necessity. Online courses utilize a multitude of media to convey course content that include streaming video content, interactive content, and videoconferencing, all of which require newer devices, updated software, and fast and reliable Internet access. Findings from this research indicate gaps in access related to these categories that limits the ability of these students to be successful in an online environment.

Institutions may need to invest in technology and faculty training to ensure that course content is offered in multiple formats and mobile optimized, especially for those students who rely heavily on cell phones for accessing course materials. Faculty may need to embrace the concept of mobile learning. Considering that many in the FGLINW group did not own or have access to a computer or a printer and had low social support for technology related assistance, institutions have to pursue these students diligently and monitor their course access woes if the digital divide is to be ameliorated. There is also a need for greater consideration on the part of faculty in dealing with students that fall behind owing to device failure/malfunction, which they are unable to remedy as they either lack the wherewithal to troubleshoot on their own or do not have access to tech savvy resources who can help in resolving the issue in time.

TECHNOLOGICAL EFFICACY

The survey results point to overall high Technological Efficacy scores for the entire sample. However, the limited differentiation across various at risk categories may point to the overall homogeneity of the sample with respect to UNS and UNR characteristics, as discussed in subsequent paragraphs.

Technological Efficacy scores were significantly higher for online course completers compared to those who enrolled but dropped or never enrolled in an online course, indicating that both self-assessment of Technological Efficacy as well as actual Technological Efficacy are possible factors influencing enrollment in online courses and their successful completion, respectively. This mirrors Liu et al.'s (2007) reporting that highlighted Technological Efficacy as a key factor that influenced student decision to drop courses.

Existing research (Compeau & Higgins, 1995b; Compeau et al., 1999; Eastin & LaRose, 2000; Gangadharbatla, 2008; Kuo, 2018; Kuo & Belland, 2019; Saadé & Kira, 2009) indicates that low levels of Technological self-efficacy are directly correlated to anxiety, which in turn results in lower outcome expectations related to use of technology, and thereby influences actual usage of technology. Correspondingly, a higher level of Technological self-efficacy is positively correlated with higher confidence, higher outcome expectations, higher task persistence, and increased usage of technology. Compeau and Higgins (1995b), and Eastin and LaRose (2000) also reported that greater usage of technology contributed to more experience, which in turn led to development of actual technology related skills, thereby establishing the link between higher levels of Technological self-efficacy and higher levels of Technological Efficacy. Technological self-efficacy and Technological Efficacy were also found to be correlated to better academic performance and performance in online learning environments (Hauser et. al., 2012; Kuo & Belland, 2016; Saadé & Kira, 2009). These linkages, as established by previous research, comport with the findings of this study that show that Technological Efficacy scores were higher for students who successfully completed an online course as compared to those who never enrolled or enrolled but dropped an online course.

The significantly higher level of Technological Efficacy for transfer students may be attributable to transfer students' relatively greater exposure to and experience with technology by virtue of prior experience at a post-secondary level. This is consistent with research that indicates that greater exposure to technology, and experience with technology positively impact level of Technological Efficacy (Compeau & Higgins, 1995a; Eastin & LaRose, 2000; Kuo, 2018).

Students who identified as independents for federal financial aid purposes had higher Technological Efficacy scores compared to dependent students, albeit at a marginally lower level of significance ($p=.06$). This finding is consistent with the gap in digital literacy that exists in the UNS and UNR student demographic as the institution draws students from area high schools that cater to disadvantaged populations. As dependent students are typically of traditional age, the statistically significant lower scores for this group as compared to independent students is likely explained by the higher age and, consequently, greater exposure to and experience with technology that characterizes independent students. This finding resonates with the findings reported by Compeau and Higgins (1995a) and Eastin and LaRose (2000). Additionally, this is supported by Kuo's study (2018) of adult African American students that found age, hours spent online, and previous online course experiences influenced Technological self-efficacy.

The findings did not indicate significant differences between Pell Grant recipients and non Pell Grant recipients, thereby indicating that for this population of UNS and UNR students, income differentials did not impact levels of Technological Efficacy. The findings from this research also did not find low Technological Efficacy to be correlated to minority demographics or first generation status, in contrast to current research that indicates that minority students do not always come to college with the necessary technological skills (Buzzetto-Hollywood et al., 2018). A possible reason for these findings may be rooted in the fact that the sample itself is drawn from a population with UNS and UNR characteristics (students largely belonging to 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).

Prior studies pertaining to Technological Efficacy refer to findings limited to population specific subsets (Hauser et. al., 2012; Saadé & Kira, 2009: MIS college students, Buzzetto-Hollywood et al., 2018; Kuo, 2018; Kuo & Belland, 2016; Kuo & Belland, 2019: minority students in a minority serving college; Rubinstein-Avila & Sartori, 2016: low income, minority, and/or infrequent Internet users in general population). This research extends the findings beyond the respective contextual subsets to a population of college students who are traditionally underserved and underrepresented. An additional finding not previously captured in existing research is the incidence of higher levels of Technological Efficacy associated with transfer students and independent students, when compared to their respective counterparts.

In summary, the findings suggest the existence of differential levels of Technological Efficacy amongst certain cohorts of the survey sample of UNS and UNR students. This is possibly explained by differences in digital skills and preparedness and associated levels of confidence, as seen from results of those who completed online courses compared to those who did not or dropped such courses after enrollment. Also, the higher levels of Technological Efficacy pertaining to transfer and independent students would indicate that greater experience and exposure to technology is likely to have had a positive impact on levels of Technological Efficacy of survey respondents. Both results are consistent with findings from previous research, as discussed earlier.

With the advent of COVID-19, and the forced shift to online learning at short notice, the impact of differential levels of Technological Efficacy among learners, especially learners from underrepresented populations who are more likely to not have adequate levels of such skills (Buzzetto-Hollywood et al., 2018), is likely to be significant.

Existing research has shown higher computer self-efficacy to be positively correlated to higher performance in online courses (Hauser et al., 2012) and that Technological self-efficacy contributes to Technological Efficacy (Compeau & Higgins, 1995a). Findings from Eastin & LaRose (2000) and Compeau and Higgins (1995b), together provide insight into the linkages between the two that indicate that individuals with high levels of computer self-efficacy experienced less anxiety or greater confidence with respect to technology, judged themselves as capable of operating with less support, had higher outcome expectations that led to higher task persistence, and this promoted greater use of technology. Higher usage led to more experience, which in turn helped in development of technology related skills (Technological Efficacy), and this further bolstered Technological self-efficacy (Compeau & Higgins, 1995a; Eastin & LaRose, 2000), thereby creating a positive feedback loop.

Conversely, individuals with low Technological self-efficacy had higher anxiety with respect to technology, exhibited negative attitudes, deemed themselves as less capable of performing without support, had lower expectations and thereby lower task persistence, which in turn led to lower usage of technology and lesser experience stemming from the lower usage. This inhibited development of technology related skills (Technological Efficacy), which in turn further negatively impacted Technological self-efficacy, thereby completing a negative feedback loop.

This underscores the importance of 3 sequential factors that are likely to be influenced disproportionately by the changed circumstances wrought about by COVID-19:

a) Reduced levels of support from faculty, peer group, institutional labs and tech resources due to classes shifting online, support that learners with lower Technological self-efficacy and consequently higher anxiety deem important to working with technology;

b) Lower task persistence stemming from lower levels of Technological self-efficacy, further impacted by less access to technology by virtue of impediments related to technological access as discussed earlier. The addition of obstacles stemming from the lack of support to this mix is likely to also contribute to less use of technology; and

c) Lower levels of technological experience due to lower level of technology usage is likely to further impede development of technology related skills (Technological Efficacy). This in turn further reduces confidence/increases anxiety due to the effect of the negative experiences on confidence, thereby impacting Technological self-efficacy.

This is likely to result in greater inequities stemming from the resultant lower levels of Technological self-efficacy as well as Technological Efficacy. This, in turn, is likely to further impede academic performance in an online setting as students less than adequately prepared skill wise to cope with the demands of online learning will be susceptible to falling behind due to a combination of the factors elucidated above.

The findings of this research show that, within the survey sample, groups of experienced learners with prior experience with technology, such as students with prior experience in online learning, transfer students, and students classified as independents for federal financial aid purposes, possess higher levels of Technological Efficacy as compared to their counterparts. With the impact of COVID-19 and the consequent additional obstacles to the development of Technological Efficacy, the gap between the student groups with prior experience and their counterparts is likely to widen further, thereby seriously impacting educational outcomes of an already disadvantaged population of UNS and UNR students.

These findings inform the recommendations, which in turn should help bridge the gap and facilitate better academic outcomes for students in an educational setting characterized by increased online course delivery.

Recommendations

The fact that lower levels of Technological Efficacy may adversely affect the academic achievement of the already at-risk student (Hauser et. al., 2012; Kuo & Belland, 2016; Saadé & Kira, 2009) has possible policy implications surrounding the question of how institutions need to bridge the gap to bring such students' skill levels up to par with computer skill sets required at the college level.

Early identification of deficiencies in Technological Efficacy levels among incoming students will be an important step towards developing preparedness initiatives at institutions serving significant UNS and UNR student populations. A careful assessment of entering students' technology related skillsets will be necessary to scaffold institutional services and allow instructors to employ complementary classroom learning strategies. In addition, institutional services such as pre-assessment tools, computer application courses, or similar competencies integrated into first year seminar courses may be considered as pathways to boost Technological Efficacy.

Given that disadvantaged students, especially in an online environment, may start with a deficit of attributes related to Technological Efficacy and that this may negatively impact confidence, self-belief, and engagement, faculty need to consider a larger role in motivating and engaging students so as to ensure success and develop an online culture of support that will help students overcome Technological Efficacy related self-doubt.

CONCLUSION

The main objective of the study was to assess if UNS and UNR students have the appropriate Technological Access and Technological Efficacy to take advantage of the expanding online classes and programs being offered by the author's institution.

The findings indicate the presence of a digital divide with respect to Technological Access and differential levels of Technological Efficacy among a sample of UNS and UNR students in a small Midwestern university that caters to primarily disadvantaged populations. The Technological Access gap was pronounced in several areas of device ownership and access as well as Internet access and usage in both the overall sample and the critical subset of the FGLINW group, with the latter reporting worse outcomes across the board. There was a significant difference between the sample and the FGLINW group with respect to use of school and public resources (devices and/or Internet). Nearly half of the sample regularly or frequently used smartphones to complete coursework. The FGLINW group also reported significantly lower levels of technology related support outside of school. Technological Efficacy scores were significantly lower for students who have either never enrolled in, or dropped out of an online course, while transfer students had significantly higher Technological Efficacy scores. Additionally, independent students were found to have higher Technological Efficacy scores, but at a marginally weaker level of significance.

This study contributes to the understanding of the digital divide as it pertains to Technological Access and Technological Efficacy. The findings of this study not only confirm existing research findings but extend such findings to a demographic section of underserved and underrepresented students who form the majority of students at the researcher's institution, and whose numbers continue to grow in higher education, yet on whose specific outcomes there is limited research. Additionally, the findings highlighted higher levels of Technological Efficacy for transfer students, and, at a slightly weaker level of significance, for independent students, both categories representing population subgroups, hitherto unexplored, and thereby topics for further research.

As online learning proliferates and institutions further move their face-to-face courses online to address the global pandemic, the learning ecosystem is reshaping higher education. In order for increased online learning to translate to better academic outcomes especially for UNS and UNR students, higher education administrators and faculty should take into consideration the gaps in technology related access and skills. Institutional interventions may be devised along with formulation of pedagogical approaches that account for such gaps in educational equity, thereby ensuring pathways to sustained student success in an expanding landscape of online education.

Recommended measures to ameliorate the differential levels of Technological Access and Technological Efficacy that this study uncovered include (a) mobile optimized course design; (b) institutional support to ameliorate technological access related woes; (c) faculty consideration of technological woes that contribute to a homework gap; (d) institutional support geared towards early identification of technological skills gap; (e) institution of remedial steps to address such gaps; and (f) adoption of complementary teaching/learning strategies that provide support, foster positive attitudes, and enhance confidence towards adoption and use of technology.

This study was conducted on students attending a single institution whose student population exhibited UNS and UNR characteristics. A more heterogeneous and diverse sample demographic across several institutions could have allowed for more diversity in findings and possibly different levels of group 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.

Further inquiry in this area can include expanding this study to other institutions constituting similar underserved and underrepresented populations.

With respect to Technological Access, accessibility of course materials on smartphones has become a critical factor in online success. Given that it is more challenging to write papers and complete assignments using a smartphone, is there a homework gap for this demographic that may impact academic success? This is an area for possible further investigation.

Future research topics may also include further investigation of factors that might explain higher levels of Technological Efficacy amongst transfer students and students who identify as independents for federal financial aid purposes. Additional research maybe conducted to investigate the impact that differing levels of Technological Efficacy might have on specific educational outcomes of UNS and UNR students.

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