Technostress Creators in Higher Education During the Covid-19 Pandemic: A Comparison of Faculty Perceptions and Experiences

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The purpose of this study is to advance the scholarship related to techno-distress in higher education. Two surveys were conducted during the COVID-19 pandemic of college and university professors to evaluate technostress creator perceptions. The Technostress Creators Scale (Tarafdar et al., 2007) was used to measure the technostress of college and university faculty early in the pandemic (2020), (n = 307) and one year later (2021), (n = 94). The cross-sectional quantitative study revealed that faculty technostress was markedly curbed throughout the periods of study, with a reduction in perceptions of computerphobia by nearly 20% comparing both samples. An analysis of the sub-dimensions clarifies this outcome.

Keywords: technology stress, higher education, faculty, COVID-19, technostress, technostress creators

INTRODUCTION

At the onset of the COVID-19 pandemic and during the sudden shift to distance learning, roughly 55% of faculty across the nation had never taught an online course, over 70% preferred face-to-face teaching, and 36% claimed that virtual instruction does not yield equivalent learning outcomes as compared to in-person delivery (Bauer-Wolf, 2019; Inside Higher Ed & Gallup, Inc., 2019). Prior to the pandemic, 6 in 10 faculty reported that they were uncomfortable with and inexperienced to use classroom technologies including the learning management system and 40% stated they did not have adequate onsite technical support or professional development to guide the design and delivery of online courses (Inside Higher Ed & Gallup, Inc., 2019). Faculty had to, in short order, learn how to translate classroom lessons, hands-on labs, demonstrations, and in-class experiments to the remote learning environment.

Without a vaccine, institutions of higher learning were forced to reevaluate their Fall 2020 semester reopening. The vast majority of Ivy League schools and scores of public and private colleges and universities across the country suspended plans to bring students back to campus and, instead, moved to a model of complete virtual instruction. Institutions who decided to open their doors had to rethink their fall operations and creatively reconfigure classroom capacities to meet physical distancing requirements. Some schools phased in classes with an online start followed by modified in-person classes after a week or two of adjustment whereas others opted to begin with face-to-face instruction from the start. Many modified their academic calendars to minimize breaks during the term along with the possibility of travel, and virus

spread. Of the colleges and universities with in-person classes, blended or hybrid learning classroom configurations were the norm.

Again, faculty were confronted with an abrupt transformation of the teaching landscape and had to precipitously adapt, the success of which was dependent upon their proficiency to merge and align information and communication technologies (ICTs) with teaching design and delivery strategies in distanced or blended learning ecosystems. Faculty who historically elected not to teach online have now been shoved into e-learning, a choice that, perhaps, was not of their own.

Fast-forward one semester to Spring/Winter 2021 and some colleges and universities phased in more face-to-face learning. However, nearly 50% of faculty continued to teach a mix of hybrid, asynchronous and in-person classes (Kaufman & Dilberti, 2021). Juggling multiple teaching environments, modalities, and technologies was a balanced act to say the least. With students and faculty in and out of the classrooms due to COVID-19 exposures and illnesses and a spike in cases, quarantine and isolation absences were frequent. Mask mandates and social distancing measures were in place and faculty were responsible to manage and enforce classroom health and safety policies. At this point, one year into the pandemic, with the mixed bag of learning environments, modalities, pedagogies, and methods, the unpredictable nature of the pandemic facilitated a greater need for faculty to continue to use ICT's for teaching and learning in order to serve their students. Research into how faculty are experiencing variations to the teaching and learning space during the COVID-19 pandemic is developing. Further, studies are piercing the veil to evaluate just how these ICT's impact faculty and students in teaching and learning environments.

LITERATURE REVIEW

Since the first online courses were offered in the 1980's, colleges and universities have taken a quantum leap in teaching and learning pedagogies through the adoption of innovations in ICTs. While ICTs generate substantial tangible and intangible benefits for institutions of higher learning including expanded student access, flexibility, and convenience along with an enhanced quality of the educational experience online or otherwise, an increased use of them can escalate the stress suffered by their users. To implement these classroom technologies effectively, faculty in higher education are deeply committed to teaching their students and investing their time and efforts, often with an impairment to work-life balance, to upgrade their knowledge and skills. With altered work patterns, higher performance demands, role ambiguities, and subsequent role overload, outside of a health crisis, faculty are exposed to an increased risk of technology stress on a regular basis. Technostress, also known as computer stress, technological stress, and technophobia, is a maladaptive disorder that originates from and is aggravated by an inability to adapt to or cope with new technologies in a healthy way (Brod, 1984; Fuglseth & Sorebo, 2014).

The purpose of this research study is to advance the understanding of technostress in higher education and the consequences to faculty, a relatively understudied area in this profession (Brooks & Califf, 2017). Examining the technostress experiences of college and university professors was a must before COVID-19 to support their health, wellbeing, and attitudes towards the users of ICTs. However, the rapidly changing instructional environment coupled with the compounded demands placed on faculty necessitated an immediate investigation.

Technostress

Technostress, like COVID-19, is a global pandemic (Bozionelos, 1996; Khan et al., 2013; Lee et al., 2016; Tu et al., 2005). Technology use is the means by which this 'stress virus' is transmitted. Originally discovered by Brod (1984), technostress was compared to a disease with symptoms that disable the coping skills of computer users to manage technologies in a 'healthy manner' (p. 16). Also referred to as technophobia, computer anxiety, and technology stress, Tu et al. (2005) described technostress as the harmful effects on the thoughts, attitudes, and behaviors rising from technology use (Hung et al., 2011; Laspinas, 2015). A variety of physical and emotional symptoms may be exhibited by those who are techno-stressed such as anxiety, worry, irritability, headache, fatigue, inability to concentrate, fear, increased

cortisol production, frustration, suspicion, obsessive thoughts, and depression (Cox, et al., 2000; Mahalakshmi & Sornam, 2012; Riedl et al., 2012; Wang et al., 2008).

The scholarship to investigate the causes and antecedents of this techno-user contagion from a range of contexts is emerging but has exacerbated with the intensified role of technology since the start of the pandemic (Boyer-Davis, 2020, 2019a, 2019b; Dahabiyeh et al., 2022; Lee, 2021; Li & Wang, 2021; Upadhyaya & Vrinda, 2021; Wang & Li, 2019). However, technostress scholarship generally follows two research paths, the person-environment (P-E) fit theory and the transaction theory (Ayyagari et al., 2011; Edwards et al., 1998; Fuglseth & Sorebo, 2014). The P-E theory focuses on the alignment between a person and the environment in which they engage. With this theory, stress does not stem from the person or the environment in isolation; rather stress materializes when a misalignment occurs between the person and their complex multidimensional environment (Bradshaw & Zelano, 2013; Chuang et al., 2016; Dahabiyeh et al., 2022; Day et al., 2010; Ennis, 2005; Jena, 2015; Maier et al., 2019; Marchiori et al., 2019; Pirkkalainen et al, 2019; Ragu-Nathan et al., 2008; Tarafdar et al., 2007, 2015, 2019, 2020; Wang et al., 2020; Tams et al. 2014; Yu et al., 2017). Contrastingly, the transaction theory examines technostress from situation-based perspectives and consequences such as the use of social media or networking sites (Li & Wang, 2021; Rasmussen et al., 2020; Salo et al., 2019; Tarafdar et al., 2020; Yao & Cao, 2017). This study builds upon the P-E theory of the person and environment and the influence between one another with respect to the incitement of technostress creators in conjunction with the transaction theory and the significance of the COVID-19 pandemic as a situational factor.

Technostress can exacerbate role overload, or the conflict between work demands and the resources (time, skills, and fitness) available to fulfill them (Maslach & Jackson, 1982; Tarafdar et al., 2011). Role overload has been identified as a precursor of poor work performance (Kahn et al., 1964; Lazarus, 1991). Technostress has also been linked to decreased productivity, job satisfaction, organizational commitment, innovation, and creativity (Brillhart, 2004; Burke & Greenglass, 1995; Hung et al., 2011; Krinsky, et al., 1984; Moore, 2000; Muir, 2008; Ragu-Nathan, et al., 2008; Shropshire & Kadlec, 2012; Simmons, 2009; Tarafdar et al., 2007, 2010, 2011). With prolonged exposure to technostress, faculty can burn out (Shropshire & Kadlec, 2012). Job burnout is evidenced to have a direct relationship with demotivation, performance problems, and job turnover (Simmons, 2009).

Tarafdar et al. (2007) first discovered the sub-dimensions of technology stress and created a five-component scale which includes: techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty. Techno-overload is described as a condition in which ICT users are forced to work more and faster. Techno-invasion occurs when ICT infringe upon and compel users to stay connected during non-work hours, upsetting the work-life balance. Techno-complexity stems from the increased time and effort spent by ICT users to update their skills, understand terminology, and learn how to operate new technologies. Techno-insecurity arises from user concern that their job may be eliminated by other employees with more advanced technological skills or from automation. Techno-uncertainty is the apprehension that can perpetuate from the rapid turnover of technology and the indeterminate future outcomes than can result. A techno-stress inhibitor sub-scale was also developed in the same study (Tarafdar et al., 2007).

Tarafdar et al. (2019) later revised the framework to differentiate between techno-eustress, techno-distress, and information systems designs. Techno-eustress is a positive outcome whereby users are challenged but enthusiastic and motivated by the use of technology. Techno-distress is the opposite of techno-eustress in that users' experience "bad" stress and negative results by means of ICT use. This study focuses on technostress creators, the techno-distress experienced with the use of ICTs.

Technostress in Teaching and Learning

For this study, techno-overload is a consequence when faculty are driven to work faster and longer from the use of ICTs and the increased work demands that result. Techno-invasion is the repercussion when ICT's drive university faculty to be constantly connected causing a disruption in their work-life balance. Techno-complexity is brought about by the complicatedness of ICT's and their frequent upgrades and changes, and the necessity for faculty to regularly refresh their knowledge and skills. Techno-insecurity is

the apprehension of being replaced by ICT's or other faculty with more experience using ICTs. Lastly, techno-uncertainty is the outcome when faculty are presented with unclear work requirements expectations that occur when ICT is assimilated into their teaching and learning environments.

From a teaching and learning perspective, technostress can adversely influence the academic achievement and output of students in higher education (Essel et al., 2021; Upadhyaya & Vrinda, 2021). Technostress perceptions of faculty teaching in higher education pre-pandemic and during have been identified (Boyer-Davis, 2020). Technostress can increase teaching exhaustion and negatively impact teaching productivity (Dahabiyeh et al., 2022). Faculty are exposed to the infection that is techno-distress on a regular basis. Changes in technology-enhanced learning such as Hybrid-flex and flipped classrooms, learning management systems, applications, artificial intelligence and machine learning, smartboards, clickers, virtual reality, robots, game learning, tablets, mobile technologies, video conferencing, and smart, connected devices have expanded faculty roles and magnified the knowledge, skills, and abilities required by them in order to teach within the 21st century digital age.

Research Question

Existing studies have evaluated technostress experienced by faculty in higher education from the hypothesized angle of how the COVID-19 pandemic may serve as a channel to further increase misalignment between person and environment (Boyer-Davis, 2020; Wang & Li, 2019). To extend the literature related to technostress and its prospective impact on educators teaching within institutions of higher learning, the following overarching research question was investigated. The current study is constructed from these previous studies and shaped by the literature.

RQ1: *In institutions of higher learning, is there a statistically significant difference in the level of technostress perceived by educators before and during the COVID-19 pandemic?*

STUDY METHODOLOGY

Sample

A questionnaire consisting of the Technostress Creators scale (Tarafdar et al., 2007) and a series of demographic questions was electronically administered at two different times during the COVID pandemic. The first sample was collected during the Spring/Winter semester of 2020. The second sample was collected a year later during the Spring/Winter semester of 2021. The population included members of the American Society of Business and Behavioral Sciences (ASBBS), an interdisciplinary professional organization comprised of faculty members in business and behavioral sciences disciplines including, but not limited to, accounting, finance, management, marketing, organizational behavior, and computer information systems. The same survey was distributed to the Management and Organizational Behavior Teaching Society (MOBTS). In addition, the survey was channeled through another educational panel, one with a wider disciplinary net.

Table 1 provides detailed demographic information, by quantity and percentage for the samples collected during 2020 and 2021. For the sample collected during 2020, faculty self-reported their gender as 68% male, 31% female, or 1% gender neutral, gender fluid, or no gender category selection was made. Faculty conveyed their age (in years) as follows: 25-34 (54%), 35-44 (22%), 45-54 (16%), 55-64 (5%), or 65 and older (1%). Faculty identified their academic rank as instructor/lecturer (17%), assistant professor (33%), associate professor (24%), full professor (23%), clinical professor (2%), or no response (<1%). Demographic information relating to the number of years of teaching experience they have was also collected. For the 2020 sample, 47% indicated that they had between 0 to 5 years of experience, 36% indicated having between 6 and ten years, 9% indicated experience of 11 to 15 years of experience, 7% indicated they had greater than 15 years of experience while 1.6% did not report their years of experience.

The sample size collected in 2020 totaled 307 observations. This sample was much larger that the 2021 sample which only contained 94 observations. The make-up of the 2021 sample was also very different. First, the majority faculty indicated that they were female (59%) with only 39% indicating that they were

males. The age indicated by the 2021 faculty that responded was much older than the 2020 sample. The 2021 sample reported that 3% of the faculty were between the ages of 25 to 34, 21% indicated their age was between 35 and 44 years of age, 25% were between 45 to 54 years of age, 34% were between 55 and 64 years of age, 14% were greater than 65 with 2% not reporting their age. The second sample (2021) also was made up of faculty members that had more years of experience and 46% had attained the rank of full professor.

TABLE 1
FREQUENCY AND PERCENTAGES OF DEMOGRAPHIC VARIABLES

Gender	Quantity 2020 (N=307)	Percentage	Quantity 2021 (N=94)	Percentage
Female	95	30.9%	55	58.5%
Male	208	67.8%	37	39.4%
Gender-fluid	1	0.3%	0	0%
Gender-Neutral	1	0.3%	0	0%
Not reported	2	0.7%	2	2.1%
Age (in years)				
25 to 34	167	54.4%	3	3.2%
35 to 44	66	21.5%	20	21.3%
45 to 54	48	15.6%	24	25.5%
55 to 64	17	5.5%	32	34.0%
Greater than 65	4	1.3%	13	13.8%
Not reported	5	1.6%	2	2.1%
Years Teaching				
0 to 5 years	144	46.9%	10	10.6%
6 to 10 years	110	35.8%	10	10.6%
11 to 15 years	27	8.8%	19	20.2%
Greater than 15	21	6.8%	55	58.5%
Not reported	5	1.6%	0	0
Rank				
Assistant Professor	102	33.2%	15	16.0%
Associate Professor	74	24.1%	20	21.3%
Full Professor	70	22.8%	43	45.7%
Clinical Professor	8	2.6%	1	1.1%
Instructor/Lecturer	51	16.6%	13	13.8%
Other	0	0	2	2.1%
Not reported	2	0.7%	0	0

Measure and Hypotheses

Technostress observations were measured using the Tarafdar et al. (2007) Technostress Creators scale. The Technostress Creators scale is comprised of 23 questions, grouped into five constructs: (a) Techno-overload, (b) Techno-invasion, (c) Techno-complexity, (d) Techno-insecurity, and (e) Techno-uncertainty. Aggregated, the construct scores measure technostress. An instrument should demonstrate a reliability of α = 0.70 or greater (Babbie, 2010). The Technostress instrument has been tested and retested to yield a reliability of 0.71 α to 0.91 α (Tarafdar et al., 2007). Each of the Technostress Creators was analyzed for significant differences in the scores before and during the COVID-19 pandemic. This resulted in the following hypotheses presented in the alternative format:

H_1. *There is a statistically significant difference in the level of technostress perceived by educators in institutions of higher learning before and during the COVID-19 pandemic.*

In addition, each of the techno-creator sub-dimensions was evaluated:

Techno-overload is described as a condition in which university faculty are forced to work more and faster.

H_a. *There is a statistically significant difference in the level of techno-overload perceived by educators teaching in institutions of higher learning during the COVID-19 pandemic.*

Techno-invasion occurs when ICTs infringe upon and compel professors to stay connected during non-teaching, research, and service hours, upsetting the work-life balance.

H_b. *There is a statistically significant difference in the level of techno-invasion perceived by educators teaching in institutions of higher learning during the COVID-19 pandemic.*

Techno-complexity is a product of the increased time and effort spent by educators to update their skills and learn how to operate new technologies in the classroom.

H_c. *There is a statistically significant difference in the level of techno-complexity perceived by educators teaching in institutions of higher learning during the COVID-19 pandemic.*

Techno-insecurity arises from faculty concerns that those with more advanced technological skills will replace them.

H_d. *There is a statistically significant difference in the level of techno-insecurity perceived by educators teaching in institutions of higher learning during the COVID-19 pandemic.*

Techno-uncertainty is the apprehension that can perpetuate from the high-speed turnover of technology and the indeterminate future outcomes than can result such as university closures and budget cuts. For example, Lincoln College in Lincoln, Illinois closed on May 13, 2022 after 157 years of operation, unable to overcome the impact of the pandemic on student enrollment and recruiting efforts (Chung, 2022).

H_e. *There is a statistically significant difference in the level of techno-uncertainty perceived by educators teaching in institutions of higher learning during the COVID-19 pandemic.*

ANALYSIS AND RESULTS

Paired Samples *t*-tests were analyzed using IBM SPSS Statistics 28 software. A Paired Samples *t*-test was selected for this study to measure the differences in the perceived technostress of college and university faculty early in the pandemic (2020) and one year later (2021). Results, presented in Table 2, were examined in total and per individual sub-construct, between the samples. The dependent variable, technostress, and paired measurements were collected and recorded in separate variables.

TABLE 2
STATISTICAL ANALYSIS OF MEAN DIFFERENCES

Variable	Mean Difference	Tukey's Mean Difference Test t-statistic		Equal Variance F-statistic (Hartley test)
		Equal Variances Assumed	Equal Variance not assumed	
H_1 Technostress	-15.936	-8.619***	-9.913***	1.706***
H_a Overload	-1.234	-2.600***	-2.775***	1.279*
H_b Invasion	-.995	-2.350**	-2.331**	1.031
H_c Complexity	-4.470	-8.044***	-8.237***	1.094
H_d Insecurity	-7.647	-14.542***	-16.328***	1.535***
H_e Uncertainty	-1.590	-3.781***	-4.200***	1.490**

Note: * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

H_1 Technostress

The Paired Samples t-test that compare overall technostress scores collected from faculty currently teaching in undergraduate and/or graduate programs in higher education show a significant difference (decline) in overall faculty perceived technostress scores comparing the Spring/Winter 2020 semester (M=81.117, SD 16.500) to the Spring/Winter 2021 semester samples (M=65.181, SD 12.632). Faculty technostress creators sub-scores decreased nearly 16 points from the onset of the COVID-19 pandemic.

The Paired Samples t-test was also conducted to compare the technostress creator sub-scores from the 2020 sample to the technostress creator sub-scores to the 2021 sample. Perceived technostress sub-scores for techno-complexity, techno-uncertainty, and techno-insecurity sharply declined between 2020 to 2021, one year into the pandemic, while techno-overload and techno-invasion mean scores did not meaningfully change between the periods.

H_a Techno-Overload

Results show an insignificant decline in techno-overload sub-scores comparing the 2020 faculty sample (M=18.298, SD 4.132) to the 2021 faculty sample (M=17.064, SD 3.654), p=<0.05, 95% CI for mean difference.

H_b Techno-Invasion

Results show an insignificant decrease in techno-invasion sub-scores comparing the 2020 faculty sample (M=14.123, SD 3.580) to the 2021 faculty sample (M=13.128, SD 3.634), p=<0.05, 95% CI for mean difference.

H_c Techno-Complexity

Results show a significant reduction in techno-complexity sub-scores comparing the 2020 faculty sample (M=17.204, SD 4.762) to the 2021 faculty sample (M=12.734, SD 4.554), p=<0.05, 95% CI for mean difference.

H_d Techno-Insecurity

Results show a significant drop in techno-insecurity sub-scores comparing the 2020 faculty sample (M=16.945, SD 4.658) to the 2021 faculty sample (M=9.298, SD 3.738), p=<0.05, 95% CI for mean difference.

H_e Techno-Uncertainty

Results show a significant negative change in techno-uncertainty sub-scores comparing the 2020 faculty sample (M=14.547, SD 3.711) to the 2021 faculty sample (M=12.957, SD 3.041), p=<0.05, 95% CI for mean difference.

The omnibus null hypothesis was rejected for significant differences in faculty technostress creators were observed when comparing perceptions in 2020 at the start of the pandemic to those one year later in 2021. Likewise, H_c, H_d, and H_e sub-hypotheses were also rejected as faculty identified suffering drastically higher levels of techno-complexity, techno-insecurity, and techno-uncertainty early on in the pandemic. H_a and H_b were not rejected as faculty did not perceive any change in their techno-overload or techno-invasion perceptions.

DISCUSSION

The aim of this cross-sectional study was to investigate technostress and its effects on faculty in higher education at various timeframes during the COVID-19 pandemic. Specifically, questions regarding the change in technostress creators and the sub-dimensions of technostress during this period were evaluated. Results were validated by survey data from two points in time during the pandemic. One sample was taken during 2020 at the start of the pandemic (n =307). The second sample was extracted in 2021 when approximately 57% of the U.S. population had received at least one COVID-19 vaccination dose with nearly half being fully vaccinated (n = 94). At that time, 20 states reached the goal of achieving 70% or more of the population having received one or more vaccine dose and the Center for Disease Control released new guidelines that fully vaccinated individuals could resume activities without social distancing or masks unless required by law (CDC.gov). The second sample was collected before the deadly Delta variant upswing in late July 2021.

The findings revealed that the overall technostress of faculty was markedly curbed throughout the periods of study, with a reduction in perceptions of computerphobia by nearly 20% comparing both samples. An analysis of the sub-dimensions clarifies this outcome. Of the technostress subgroupings, 3 out of 5 were distinctly lower later in the pandemic. An explanation rooted in the literature explains the potential causes of the variance in technostress perceptions.

Techno-Complexity

Techno-complexity describes how faculty are forced to continuously upgrade their knowledge, skills, and abilities (KSA's) to not only keep up with the rapid change in existing technologies but also to adopt new technological innovations and embrace implementations. In this study, participants experienced a significant decline in techno-complexity between the samples by nearly 26%. One justification may be related to the age range of the two samples. 76% of the 2020 sample is classified as digital native, born on or after 1980 in a world dominated by the internet of things and ICTs (Joiner et al., 2013; Lusoli & Miltgen, 2009; Prensky, 2001). Only 25% of the 2021 sample is native to the technology age with 75% categorized as digital immigrants, raised prior to the widespread adoption of digital technologies. Interestingly, identifying as a male digital native meant more techno-complexity was experienced as compared to female digital immigrants.

Consistent with studies by Çoklar and Şahin (2011), Marchiori et al. (2019), Ragu-Nathan et al. (2008), and Tarafdar et al. (2011), older users may tend to perceive the technological environment to be less complex than their younger faculty counterparts. In higher education, younger faculty earlier in their careers may not be as accustomed to the operations of learning management systems, other required teaching technologies, and innovative digital pedagogies as more established faculty in age and rank, which may have resulted in younger faculty experiencing more techno-complexity as compared to older faculty (Li & Wang, 2021).

Considering the influence of gender on the levels of faculty technostress, about twice as many females participated in the 2021 sample (58.5%) as compared to the 2020 sample (30.9%). Previous studies have determined that females experience greater techno-complexity than their male counterparts (Çoklar &

Şahin, 2011; Essel et al., 2021; Jena & Mahanti, 2014; Marchiori et al. 2019). This study contradicts these findings. More techno-complexity was reported by the predominantly male sample from 2020 as compared to the more highly identifying female sample from 2021, consistent with results from Ragu-Nathan et al. (2008). With older, more established, tenured female faculty in the 2021 sample as compared to the 2020 sample, they may have been more adept and equipped to manage the stress-generating effects of ICTs in their faculty work (Ahuja & Thatcher, 2005).

Outside of the sample demographics, the faculty landscape shaped by the pandemic radically shifted between the sample collection periods. In 2020, the COVID-19 virus pushed faculty to teach remotely at a time when they may not have been prepared to do so. However, one year later in 2021, faculty were far more experienced with the ICTs essential to administer higher learning in online or hybrid environments. The techno-complexity falloff between the periods of study could stem from enhanced digital literacy, professional development, and more experience with the use of teaching technologies (Fuglseth & Sorebo, 2014; Tarafdar et al., 2015). During this period of adjustment, faculty had the opportunity to acclimatize to ICT technologies like Zoom, Meet, and Teams along with learning management systems such as Canvas, Blackboard, Moodle, and Google Classroom. In doing so, they improved their self-efficacy and confidence in their work abilities with ICT's, no longer perceiving them to be as complex (Bandura, 1986; 1997; Bagozzi, 1978; Califf & Brooks, 2020).

Techno-Insecurity

Techno-insecurity, the stress that emerges from the use of ICTs and the job security threat of being replaced by faster, more efficient technologies or peers with a greater skillset to use them, steeply declined by 45% when comparing the 2020 sample to that from 2021. During a period of job insecurity, employees will shield their positions by strengthening their work value (Keegan, 2015). The 2021 survey group has a greater tenured faculty density as compared to the 2020 respondents. Therefore, with more tenure protection afforded the 2021 participants, job insecurity and techno-insecurity perceptions may be moderated.

During the period of pandemic lockdowns and throughout 2020, higher education lost over 650,000 jobs or 13% of its pre-pandemic workforce (Findijis, 2021; Lederman, 2021). Fast forward to 2021 and the higher education workforce began to rebound (Bauman, 2022). A renewed job outlook optimism along with the promise of a return to a somewhat pre-pandemic normal with improved vaccine availability and fewer new COVID-19 cases may have triggered the decline in job insecurity, which conflated techno-insecurity perceptions of the 2021 sample and perhaps those related to techno-uncertainty next examined.

Techno-Uncertainty

Techno-uncertainty, the instability and role ambiguity brought forth through frequent changes in technology and the ensuing constant evolution of the workplace, dropped 10% from 2020 to 2021 samples. As more institutions of higher learning returned to the classrooms in 2021, less doubt about how and where classes would be held hypothetically suppressed some workplace uncertainty and anxieties. As to techno-uncertainty, faculty became more proficient with the tech tools to do the job throughout the period of study. Once faculty taught two or more semesters or terms online, they became more adept in that particular learning space and more confident about their tech-intelligence and the work environment. Consistent with techno-complexity, an older sample population in 2021 may be another reason why techno-uncertainty dropped from 2020 (Ragu-Nathan, 2008).

Techno-Overload

Techno-overload did not change in a significant way between the samples. For one, faculty responsibilities are such that teaching, research, advising, recruiting, and service commitments are not 9-to-5 jobs. The same workload, if not more, was expected between the periods of study. With deep institutional budget cuts felt across the country coupled with rising inflation and an enrollment crisis, colleges and universities are doing more with less. According to the National Student Clearinghouse Research Center (2022), approximately 665,000 fewer students enrolled in undergraduate programs during the Spring/Winter 2022 semester, a decline of almost 5%. Graduate program enrollments also waned around

1%. Comparably, another detrimental pandemic is looming over higher education due to the record low U.S. population birthrate, an enrollment abyss. While not all institutions of higher learning will feel this plummet, those who do will suffer greatly with expectations of double-digit enrollment decline after 2025 (Grawe, 2019).

Technology is advancing at exponential speeds and as a result, the technology life cycle is shrinking (Mecke, 2021). Despite the efficiencies extended through innovation, the adoption phase can seem to be an infinite implementation loop of testing and training, followed by evaluation and feedback, upgrades, updates, breakdowns and fixes. Techno-overload remained unchanged between the periods because any throughput yielded by way of technology improvements for teaching and learning was consumed by the investment necessary to become competent using them.

An analysis of the descriptive statistics revealed that gender, age, years teaching, and rank did not influence differences in the techno-overload scores from the two samples. This result matches previous studies (La Torre et al., 2019, 2020; Setyadi, et al., 2017).

Techno-Invasion

In conjunction with techno-overload, the techno-invasion sub-dimension differences between the 2020 and 2021 groups were unchanged. The number of connected devices is now 46 billion and counting, with an expected jump to 125 billion by 2030 (McKinsey & Company, 2022). With the portability of technology, availability and speed of access, and the onset of smart applications to manage the security of our homes, lighting, refrigerators, vehicles, cardiac pacemakers, genetic indicators, falls, and a-fib detection, life as we know it is now a tech saturated world.

A possible explanation is that the levels to which technology has encroached on the work-life balance are so deep-seated that the blurring between the lines is now becoming more accepted and expected. In 2020, over 70% of employees who could work from home were as compared to about 60% this year, up 23% since before the start of the pandemic (Pew Research Center, 2022). With more work from home employment arrangements, techno-invasion is more prevalent. However, in the same survey, 44% of those working from home claimed that work/life balance has improved with greater autonomy and flexibility over their workdays.

Furthermore, faculty have become more dependent upon technological platforms, systems, tools, apparatus, and applications to do their jobs. Students are now demanding more fully online, hybrid, and Hyflex course types after experiencing remote learning during the emergency shutdown (MIT Sloan, 2021).

IMPLICATIONS FOR RESEARCH

The implications of this study are highly important to both theoretical paradigms that guide the study of technostress. This analysis builds on one of the first of its kind to scrutinize how changes in the higher education environment during a pandemic can induce or reduce variations in technostress (Boyer-Davis, 2020). Furthermore, the severe state of affairs at the onset of the pandemic and the de-escalation of technostress thereafter supports the transaction theory (Tarafdar et al., 2015). A research gap was filled through this investigation and perhaps a connection was made that could unify both person-environment fit and transaction frameworks as the occurrence, event, or incident provokes a ripple effect, ensuing disruption through the environment and the person, augmenting technostress perceptions.

Another discovery is that, as self-efficacy propagated, techno-complexity, techno-insecurity, and techno-uncertainty decreased. Improved digital literacy and involvement facilitation, both known technostress inhibitors, reduced the impact of these sub-dimensions of technostress (Ragu-Nathan et al., 2008; Tarafdar et al., 2011).

Gender and age did sway the results but not how the majority of studies in the literature have reported. Female digital immigrant faculty higher in rank experience less technostress than their male digital native faculty lower in rank.

IMPLICATIONS FOR FACULTY

The results of the study emphasize that another plague began wreaking havoc upon faculty and students across the country well before the pandemic. The pandemic exposed the truth of the technostress experienced by faculty on a regular basis. However, lessons have been learned since. Faculty may be far more prepared to transition to virtual learning if the need arises. While technology enabled faculty to work from home and continue to do their jobs during stay at home orders and beyond to support physical distancing safety precautions, work and life bled into one another, blurring the balance between home and the job. Faculty work is not 9-to-5 as a rule but COVID completely disrupted whatever stability may have been in place. The balance between work and home will continue to be a tightrope walk due to the technologic spillover at home until life can return to the pre-COVID homeostasis. Until then and thereafter, faculty should methodically strive to separate the two, schedule downtime, step away from the computer and connected devices, and invest in their mental and physical health. A similar strategy should be embraced by faculty who teach entirely online, vulnerable to techno-invasion on a regular basis, apart from the contagion.

LIMITATIONS

The cross-sectional survey was conducted at two different periods of time. The study was limited in scope by the use of a survey panel of college and university faculty, primarily teaching business disciplines. The technostress views and beliefs of business faculty may vary with those teaching non-business disciplines. Educators from the K-12 system were not selected for participation in the research study. In the United States alone, over 3.2 million public school teachers were expected to teach during the 2020-2021 period (Hussar et al., 2020). The K-12 educators' segment is a sizeable one to omit from the study as only an average of 1 million college and university professors are employed in the United States (Hussar et al., 2020). Similarly, the technostress interpretation and outlooks comparing faculty from higher education and K-12 environments may not align.

Only faculty presently teaching in higher education were surveyed. Those who either separated or retired from institutions of higher learning were not considered. Qualitative responses, which could have extended the meaning of the research study and provided a greater understanding of the technostress observed by educators in environments during COVID-19, were not collected from the survey participants. The survey panel drew from both domestic and international populations. Technostress tolerances may not be universal, fluctuating between geographic borders and diverse societies.

CONCLUSION

Through the lenses of the P-E fit and transaction theories and the framework of technostress creators including techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty, faculty were discovered to be statistically less techno-stressed between the later stages of the pandemic in total and as related to techno-complexity, techno-insecurity, and techno-uncertainty. Armed with this information, institutions of higher learning should continue to expand their instructional design, professional development, and counseling services budgets and staffing to encourage more adoption, involvement, and digital literacy and counteract the productivity decline, emotional exhaustion, work/life imbalance, techno-addiction, and mental health stresses that can occur through the use of them (Brooks & Califf, 2017; Li & Wang, 2021). This investment is critical now and into the future to support their faculty to cope during this incomprehensible health crisis event and beyond to the impending enrollment bust that will inexorably transform the higher education topography.

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