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BRIEF REPORT

Gender disparities in remote teaching readiness and mental health problems among university faculty during the COVID-19 pandemic

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ABSTRACT

Objectives: The main purpose of this study was to examine (1) gender differences in remote teaching readiness and mental health problems among university faculty, and (2) to what extent remote teaching readiness is associated with mental health problems among university faculty, during the COVID-19 pandemic.

Method: Survey participants of the study comprised 779 university faculty (58.2% men, 39.4% women, and 2.4% other gender identities or did not report) from 122 higher education institutions in the United States.

Results: Chi-square tests and independent *t*-test findings showed that female faculty reported significantly greater remote teaching challenges – in terms of both technology and course design – and higher levels of anxiety and depression during the COVID-19 pandemic. Structural equation modelling results indicated that remote teaching readiness was associated with mental health problems among faculty during the COVID-19 pandemic.

Conclusions: The findings suggest that gender differences in remote teaching readiness can partially explain the gender disparities in mental health problems among faculty, with female faculty being disadvantaged.

KEY POINTS

What is already known about this topic:

(1) Pre-pandemic evidence indicate that that female faculty tended to have lower confidence and less experience using technology in their teaching.

(2) Female faculty reported significantly greater anxiety and depressive symptoms during the COVID-19 pandemic.

(3) Increased teaching load, reduction in research productivity, and instability in work-life balance may explain the mental health issues experienced by university faculty.

What this paper adds:

(1) Female faculty reported significantly greater remote teaching challenges – in terms of both technology and course design – during the COVID-19 pandemic.

(2) Remote teaching readiness (or challenges) was associated with mental health problems of university faculty.

(3) Remote teaching readiness can partially explain the gender differences in mental health problems among faculty during the COVID-19 pandemic.

Objectives

The COVID-19 pandemic has disrupted education globally since 2020. Many face-to-face classes on university campuses were forced to transition to remote instruction. This sudden, unexpected transition to *emergency remote teaching* created novel challenges beyond those involved in conventional online course design and delivery (Hodges et al., 2020). Most faculty had limited time to adjust their pedagogies, redesign course curricula, and master the required technologies (Alqabbani et al., 2020; Cutri et al., 2020). Those faculty who were new to remote instruction received little to no formal training

on how to support learning online (Cutri & Mena, 2020; Gülbahar & Adnan, 2020). Early, pre-pandemic evidence has documented that female faculty tended to have lower confidence and less experience using technology in their teaching (e.g., Jackowski & Akroyd, 2010; Zhou & Xu, 2007). It is unclear, however, whether and to what extent gender disparities in remote teaching readiness exist during the COVID-19 pandemic.

High-demand, emergency remote teaching and limited preparedness may have a negative impact on faculty members' mental health. The limited but growing body of evidence has indicated that university

faculty experienced increased mental distress during the COVID-19 pandemic (Docka-Filipek & Stone, 2021; Weyandt et al., 2020). Female faculty reported significantly greater anxiety and depressive symptoms (Docka-Filipek & Stone, 2021). Increased teaching load, reduction in research productivity, instability in work-life balance, lack of control, and isolation in collaboration may explain the mental health issues experienced by faculty members (Docka-Filipek & Stone, 2021; Malisch et al., 2020; Weyandt et al., 2020). No research to date, however, has explored whether faculty' mental health problems during the COVID-19 pandemic were associated with the unpreparedness for or challenges inherent in remote teaching. This study fills this gap by investigating (1) the gender differences in mental health problems among university faculty, (2) whether and to what extent remote teaching readiness is related to faculty mental health problems, and (3) whether and to what extent gender differences in mental health problems can be explained by remote teaching readiness.

Methods

Participants

The data for this study were collected as part of a nationwide survey of faculty in science and engineering in the US through an online platform – Qualtrics— in June 2020. Approximately 26% of invited institutions (122 out of 470) participated in this study. The faculty participants were invited through either their college deans/associate deans or our direct email invitations. The research protocol was approved by the Institutional Review Board at Claremont Graduate University (#3924). Informed consent from participants was obtained electronically prior to their participation in the survey. The analytic sample included only those survey respondents who responded to the questions on remote learning readiness and mental health problems. The final sample size is 779 (58.2% men, 39.4% women, and 2.4% other gender identities or did not report) from 122 higher education institutions in 39 US states. Tables A1 and A2 in Appendix provide background characteristics of faculty participants.

Measures

Remote teaching readiness was measured using two self-reported scales: (1) technological challenges in transitioning to remote teaching, and (2) challenges in adapting course design to remote teaching. These two scales asked participants to identify their issues with technology use and course design, with values 0 (not applicable) or 1 (applicable; EDUCAUSE, 2020). The scores of the total 16 items of technological and course design challenges were reversed when constructing the remote teaching readiness factor. The mental health questions asked participants to indicate the extent to which they experienced depressive (2 items, 4-point Likert scale) and anxiety symptoms (2 items, 4-point Likert scale) in the last seven days (Kroenke et al., 2009). The gender identity was assessed with the question: "which best describes your gender?" Participants selected one of the following options: "male", "female", "transgender", "other gender", or "I'm not sure". An additional set of background characteristics was collected and included as controls in our models, including disability, age, marital status, and academic rank. Tables A1 and A2 provide survey items and summary statistics for all variables.

Analytic strategies

A series of chi-square tests and independent samples t-tests were used to examine the differences in remote teaching readiness and mental health problems between female (n = 307) and male faculty (n = 453). Other gender identities were excluded from these tests due to the small sample size (n = 19; 2.44%). A design-based multilevel structural equation modelling (MSEM) was performed to identify the association between remote teaching readiness and mental health problems among faculty, controlling for gender and other demographics (i.e., disability, age, marital status, and academic rank). The design-based MSEM approach is recommended for the study primarily focusing on the same level variables to adjust the underestimated standard errors due to the nested data structure (for more details: Muthén & Muthén, 1998–2017; Wu & Kwok, 2012). The MSEM models were performed in *Mplus 8.6* (Muthén & Muthén, 1998–2017). All variables were measured without missing values, except an 8.0% missing rate for age. The full information maximum likelihood (FIML) approach was employed to improve the estimation due to the missing data (Li & Lomax, 2017; Mazza et al., 2015).

Results

Gender disparities in remote teaching readiness and mental health problems

Our data indicate that gender differences in remote teaching readiness and mental health problems existed among faculty in the US during the COVID-19

pandemic (see Tables A3, A4, and A5 in Appendix). While 36.6% and 20.1% of male faculty reported discomfort or lack of familiarity with required technologies and access to specialized software, the percentages were significantly higher (46.3% and 28.3%, respectively) for female faculty (see Figure 1). Similarly, whereas 36.4% and 39.7% of male faculty reported having limited personal time or energy to effectively adapt course design and challenges in translating course lessons to a remote environment, disproportionately more female faculty mentioned such challenges (53.7% and 49.8%, respectively; see Figure 2). In terms of mental health problems, female

faculty reported significantly more frequent anxiety and depressive symptoms, compared with their male peers (see Figure 3).

Associations between remote teaching readiness and mental health problems

The initial MSEM model controlling for background characteristics but without adding remote teaching readiness showed that female faculty reported significantly greater mental health problems than their male counterparts by 0.38 standard deviation ($p < 0.001$). When remote teaching readiness was included in the
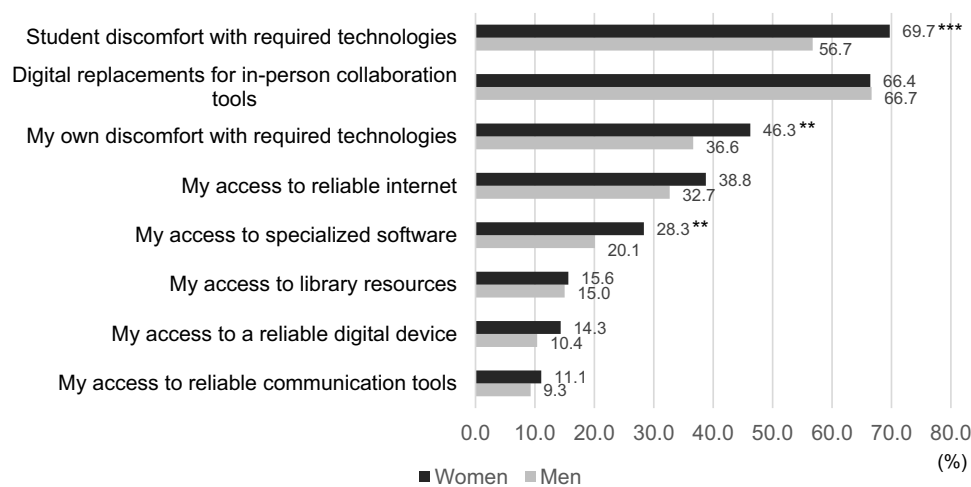

Figure 1. Gender disparities in technological challenges when transitioning to remote teaching. Note: Chi-Square test was used to examine the significant difference between female (*n*=307) and male faculty (*n*=453). Other gender (*n*=19) was excluded. *$p<.05$, **$p<.01$, ***$p<.001$.
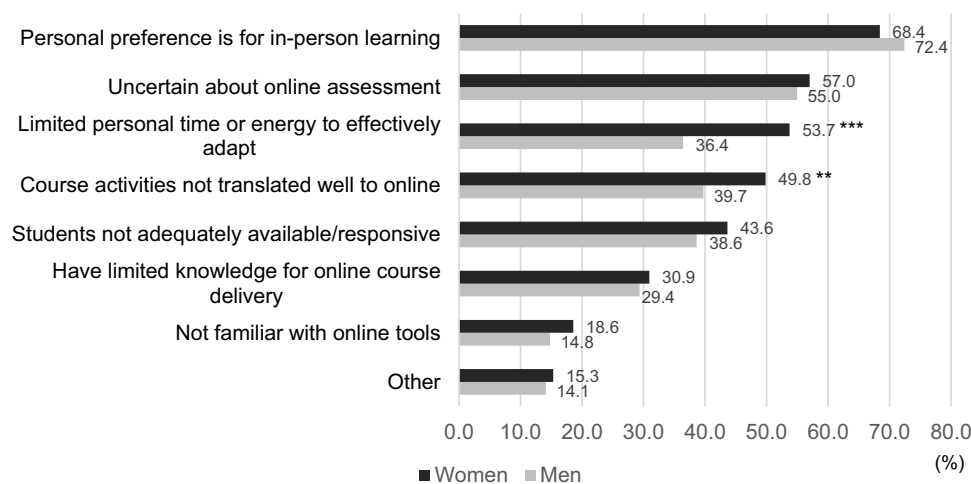

Figure 2. Gender disparities in challenges of adapting course design to remote teaching. Note: Chi-Square test was used to examine the significant difference between female (n=307) and male faculty (n=453). Other gender (n=19) was excluded. **$p<.01$, ***$p<.001$.
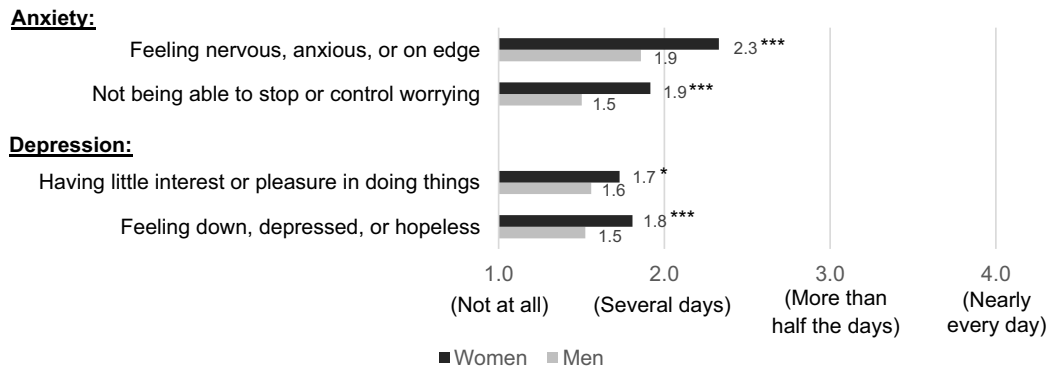
Figure 3. Gender disparities in mental health problems. Note: Independent samples *t*-test was used to examine the significant difference between female (n=307) and male faculty (n=453). Other gender (n=19) was excluded. *p<.05, ***p<.001.

MSEM model (full model; see Figure 4 and Table 1), the estimated gender gap in mental health problems was reduced to 0.30 standard deviation (a reduction of roughly 21.1%; the estimated R^2 value for mental health problems increased from 0.12 to 0.16). Furthermore, our full MSEM model indicated that remote teaching readiness is significantly negatively associated with mental health problems among faculty ($\beta = > -0.22$, $p < 0.001$); meanwhile, female faculty showed a lower level of remote teaching readiness ($\beta = > -0.36$, $p < 0.001$) and a higher level of mental health problems ($\beta = 0.30$, $p < 0.01$), consistent with the descriptive statistics reported above. We found no significant moderating effects of gender identity on the relationship between remote teaching readiness and mental health problems.

Conclusions

This study makes several important contributions to the literature in education, mental health, and the
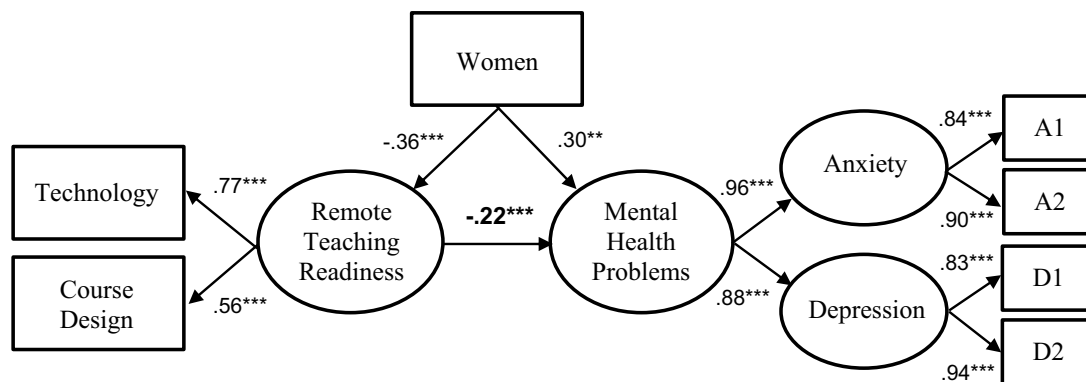

Figure 4. The association between remote teaching readiness and mental health problems. Note: N = 779. The design-based multilevel structural equation modeling (MSEM) was performed to correct the underestimated standard errors due to the nested data structure (faculty clustered within institutions). The model showed a good fit with empirical data: Chi (50) = 74.31, *p* < 0.05; RMSEA=.03, CFI=.99, SRMR=.02. Values are standardized path coefficients. Latent factor = oval; observed variable = rectangle. A1 = feeling nervous, anxious, or on edge; A2 = not being able to stop or control worrying; D1= having little interest or pleasure in doing things; D2= feeling down, depressed, or hopeless. The reliability of the anxiety factor is good (Cronbach's alpha = .862; Spearman-Brown reliability = .863; Taber, 2018). The reliability of the depression factor is good (Cronbach's alpha = .862; Spearman-Brown reliability = .863; Taber, 2018). The reliability of the higher-order mental health problems factor is good (Omega = .870; Weyn et al., 2021). The factor of remote teaching readiness was constructed by calculating the reversed scores of 16 items of technological and course design challenges. The Cronbach's alpha and Spearman-Brown reliability coefficients of the remote teaching readiness factor are .602 and .603, respectively, which are acceptable (Taber, 2018). R^2 for mental health problems = .16; R^2 for remote teaching readiness = .05. All variables were controlled for background characteristics including gender, disability, age, marital status, and academic rank. For reasons of clarity, all the covariates (except Women) and uniquenesses were not shown in the figure. **p<.01, ***p<.001.

Table 1. Standardized path coefficients for the full MSEM.

Variable relationships	β	(S.E.)
Measurement models		
Technology ← Remote Teaching Readiness factor	.77***	(.11)
Course Design ← Remote Teaching Readiness factor	.56***	(.08)
Depression 1 ← Depression factor	.83***	(.02)
Depression 2 ← Depression factor	.94***	(.02)
Anxiety 1 ← Anxiety factor	.84***	(.02)
Anxiety 2 ← Anxiety factor	.90***	(.02)
Depression factor ← Mental health problems factor	.88***	(.05)
Anxiety factor ← Mental health problems factor	.96***	(.05)
Structural models		
Hypothesized relationships		
Mental health problems ← Remote Teaching Readiness	−.22***	(.05)
Control relationships		
Remote Teaching Readiness ← Women	−.36***	(.08)
Remote Teaching Readiness ← Other gender	.07	(.32)
Remote Teaching Readiness ← Disabilities	−.31	(.17)
Remote Teaching Readiness ← Disabilities (didn't report)	−.07	(.21)
Remote Teaching Readiness ← Age	−.03	(.09)
Remote Teaching Readiness ← Age (didn't report)	.04	(.09)
Remote Teaching Readiness ← Single	−.01	(.12)
Remote Teaching Readiness ← Marital status (didn't report)	−.42	(.34)
Remote Teaching Readiness ← Assistant Professor	−.10	(.15)
Remote Teaching Readiness ← Associate Professor	.04	(.13)
Remote Teaching Readiness ← Other academic rank	−.12	(.19)
Mental health problems ← Women	.30**	(.09)
Mental health problems ← Other gender	.32	(.35)
Mental health problems ← Disabilities	.33*	(.14)
Mental health problems ← Disabilities (didn't report)	.00	(.17)
Mental health problems ← Age	−.16*	(.07)
Mental health problems ← Age (didn't report)	−.10	(.09)
Mental health problems ← Single	.03	(.13)
Mental health problems ← Marital status (didn't report)	−.30	(.29)
Mental health problems ← Assistant Professor	.38**	(.13)
Mental health problems ← Associate Professor	.13	(.11)
Mental health problems ← Other academic rank	−.04	(.17)

Note: β = standardized path coefficients. S.E. = standard error. *$p<.05$, **$p<.01$, ***$p<.001$.

COVID-19 pandemic. Adding to a growing body of evidence on the gender disparities in faculty work and well-being, our study documented that female faculty across US institutions reported significantly greater remote teaching challenges – in terms of both technology and course design – and higher levels of anxiety and depression during the COVID-19 pandemic. Our study is also one of the first to demonstrate that remote teaching readiness (or challenges) was associated with mental health problems of university faculty in the early stage of the COVID-19 pandemic. More importantly, our results indicated that remote teaching readiness can partially explain the gender differences in mental health problems among faculty during the COVID-19 pandemic.

The COVID-19 pandemic may have accelerated the pre-existing gender disparities in academia across disciplines, with females being disadvantaged (King, 2008; Oleschuk, 2020). Pre-pandemic studies showed that female faculty tended to have more teaching tasks, experience more financial difficulties, and be more responsible for childcare and housework, than their male counterparts (Ceci et al., 2014; Malisch et al., 2020; Ong et al., 2011). Several recent studies found that research time and journal submissions of female faculty decreased more substantially than those of their male counterparts during COVID-19 (e.g., Amano-Patiño et al., 2020; Gabster et al., 2020). Our study offers new evidence how the unplanned shift to emergency remote learning in higher education during the COVID-19 pandemic has created disproportionately greater teaching challenges for female faculty, which are likely to negatively affect their mental health. This finding is alarming, given numerous studies have documented that female faculty tended to report higher level of job burnout, even before the COVID-19 pandemic (see systematic review by Watts & Robertson, 2011). It is important to note that women are more likely than men to admit to mental distress (Pool et al., 2007), which may bias the results in self-report studies.

In our study, university faculty, regardless of gender identity, generally reported certain degrees of unpreparedness for remote teaching during the COVID-19 pandemic. Higher education institutions should provide faculty with adequate training and resources in effectively delivering remote teaching, which may help alleviate mental health problems among faculty members. Additional support for female faculty who tend to face more challenges in remote teaching would be beneficial in addressing both gender disparities in remote teaching readiness and mental health issues. Creating a more gender-equal online teaching support system is especially imperative as the digital age of higher education is expected to become mainstream by 2025 (Cutri & Mena, 2020), or even sooner because of the acceleration caused by COVID-19. However, the stressor of remote teaching unpreparedness may be just one of many sources of mental health problems among faculty, particularly female faculty, future research and effort should address other

personal and institutional factors (e.g., teaching load, childcare and housework).

Data availability statement

The data that support the findings of this study are available from the corresponding author, Dr. Guan Saw, upon reasonable request.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix

Table A1. Summary statistics for continuous variables (*N* = 779).

Variables	Mean	SD	Min.	Max.	Miss.
Remote Teaching Readiness					
Technology	6.35	1.53	1.00	8.00	0%
Course design	5.85	1.63	1.00	8.00	0%
Mental Health Problems					
Anxiety: Feeling nervous, anxious, or on edge	2.05	1.01	1.00	4.00	0%
Anxiety: Not being able to stop or control worrying	1.67	0.95	1.00	4.00	0%
Depression: Having little interest or pleasure in doing things	1.63	0.88	1.00	4.00	0%
Depression: Feeling down, depressed, or hopeless	1.64	0.85	1.00	4.00	0%
Age	48.43	11.38	29.00	76.00	8%

Note: Min. = minimum; Max. = maximum; Miss. = missing data.

Table A2. Summary statistics for categorical variables (*N* = 779).

Variables	N	%	Min.	Max.
Technological challenges in transitioning to remote teaching				
Student discomfort with required technologies	480	61.6	0.00	1.00
My own discomfort with required technologies	313	40.2	0.00	1.00
My access to reliable communication tools	80	10.3	0.00	1.00
My access to reliable internet	274	35.2	0.00	1.00
My access to a reliable digital device	94	12.1	0.00	1.00
My access to specialized software	182	23.4	0.00	1.00
My access to library resources	119	15.3	0.00	1.00
Digital replacements for in-person collaboration tools	520	66.8	0.00	1.00
Challenges in adapting course design to remote teaching				
Not familiar with online tools	124	15.9	0.00	1.00
Have limited knowledge for online course delivery	232	29.8	0.00	1.00
Limited personal time or energy to effectively adapt	337	43.3	0.00	1.00
Personal preference is for in-person learning	549	70.5	0.00	1.00
Course activities not translated well to online	341	43.8	0.00	1.00
Uncertain about online assessment	436	56.0	0.00	1.00
Students not adequately available/ responsive	320	41.1	0.00	1.00
Other	115	14.8	0.00	1.00
Gender				
Female	307	39.4	–	–
Male*	453	58.2	–	–
Other	19	2.4	–	–
Disabilities				
Disabled	60	7.7	–	–
Non-disabled*	697	89.5	–	–
Did not report	34	4.4	–	–
Marital status				
Single	125	16.0	–	–
Married or marriage-like relationship*	627	80.5	–	–
Did not report	27	3.5	–	–
Academic rank				
Full professor*	284	36.5	–	–
Associate professor	212	27.2	–	–
Assistant professor	213	27.3	–	–
Other	70	9.0	–	–

Note: Min. = minimum; Max. = maximum; No missing data for all of these variables. * Represents the reference group in each categorical covariate.

Table A3. Gender disparities in technological challenges when transitioning to remote teaching.

Item	M	SD	χ^2
Student discomfort with required technologies			
Women	.70	.46	13.07***
Men	.57	.50	
Digital replacements for in-person collaboration tools			
Women	.66	.47	.00
Men	.67	.47	
My own discomfort with required technologies			
Women	.46	.50	7.01**
Men	.37	.48	
My access to reliable internet			
Women	.39	.49	2.98
Men	.33	.47	
My access to specialized software			
Women	.28	.45	6.95**
Men	.20	.40	
My access to library resources			
Women	.16	.36	.06
Men	.15	.36	
My access to a reliable digital device			
Women	.14	.35	2.72
Men	.10	.31	
My access to reliable communication tools			
Women	.11	.31	.661
Men	.09	.29	

Note: Chi-Square test. N_{Women} = 307. N_{Men} = 453. Other gender (N = 19) was excluded. *p < .05, **p < .01, ***p < .001.

Table A4. Gender disparities in challenges of adapting course design to remote teaching.

Item	M	SD	χ^2
Personal preference is for in-person learning			
Women	.68	.47	1.42
Men	.72	.45	
Uncertain about online assessment			
Women	.57	.50	.31
Men	.55	.50	
Limited personal time or energy to effectively adapt			
Women	.54	.50	22.35***
Men	.36	.48	
Course activities not translated well to online			
Women	.50	.50	7.59**
Men	.40	.49	
Students not adequately available/responsive			
Women	.44	.50	1.91
Men	.39	.49	
Have limited knowledge for online course delivery			
Women	.31	.46	.22
Men	.29	.46	
Not familiar with online tools			
Women	.19	.39	1.91
Men	.15	.36	
Other			
Women	.15	.36	.21
Men	.14	.35	

Note: Chi-Square test. N_{Women} = 307. N_{Men} = 453. Other gender (N = 19) was excluded. *p < .05, **p < .01, ***p < .001.

Table A5. Gender disparities in mental health problems.

Item	M	SD	t
Anxiety			
Feeling nervous, anxious, or on edge			
Women	2.33	1.05	6.31 ***
Men	1.86	.94	
Not being able to stop or control worrying			
Women	1.92	1.04	
Men	1.50	.83	5.83 ***
Depression			
Having little interest or pleasure in doing things			
Women	1.73	.94	2.58 *
Men	1.56	.83	
Feeling down, depressed, or hopeless			
Women	1.81	.89	4.52***
Men	1.52	.79	

Note: Independent samples t-test. $N_{Women} = 307$. $N_{Men} = 453$. Other gender (n = 19) was excluded. *$p < .05$, **$p < .01$, ***$p < .001$.