The Effect of Gender and STEM/non-STEM Disciplines on Remote Learning: A National Study of Undergraduates in Qatar

Mary L. Newsome[1], Anthony A. Pina[2], Mohammad Mollazehi[3], Khalid Al-Ali[4] and Yousef Al-Shaboul[5]
[1]Qatar University
[2]Sullivan University
[3]Qatar University
[4]Ministry of Education and Higher Education, State of Qatar
[5]Qatar University
[1]ORCID 0000-0002-4315-358X
[2]ORCID 0000-0001-9106-5165
[3]ORCID 000-0001-9906-9718
[4]ORCID 0000-0003-1507-9754
[6]ORCID 0000-0002-4453-670X
mary.newsome@qu.edu.qa
APina@sullivan.edu
Mollazehi33@gmail.com
k.alali@edu.gov.qa
yalshaboul@qu.edu.qa

Abstract: The sudden and prolonged disruption to learning caused by the COVID-19 pandemic has exposed the vulnerabilities of traditional higher education and revealed the need for a rapid transformation. Lessons from the pandemic have made it clear that the future of higher education will rely heavily on e-learning and the agility of institutions to seamlessly transition between face-to-face, blended/hybrid, and fully online learning. As institutions begin their post-pandemic planning, the online experiences of different groups of learners during the pandemic offer valuable insight into what is working and what isn't. Consequently, this study explored the effect of gender and discipline (STEM/non-STEM) on students' perceptions of (1) course design, (2) assessment, (3) student behavior, (4) instructor behavior, and (5) tools and technologies during forced online learning. Additionally, the researchers investigated the effect of gender and discipline on students' overall satisfaction with remote learning and explored the influence of students' perceptions on satisfaction. Study participants were 1,825 undergraduates at eight universities in Qatar. Using the QLT evaluation rubric, the researchers adapted a 27-item survey to measure students' perceptions of key aspects of quality online teaching and learning and to gauge overall satisfaction. Using a SEM approach, study results showed that (1) male students had more positive perceptions of instructor behavior, assessment, and tools and technologies compared to females, (2) males were more satisfied overall with their remote learning experiences, (3) students in STEM disciplines had significantly more negative perceptions of all the aspects of online learning explored in the study, (4) students in STEM disciplines were significantly less satisfied overall with remote learning, and (5) students' perceptions of tools and technologies, assessment, and course design most influenced their overall satisfaction. This study also considers the unique cultural context in Qatar when interpreting results, particularly in regards to women. These findings have important implications for faculty development and post-pandemic planning in higher education in general and the Gulf in particular.

Keywords: remote learning, student satisfaction, STEM, COVID-19 pandemic, gender, Qatar

1. Introduction

Since early 2020, virtually every Higher Education Institution (HEI) around the world has been mandated to deliver education remotely in response to the COVID-19 pandemic. Such drastic and prolonged measures pose significant challenges to institutions, faculty, and students. While distance and online learning are well-established modes of delivery at distance education institutions, that is not necessarily the case at traditional HEIs. That is, faculty may not have the skill sets needed, students are not choosing the online mode, and institutions may lack needed infrastructure and support. Further exacerbating the challenges posed by the pandemic is the lack of clear contingency plans for what Hodges et al., (2020) termed "emergency remote teaching" or ERT. With ERT, the aim is to provide temporary access to instruction and instructional support in a way that is quick to set up and reliably available during a crisis (Hodges et al., 2020, p.6). However, even those institutions with contingency plans in place were likely not prepared for more than a year of ERT.

The growing body of pandemic research suggests traditional higher education (HE) is heading for a rapid transformation full of uncertainty. In such cases, studies of students' satisfaction offer valuable insight into areas for improvement (Schlesinger, et al., 2016). Although there are many studies investigating student satisfaction throughout the pandemic, there is limited research exploring the effect of gender on students' experiences with remote learning. Likewise, the literature investigating the experiences of students in STEM and non-STEM fields during the pandemic is lacking. Furthermore, to the authors' knowledge, there are no other studies investigating the impact of gender and discipline on student satisfaction with remote learning at a national level in the gulf region. Consequently, the current study seeks to add to the literature by investigating these factors and taking into consideration the unique cultural context in Qatar, particularly in regards to women.

2. Literature Review

The terms *satisfaction* and *quality*, particularly in the context of HE, generally go hand-in-hand. In fact, it is widely accepted that quality drives satisfaction and that satisfaction is an excellent measure of quality (Drugas, 2020). Satisfaction has also been linked with students' persistence, graduation rate, and learning (Bryant and Bodfish, 2014). Furthermore, student satisfaction is an indicator of institutional performance (Nastasić, Banjević and Dragana, 2019); a global concern given the prolonged period of ERT imposed by the pandemic and the real likelihood of future crises. Investigating students' experiences with remote learning, then, offers insight into areas where student satisfaction is strong and where improvement is needed (Smimou and Dahl, 2011).

2.1 Gender and Satisfaction with Online Learning

The literature regarding the effect of gender on students' perceptions of and satisfaction with online learning is quite mixed (Ekawati, Sugandi, and Kusumastuti, 2017; O'Driscoll, 2012; Sultan and Wong, 2012). On one hand, relatively early studies have reported that males have more experience using technology for different purposes and are, consequently, more comfortable with it, giving them an added advantage and creating more positive online experiences (Tucker, 2014; Lin et al., 2012). Similarly, studies of technology-supported learning have shown that female students have more anxiety around online assessment due to fewer computing experiences and lower levels of computer self-efficacy (He and Freeman, 2010). Other studies have shown that females prefer e-learning assessments that involve projects and group work, while males prefer to solve problems on their own (Adamus et al., 2009). More recent work has suggested the gender-based differences reported in earlier studies are less applicable to technologically adept millennials and Generation Z learners (Cutler, 2014; Harvey and Parahoo, 2017). However, a study by Hsiao and Shiao (2018) investigating gender differences in distance learning found that female students outperformed male students and, subsequently, indicated a higher level of satisfaction. During forced online learning due to the COVID-19 pandemic, however, Hsiao (2021) investigated 18,085 university students in Taiwan and found that although females outscored males , they were significantly less satisfied with online learning ($P < 0.0001$). A study investigating students' satisfaction at universities in Saudi Arabia found that females were more satisfied with their learning experience when courses with male instructors were taught in a blended learning environment (Alebaikan, 2010). Such findings support Albalawi's (2007) study, which showed that university lecturers believed web-based instruction enhanced learning among students at gender-segregated HEIs in Saudi Arabia. For students coming from regions where gender segregation is commonplace, it is conceivable that gender may influence their experiences with online learning.

2.2 Online Learner Satisfaction and STEM/non-STEM Disciplines

Several studies have reported discipline as a significant factor influencing student satisfaction with online learning (Lim and Richardson, 2021; Smith et al., 2008). Similarly, Nelson Laird et al, (2011) highlighted the differences in learning approaches used in STEM and non-STEM fields. Nonetheless, there are relatively few studies investigating the unique challenges of delivering STEM instruction online (Chen, Bastedo, and Howard, 2015; Lee, 2014; Watkins and Mazur, 2013). Of the research available, recent studies suggest students in STEM fields highly value interaction and collaboration in their online learning experiences. For example, in a study comparing student satisfaction with face-to-face and online learning among nursing students, Abdelaziz et al. (2011) reported that students were accepting of online instruction as a temporary mode of learning but complained that their online experiences lacked the desired interaction with students and instructors. Hegeman (2015) found that math students in online courses preferred instructor-generated videos and guided note-taking sheets over publisher materials such as textbooks. In an investigation of undergraduates in an online calculus course, Vajravelu and Muhs (2017) found that participation in small group problem-solving sessions for homework assignments and online skills tests significantly increased engagement and overall satisfaction. In

addition, Chen, Bastedo, and Howard (2015) explored the influence of online design elements on learner satisfaction and found that students in STEM fields were most satisfied with online learning experiences characterized by active learning activities, interactive engagement strategies, and robust assessment design. Most recently, a study of satisfaction with online learning during the pandemic conducted by Faize and Nawaz (2020) surveyed 196 Bioscience undergraduates using closed and open-ended items. Study results revealed that students were largely dissatisfied with their online learning experience citing lack of interaction with students and instructors as well as an inability to do hands-on experiments as the main cause. These findings emphasize an urgent need for more studies aimed at understanding STEM students' perceptions of online learning, enhancing the delivery of STEM instruction online, and improving STEM instruction in ERT contexts.

3. Cultural Considerations for Remote Learning in Qatar

Although many institutions around the world struggled to ensure learners' had access to internet and needed tools and technologies in the early stages of the pandemic, oil-rich Qatar with its relatively small population (less than 3 million inhabitants) suffered little in this regard. When all HEIs in Qatar were mandated to switch to fully online learning in early March 2020, the transition was facilitated by existing learning management systems such as Blackboard, increasing support to faculty, a COVID hotline established by MOEHE (Ministry of Education and Higher Education), and increased support from the country's national telecommunications provider to guarantee accessibility and connectivity. Furthermore, the MOEHE worked with institutions to ensure that learners who did not have access to needed devices or internet were provided for.

Qatar's deeply rooted values, on the other hand, likely have bearing on the learning experiences of students during the pandemic, particularly for women who are cornerstones of Qatari culture carrying substantial responsibility for maintaining social institutions such as marriage and family (Liloia, 2019). The Arabic phrase, "Rabbaitul Bait" (meaning queen of the house) embodies the significance of Arab women's roles in the home. The country's national development strategy also elaborates on the vital role of women, "Through their nurturing of language, codes of ethics, behavioral patterns, value systems and religious beliefs, women play an indispensable role in upholding traditional, familial, and cultural values" (General Secretariat for Development Planning, 2011, p.165). These values reinforce women's primary role as a domestic one and instill a sense of pride and honor in prioritizing family responsibilities over individual ambitions (Al-Malki et al, 2012; Golkowska, 2014). In the context of the pandemic, then, women are likely disproportionately responsible for the online learning of their children, siblings, and other family members in the home. Although size and composition of households in the Gulf have been affected by globalization, late marriage, and divorce, many Arab households are still large by Western standards and often include extended family (Al-Khraif et al., 2015). The average Qatari household, for example, consists of 10 individuals (Qatar Public Statistics Authority, 2018). It is also important to point out that prioritizing a "domestic" role is not a contradiction to Gulf women pursuing HE. In fact, nearly 70% of the 31,000 students enrolled in HE are female (Qatar Public Statistics Authority, 2018). This cultural context should be considered when interpreting study results.

4. Research Model and Hypotheses

Based on a review of the literature and consideration of the QLT online course evaluation rubric (California State University, 2021), a conceptual, structural model was designed to investigate the effect of gender and discipline (STEM/non-STEM) on students' perceptions of (1) course design/materials, (2) assessment and evaluation, (3) student behavior, (4) instructor behavior, and (5) tools and technologies during remote learning. The research model was also designed to study the effect of gender and discipline on students' overall satisfaction and to explore the influence of students' perceptions on overall satisfaction. The research model is presented in figure 1 below. The specific research hypotheses are:

H1: Gender influences students' perceptions of course design/materials, assessment and evaluation, instructor behavior, student behavior, and tools and technologies.
H2: Gender influences students' overall satisfaction with remote learning.
H3: Discipline (STEM/Non-STEM) influences students' perceptions of course design/materials, assessment and evaluation, instructor behavior, student behavior, and tools and technologies.
H4: Discipline (STEM/Non-STEM) influences students' overall satisfaction with remote learning.
H5: Students' perceptions of course design/materials, assessment and evaluation, instructor behavior, student behavior, and tools and technologies influence their overall satisfaction with remote learning.

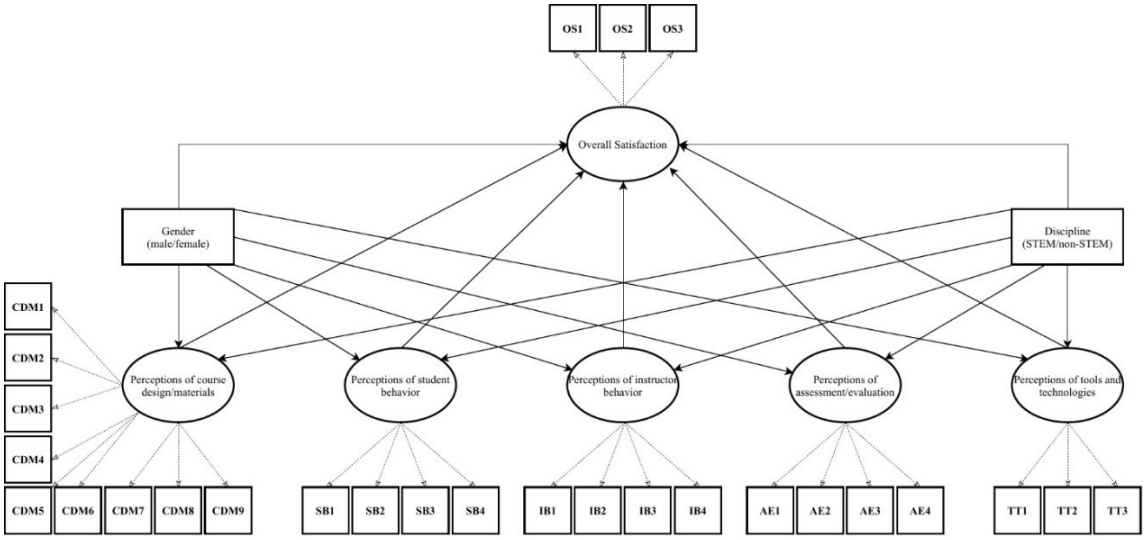

Figure 1: Research model

5. Methodology

5.1 Setting

This study took place at a large HEI in the State of Qatar during fall 2020. A total of 14 public and private HEIs were invited to participate. Of those, eight confirmed their willingness to take part. Participating HEIs were Qatar University, Community College of Qatar, College of the North Atlantic-Qatar, University of Calgary-Qatar, Qatar Finance and Business Academy of Qatar with Northumbria University, Virginia Commonwealth University-Qatar, AFG College with the University of Aberdeen, and Stenden Qatar-University of Applied Sciences. Because all undergraduate courses at these institutions were mandated to be taught fully online and some graduate courses, primarily those with labs, were permitted to have periods of face-to-face instruction (likely due to their significantly smaller class sizes) during the fall 2020 semester, the researchers only targeted undergraduate students. Additionally, because this study investigates STEM/non-STEM students, the researchers targeted only those undergraduates who had declared an area of study. Table 1 details the demographics of the HEIs that participated in the study.

Table 1: Demographics of Participating HEIs (Qatar Planning and Statistics Authority, 2019

Institution	Sector	Undergrad Population	Male	Female	STEM Learners	Non-STEM Learners
Qatar University	Public	20,396	4,226	16,170	5,986	14,410
Community College of Qatar	Public	5,120	1,331	3,789	422	4,698
College of North Atlantic-Qatar	Public	3,378	1,919	1,459	1,385	1,993
University of Calgary-Qatar	Private	409	36	373	409	0
Qatar Finance and Business Academy of Qatar with Northumbria University	Public	272	106	166	0	272
Virginia Commonwealth University School of the Arts in Qatar	Qatar Foundation	333	136	197	0	333
AFG College with the University of Aberdeen	Private	339	171	168	132	207
Stenden Qatar-University of Applied Sciences	Private	248	116	132	0	248
Total		30,495	8,041	22,454	8,334	22,161

5.2 Sample and Data Collection

All undergraduates at participating HEIs who had declared an area of study were invited to participate in an online survey via their institutional email address. Data was collected from November to December during fall 2020 near completion of the third semester of forced online learning. The survey included informed consent and was voluntary with the option to exit at any time. The study population consisted of 30,495 undergraduates (male = 8,041 and female = 22,454). Study participants were *n* = 1,825 undergraduates comprised of 482 males

(26.4%) and 1,343 females (73.6%), which is representative of the population. Furthermore, there were 1,119 study participants (61.3%) from non-STEM disciplines and 706 participants (38.7%) from STEM disciplines, which reflects the higher percentage of non-STEM students in the population. The survey response rate was 6 percent, and the sampling margin of error was ± 2%. The institutional review board did not permit the researchers to ask respondents to identify their institution; consequently, this study deals with aggregate data from those institutions who confirmed their participation.

5.3 Instrument

The researchers adapted a student survey from the widely used QLT course evaluation rubric (California State University, 2021) to explore students' perceptions of key aspects of quality online teaching and learning. The QLT rubric is grounded in Chickering and Gamson's (1987), *Seven Principles of Good Practice in Undergraduate Education,* which presents a philosophy for quality teaching and learning (whether face-to-face or online). QLT is commonly used by instructional designers, faculty developers, and faculty, particularly those new to online learning, to effectively design and deliver online, blended, and flipped courses (Cain, 2017). Due to the length of QLT (9 sections comprised of 53 objectives) and the technical language of the rubric, the researchers condensed the sections based on five overlapping themes present in the rubric to construct the student survey; Consequently, the survey sub-scales were: (1) Course Design/Materials, (2) Assessment and Evaluation, (3) Instructor Behavior, (4) Student Behavior, and (5) Tools and Technologies with a sixth scale for Overall Satisfaction. The survey consisted of 27 Likert-type items adapted from the QLT objectives using a scale of 1 to 5 (1 – strongly disagree to 5 – strongly agree). The survey was reviewed by an expert panel of faculty, staff, and administrators from three institutions who had extensive experience in either survey design, course/instructional design, or online pedagogy. The review process resulted in the rewording of several items to be more student friendly. Information on the 27 individual items is provided later in Table 4. A confirmatory factor analysis (CFA) was performed to evaluate the construct validity of the instrument. The results of the CFA are reported below.

6. Data Analysis

The current research utilizes the partial least squares path modeling (PLS-PM) procedure using SmartPLS 3 software (Hair et al., 2016). PLS-PM was selected because of its ability to estimate complex cause-effect relationship models with latent variables. This technique is appropriate when all components are measured through a questionnaire. Compared to other similar procedures like regression analysis, this procedure is more powerful. It investigates linear causal relationships among variables while concurrently minimizes bias caused by measurement error (Ullman and Bentler, 2003). The model was assessed and interpreted in two stages: (1) the measurement model, which assessed the relationship between observed data and latent variables and (2) the structural model, which assessed the relationship between latent variables (Benitez et al., 2020, Henseler, 2018).

6.1 Assessment of Measurement Model

The researchers assessed the convergent validity of survey items through a confirmatory factor analysis. According to Hair et al. (2019), the standardized factor loading for all items should be greater than 0.7. As shown in Table 2, the standardized factor loadings of all the constructs in the model are between 0.706 and 0.904.

Cronbach's alpha and composite reliability were measured to evaluate construct reliability. According to Hair et al. (2019), the minimum acceptable value for both Cronbach's alpha and composite reliability is 0.70. Table 3 shows the range of Cronbach's alpha values are between 0.751 and 0.937, and the range of composite reliability values are 0.842 and 0.947. For convergent validity, the researchers adhered to the suggestions of Henseler et al. (2014), which suggests the average variance extracted (AVE) should be greater than or equal 0.50. Table 3 shows the AVE values are greater than 0.50. Discriminant validity was measured using Fornell Larcker's (1981) criterion, which suggests the square root of AVE of each factor (main diagonal) must be greater than the absolute value of their correlation coefficients (off-diagonal). Table 3 shows the square root of AVE for all factors are greater than the correlation coefficients in the corresponding rows and columns.

Table 2: Factor loadings of constructs

Constructs	Code	SL	SE	t-values
Course Design/Materials (CDM)	CDM1	0.816	0.011	77.136
	CDM2	0.820	0.010	84.478
	CDM3	0.864	0.008	114.153
	CDM4	0.848	0.007	113.362
	CDM5	0.803	0.011	76.392
	CDM6	0.808	0.010	81.365
	CDM7	0.840	0.007	118.807
	CDM8	0.772	0.012	64.462
	CDM9	0.762	0.012	61.677
Student Behavior (SB)	SB1	0.802	0.010	82.861
	SB2	0.749	0.014	52.860
	SB3	0.766	0.013	56.865
	SB4	0.706	0.016	43.354
Instructor Behavior (IB)	IB1	0.840	0.009	90.664
	IB2	0.895	0.006	153.814
	IB3	0.867	0.007	129.282
	IB4	0.855	0.008	106.520
Assessment/Evaluation (AE)	AE1	0.801	0.011	73.519
	AE2	0.888	0.006	144.684
	AE3	0.854	0.009	90.630
	AE4	0.904	0.005	180.262
Tools and Technologies (TT)	TT1	0.863	0.008	113.852
	TT2	0.832	0.010	82.650
	TT3	0.789	0.014	54.487
Overall Satisfaction (OS)	OS1	0.881	0.004	208.047
	OS2	0.875	0.006	145.403
	OS3	0.783	0.013	58.413

Notes: SL= Standardized loadings, SE = Standard error, t-values are significant at the level of 0.1%

Table 3: Measurement statistics for instrument validity and reliability

Latent Constructs	α	CR	AVE	Latent Constructs					
				CDM	SB	IB	AE	TT	OS
CDM	0.937	0.947	0.665	**0.815**					
SB	0.751	0.842	0.572	0.743	**0.757**				
IB	0.887	0.922	0.747	0.794	0.734	**0.864**			
AE	0.884	0.921	0.744	0.781	0.685	0.803	**0.862**		
TT	0.771	0.868	0.686	0.736	0.645	0.702	0.738	**0.828**	
OS	0.808	0.884	0.718	0.639	0.587	0.610	0.642	0.637	**0.847**

Table 4 below shows the descriptive statistics, relative importance index (RII), and rank of items based on RII value for the 27 items included in the questionnaire. The item means ranged from 2.59 to 3.84. The RII values ranged from 51.86% to 76.82%. According to RII, the highest five ranked items belong to "Tools and Technologies" and "Course Design"; Those items were "TT3", "CDM2", "CDM5", "TT1", and "CDM1", with RII values that ranged between 75.03% and 76.82%. Conversely, the lowest five ranked items belonged to "Assessment/Evaluation", "Instructor Behavior", "Student Behavior" and "Overall Satisfaction". Those items were "AE3", "AE2", "IB1", "SB2", and "OS2", with RII values that ranged between 51.86% and 61.88%.

Table 4: Descriptive statistics and relative importance index (RII) of survey items

Code	Items	Mean	SD	RII (%)	Rank
CDM1	My online courses included clear instructions on how to get started, including how to navigate the course	3.75	1.21	75.03	5
CDM2	My online courses provided contact information for the instructor and/or the program/department	3.81	1.24	76.14	2
CDM3	My online courses provided clear course objectives	3.74	1.19	74.74	6
CDM4	I understood what was expected of me in terms of my participation in online courses	3.59	1.29	71.86	11
CDM5	My online courses provided clear instructions for completing assignments in a timely manner	3.80	1.19	75.93	3
CDM6	My online courses provided clear rubrics that helped me understand how I would be graded on assignments/assessments	3.65	1.26	73.06	7
CDM7	The content of my online courses helped me deepen my understanding of the course topics	3.29	1.33	65.82	19
CDM8	My online courses utilized a variety of sources that supported my learning (articles, videos, tutorials, websites, etc.)	3.62	1.22	72.41	10
CDM9	My online courses provided links to help me access campus support and resources	3.58	1.24	71.51	13
SB1	I had many opportunities to participate in group/class discussions during online classes	3.65	1.25	72.97	8
SB2	I visited my instructors during their online office hours	2.96	1.29	59.23	26
SB3	I utilized the online support and resources provided by my institution (i.e., library, writing/research support, counseling, etc.)	3.15	1.25	63.07	21
SB4	When taking an online course, I prefer to join live video lectures	3.64	1.38	72.87	9
IB1	My instructors provided me with frequent feedback on my progress and performance throughout my online courses	3.07	1.28	61.39	25
IB2	My instructors provided feedback that helped me improve my learning	3.13	1.29	62.56	22
IB3	During my online courses, I was usually able to get timely help when I had questions	3.44	1.30	68.81	18
IB4	My instructors were able to manage group discussions effectively	3.50	1.21	70.06	16
AE1	My online courses included a variety of assessments/evaluations	3.58	1.20	71.52	12
AE2	The grading in my online courses was fair	3.09	1.37	61.76	24
AE3	My grades were accurate reflections of my learning	3.09	1.34	61.88	23
AE4	The assessments used in my online courses helped me keep track of my own progress	3.25	1.30	65.09	20
TT1	I had the technology skills needed to succeed in online courses	3.75	1.21	75.03	4
TT2	My instructors had the technology skills needed to teach online	3.50	1.23	69.99	17
TT3	I had adequate internet access/devices to participate in online courses	3.84	1.14	76.82	1
OS1	I am confident in my ability to succeed in online learning	3.54	1.36	70.85	15
OS2	I prefer online learning over face-to-face learning	2.59	1.61	51.86	27
OS3	I would like to have the option to take some or all of my courses online in the future	3.57	1.54	71.35	14

6.2 Structural Model Assessment

The structural model was assessed by analyzing the variance inflation factor (VIF) values, coefficient of determination (R^2) and the predictive relevance of the structural model (Q^2). According to Hair et al. (2016),

to have minimal collinearity, obtained VIF values must be less than 5. The VIF values for the structural model ranged from 1.035 to 3.887. The coefficient of determination (R^2) estimates the total variance explained, which in turn estimate the model predictive accuracy. In the current study, the R^2 statistic was 0.508 indicating the total effect size for the structural model is moderate (Henseler et al., 2009). Finally, the predictive relevance of the model (Q^2) estimates the quality of the PLS path model. Since the Q^2 statistic is greater than the threshold limit of zero ($Q^2 = 0.344$), the predictive relevance of the structural model is acceptable (Henseler et al., 2009).

6.3 Model Fit

Several fit statistics were used to assess the structural model, namely standardized root mean square residual (SRMSR), root mean square error of approximation (RMSEA), goodness of fit index (GFI), and the comparative fit index (CFI). According to Cangur and Ercan, (2015) the acceptable threshold for the value of SRMR for a good fit is less than 0.08. Steiger, (2007) suggests a value of RMSEA of less than 0.07 is needed for a good fit, and Hooper et al. (2008) hold that both GFI and CFI values must be greater than 0.95. As reported in Table 5, the value of SRMR was 0.023; the value of RMSEA was 0.044; the GFI value was 0.955, and the CFI value was 0.976. Consequently, the model is a good fit according to all four fit indices.

Table 5: Fit indices for the structural model

SRMR < 0.08	RMSEA < 0.07	GFI > 0.95	CFI > 0.95
SRMR	RMSEA	GFI	CFI
0.023	0.044	0.955	0.976

6.4 Hypotheses Testing

This study sought to explore the perceptions of male and female students as well as STEM and non-STEM students toward various aspects of online learning and to determine whether gender or discipline effects overall satisfaction. Moreover, this study examined the influence of students' perceptions of remote learning on overall satisfaction. To test the specific research hypotheses, a structural equation model (SEM) approach was used. For the structural model of this study, the p-value of the path coefficients were found using a PLS process with a bootstrapping procedure, which consisted of 10000 bootstrap samples and 1825 bootstrap cases. The path coefficients, standard errors, t-values, and p-values are shown below in Table 6.

Table 6: Structural model results

Structural path*	Path coefficient	Boot S.E	t-value (bootstrap)	p-value
Gender (Male) ---> CDM	0.029	0.024	1.199	0.231
Gender (Male) ---> SB	0.019	0.024	0.787	0.431
Gender (Male) ---> IB	0.073	0.024	3.066	0.002
Gender (Male) ---> AE	0.078	0.024	3.308	0.001
Gender (Male) ---> TT	0.061	0.023	2.654	0.008
Gender (Male) ---> OS	0.062	0.016	3.797	0.000
Discipline (STEM) ---> CDM	-0.047	0.024	1.980	0.048
Discipline (STEM) ---> SB	-0.109	0.023	4.674	0.000
Discipline (STEM) ---> IB	-0.102	0.023	4.362	0.000
Discipline (STEM) ---> AE	-0.111	0.023	4.729	0.000
Discipline (STEM) ---> TT	-0.063	0.023	2.701	0.007
Discipline (STEM) ---> OS	-0.084	0.017	4.973	0.000
CDM ---> OS	0.180	0.035	5.128	0.000
SB ---> OS	0.129	0.029	4.437	0.000
IB ---> OS	0.033	0.036	0.911	0.362
AE ---> OS	0.190	0.036	5.352	0.000
TT ---> OS	0.250	0.030	8.296	0.000

*Reference group for the variable gender is "female" and for discipline is "non-STEM"

According to Table 6, there was a significant relationship between gender and perceptions of instructor behavior, assessment and evaluation, tools and technologies at the level of 5%. Likewise, there was a significant relationship between gender and students' overall satisfaction with remote learning. Since the reference group for the variable gender is "female", and the path coefficients are positive, this means that males have more positive perceptions of instructor behavior ($\beta = 0.073$), assessment and evaluation ($\beta = 0.078$), tools and technologies ($\beta = 0.061$) and were overall more satisfied ($\beta = 0.062$). However, the relation between gender and perceptions of course design/materials and student behavior was not significant (p-value > 0.05).

Additionally, there was a significant relationship between discipline and perception of course design/materials, assessment and evaluation, instructor behavior, student behavior, and tools and technologies at the level of 5%. Similarly, there was a significant relationship between discipline and students' overall satisfaction with remote learning. Since the reference group for the variable discipline is "non-STEM", and the path coefficients are negative, this means non-STEM students have more positive perceptions of course design/materials ($\beta = -0.047$), students' behavior ($\beta = -0.109$), instructor behavior ($\beta = -0.102$), assessment and evaluation ($\beta = -0.111$), tools and technologies ($\beta = -0.063$), and were overall more satisfied ($\beta = -0.084$).

Finally, the results indicate that participants' perceptions of tools and technologies ($\beta = 0.250$), had the highest significant effect on students' overall satisfaction with remote learning followed by their perceptions of assessment and evaluation ($\beta = 0.190$), course design/materials ($\beta = 0.180$), and student behavior ($\beta = 0.129$). The only insignificant factor was participants' perceptions of instructor behavior ($\beta = 0.033$) since the p-value was greater than 0.05.

7. Discussion

7.1 Influence of Gender on Perceptions and Satisfaction

Although Harvey and Parahoo (2017) claim learners' gender is less relevant to studies of online learning among technologically adept millennials, study findings suggest that it influences students' perceptions of online learning as well as their overall satisfaction. Specifically, of the five aspects of online learning explored in the study, male students' perceptions of instructor behavior, assessment and evaluation, and tools and technologies were significantly more positive compared to females. Additionally, male students were more satisfied overall with their remote learning experiences throughout the pandemic. There was no statistically significant relationship between gender and course design/materials or student behavior.

These findings seem to confirm earlier studies of technology-supported learning, which report that male students have more positive online experiences (Tucker, 2014; Lin et al., 2012). It is worth pointing out, however, that many of these studies were conducted among learners who had chosen the online format voluntarily, which is not the case in the current context. Furthermore, because this study took place in an ERT setting, instructors likely lacked sufficient time to create online environments that properly account for different learning styles or learner preferences (Senel and Senel, 2021). Studies conducted among faculty at Gulf universities during the pandemic, for example, reported that instructors perceived themselves to be underprepared for online teaching and believed they needed more professional development, particularly regarding e-assessments (Guangul et al., 2020; Sharadgah and Sa'di, 2020).

Another explanation for study findings is that females in Gulf countries bear the primary responsibility for domestic issues. Paired with the stresses of an ERT environment, this may have impacted female students' perceptions of online learning, particularly high stakes aspects such as assessment and evaluation. Prior to the pandemic, Golkowska's (2014) study of Arab women in the Gulf reported that Qatari women in HE struggled to balance the responsibilities and expectations of university and family. This already difficult balance was likely exacerbated by the extreme mandates issued in response to the COVID-19 outbreak. To illustrate, Al-Rabiaah et al., (2020), reported higher stress levels among female students at Saudi universities during the pandemic. Similarly, researchers at the Institute for Population Health at Weill Cornell Medicine-Qatar found that elevated stress levels among university students during the pandemic was significantly associated with being female (Cheema et al., 2020).

More research is needed to confirm study findings, and the researchers particularly encourage qualitative studies aimed at gaining a deeper understanding of female students' perceptions of the aspects of online learning explored in this study. More studies are also needed investigating gender and perceptions of online learning during the pandemic at other institutions and in different countries. Furthermore, study findings suggest a need for faculty professional development and for careful consideration of how well the online learning environment that is created serves the different genders (Carr Chellman, 2014). While an ERT context arguably provides some justification for a lack of preparedness, we should learn from these pandemic experiences. It is imperative that we work toward a system allowing for a seamless transition between face-to-face, hybrid, and fully online learning that can be utilized in the event of future crises.

7.2 Influence of STEM/non-STEM Discipline on Perceptions and Satisfaction

Study results also showed that students in STEM disciplines had more negative perceptions of all the aspects of online learning explored. Furthermore, results showed that STEM students were less satisfied overall with their online learning experience throughout the pandemic. Study findings are consistent with literature regarding online STEM instruction during the pandemic. In a national survey investigating undergraduates' perceptions of online learning during the COVID pandemic, STEM students perceived lack of face-to-face interaction and the ability to do hands on experiments as their greatest challenges (Means, Neisler, and Langer Research Associates, 2020). Likewise, Karim (2021) investigated environmental engineering students' perceptions of their online learning experiences during the pandemic and reported overwhelmingly unfavorable responses, particularly regarding online assessment; however, regarding instruction, the study results did suggest online synchronous delivery as an acceptable, short-term option.

The most plausible explanation for STEM students' significantly more negative perceptions of online learning during the pandemic is that STEM learners highly value interaction and collaboration in their online learning experiences (Chen, Bastedo, and Howard, 2018). Because of the sudden shift online, universities and instructors lacked the time, and possibly skills, needed to reconstruct the "sophisticated educational ecosystem" they know is necessary for the optimal learning experience (Mohmmed et al., 2020, p.2). While distance learning is more than capable of delivering STEM education under ideal circumstances (i.e., properly trained instructors, well designed courses, willing students, etc.), STEM instruction during the pandemic was far from ideal. Rather, STEM instructors were tasked with converting hands-on, experiential learning to a remote interface essentially overnight, and students were tasked with receiving instruction and processing information in an entirely new way against their choice (Gregory, 2020). It is not surprising under these circumstances that STEM students' perceptions of online learning are less than desirable.

These findings are alarming considering the global advocacy for STEM education (American Institutes for Research, 2016) and our increasing reliance on online learning. Given there are relatively few studies investigating the unique challenges of delivering STEM instruction online and the grim findings from research on STEM instruction during the pandemic, there is an urgent need for continued research. Additionally, the researchers did not explore possible differences in students' perceptions based on synchronous and asynchronous online instruction; therefore, replications of the current study taking this into account are encouraged. The use of synchronous virtual classrooms may prove a viable solution for ensuring the interaction and collaboration highly valued by STEM learners is preserved in emergency settings. Furthermore, clear contingency plans for ERT were scarce in general leading into the COVID-19 pandemic and essentially non-existent for the delivery of STEM instruction (Meyer and Wilson, 2011). Consequently, the researchers urge traditional HEIs to draw from studies exploring STEM instruction throughout the pandemic and from current best practices for STEM online courses to formalize contingency plans regarding STEM instruction in ERT settings.

7.3 Factors Influencing Overall Satisfaction

Of the five aspects of online learning explored in this study, results showed that learners' perceptions of tools and technologies, assessment and evaluation, and course design had the greatest influence on students' overall satisfaction. These findings are compatible with existing research. For example, studies have reported that effective use of technology enhances online learning and subsequently learner satisfaction (JISC, 2018; Shieh and Cefai, 2017). Studies have also shown that satisfaction with online learning is significantly influenced by students' clear understanding of course assessments (Wang et al., 2006) and being assessed in a variety of ways (Richards-Babb et al., 2015). Finally, research has shown that quality course design optimizes online learning experiences and increases student satisfaction (Placencia and Muljana, 2019).

These findings provide insight regarding what could be considered as core components of ERT. However, because ERT occurs under crises conditions that are either mitigated or exacerbated by the geographic, cultural, or economic context, a one-size fits all approach would likely miss the mark. In remote regions or in impoverished communities, ERT may need to account for a lack of accessibility or connectivity necessary to carry out the basics of sending and receiving learning materials, while in wealthy Gulf countries, for instance, and depending on the source of the crises, ERT may involve securing synchronous virtual classrooms. The literature on ERT is largely concerned with quickly providing *temporary* access to instruction and instructional support. However, the COVID-19 pandemic has revealed that ERT can persist for relatively prolonged periods.

Consequently, the researchers encourage colleges and universities to consider the pandemic research relevant to their unique contexts to tailor ERT to their specific needs.

8. Limitations and Further Research

The limitations of this study could be useful in guiding further research. Our results are limited to students' perceptions of their online experiences *overall*, after three semesters of remote learning. Therefore, we recommend researchers to investigate the structural model used in the current study upon students' completion of a hybrid/online course where measures of satisfaction can be directly correlated to a given course and/or instructor. Another limitation of this study is that it measured students' experiences with online learning in courses that were not designed as online courses. The sudden transition online likely left many instructors with insufficient time to create their ideal online course. Future studies could implement the model for courses designed as blended/hybrid/online courses to explore possible similarities. Finally, similar studies at other institutions and in other countries are needed to confirm study findings and inform post-pandemic planning in HE. Further studies differentiating between different fields of study among STEM students, especially those which require lab time (e.g. chemistry) and those which do not (e.g. mathematics) would be of interest. Likewise, studies of instructors' experiences with online learning are needed as well as studies comparing these variables among students and faculty.

References

Abdelaziz, M., Kamel, S. S., Karam, O., & Abdelrahman, A., 2011. Evaluation of e-learning program versus traditional lecture instruction for undergraduate nursing students in a faculty of nursing. *Teaching and Learning in Nursing,* [e-journal] *6*(2), pp. 50–58. https://doi.org/10.1016/j.teln.2010.10.003.

Adamus, T.; Kerres, M.; Getto, B.; Engelhardt, N., 2009. Gender and E-tutoring: A concept for gender sensitive E-tutor training programs. *5th European Symposium on Gender & ICT Digital Cultures: Participation – Empowerment – Diversity*. 5-7 March 2009. University of Bremen. Available at: http://www.informatik.uni-bremen.de/soteg/gict2009/proceedings/GICT2009_Adamus.pdf. [Accessed 17 February 2021].

Albalawi, M. S., 2007. *Critical factors related to the implementation of web-based instruction by higher- education faculty at three universities in the Kingdom of Saudi Arabia.* PhD. The University of West Florida. http://dx.doi.org/10.5539/hes.v2n2p124.

Alebaikan, R., 2010. *Perceptions of blended learning in Saudi universities*. PhD. University of Exeter. Available at: http://search.shamaa.org/FullRecord?ID=268639. [Accessed 30 January 2021].

Al-Khraif, R., Salam, A. A., Elsegaey, I., & Al-Mutairi, A., 2015. Changing age structures and ageing scenario of the Arab world. *Social Indicators Research*, *121*(3), pp.763–785.

Al-Malki, A., Kaufer, D., Ishizaki, S., Dreher, K., 2012. *Arab women in Arab news: Old stereotypes and new media*. Doha, Qatar: Bloomsbury Qatar Foundation Publishing.

Al-Rabiaah, A., Temsah, M., Al-Eyadhy, A., Hasan, G., Al-Zamil, F., Al-Subaie, S., Alsohime, F., Jamal, A., Alhaboob, A., Al-Saadi, B., & Somily, A., 2020. Middle East Respiratory Syndrome-Corona Virus (MERS-CoV) associated stress among medical students at a university teaching hospital in Saudi Arabia. *Journal of Infection and Public Health, 13*(5), pp.687–691. https://doi.org/10.1016/j.jiph.2020.01.005.

American Institutes for Research, 2016. *STEM 2026: A vision for innovation in STEM education*. [pdf] Available at: <https://www.air.org/system/files/downloads/report/STEM-2026-Vision-for-Innovation-September-2016.pdf>. [Accessed 03 February 2021].

Benitez, J., Henseler, J., Castillo, A., Schuberth, F., 2020. How to perform and report an impactful analysis using partial least squares: guidelines for confirmatory and explanatory IS research. *Information & Management 2*(57)103168. https://doi.org/10.1016/j.im.2019.05.003.

Beyer, S. 2008., Gender differences and intra-gender differences amongst management information systems students. *Journal of Information Systems Education, 19*(3), pp.301-310.

Bryant, J., & Bodfish, S., 2014. *The relationship of student satisfaction to key indicators for colleges and universities*. Noel-Levitz, Inc. 2350 Oakdale Boulevard, Coralville, IA.

Cain, G., 2017., Course rubrics: CSU's QOLT. *Brainstorm in progress*, [blog] 27 September. Available at: <https://geoffcain.com/blog/course-rubrics-csus-qolt/> [Accessed 23 January 2021].

California State University, 2021. CSU Quality learning and teaching (QLT) rubric sections and objectives. Available at:https://docs.google.com/document/d/1ilqtDHjYfuJfjq1f8lG_bGhH9Xskcad-2a8aaPmnHG8/edit?usp=sharing [Accessed 09 September 2020].

Cangur, S., & Ercan, I., 2015. Comparison of model fit indices used in structural equation modeling under multivariate normality. *Journal of Modern Applied Statistical Methods*, *14*(1), p.14-21.

Carr Chellman, A., 2014. Where the boys are: Understanding online learning and gender. *eLearn Magazine*, [online] 03 August. Available at: <https://elearnmag.acm.org/featured.cfm?aid=2662455> [Accessed 17 December 2020].

Cheema, S., Maisonneuve, P., Abraham, A., Chaabna, K., Tom, A., Ibrahim, H., Mushannen, T., Yousuf, W., Lowenfels, A. & Mamtani, R., 2021. Factors associated with perceived stress in Middle Eastern university students, J*ournal of American College Health.* 10.1080/07448481.2020.1865979.

Chen, B., Bastedo, K., & Howard, W., 2018. Exploring design elements for online STEM courses: Active learning, engagement & assessment design. *Online Learning, 22*(2), pp.59- 75. http://dx.doi.org/10.24059/olj.v22i2.1369.

Chickering, A. W., & Gamson, Z. F., 1987. Seven principles for good practice in undergraduate education. *American Association of Higher Education Bulletin 39*(7), 3-7.

Cutler, Z., 2014. Unexpected ways millennials are impacting education. *The Huffington Post*. [online] 21 July. Available at: http://www.huffingtonpost.com/zach-cutler/how-millennials-impact- education_b_5604865.html. [Accessed 14 November 2020].

Drugas, M. I., 2020. Teaching psychology during the COVID-19 pandemic: Challenges for online courses. *Psychological Thought*, *13*(2), pp.273-285. https://doi.org/10.37708/psyct.v13i2.541.

Ekawati, A. D., Sugandi, L., & Kusumastuti, D. L., 2017. Blended learning in higher education: Does gender influence student satisfaction on blended learning? In: *International Conference on Information Management and Technology (ICIMTech)*, 2017. (pp. 160-164). https://ieeexplore.ieee.org/document/8273530.

Faize, F., & Nawaz, M., 2020. Evaluation and improvement of students' satisfaction in online learning during COVID-19. *Open Praxis, 12*(4), pp.495-507. http://dx.doi.org/10.5944/openpraxis.12.4.1153.

Fornell, C., & Larcker, D. F., 1981. Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research*, *18*(1), pp.39-50.

General Secretariat for Development Planning, 2011. *Qatar National Development Strategy 2011-2016: Towards Qatar National Vision 2030*. [pdf] Gulf Publishing and Printing Company, Doha. Available at: https://www.psa.gov.qa/en/nds1/Documents/Downloads/NDS_EN_0.pdf [Accessed 21 January 2021].

Golkowska, K. U., 2014. Arab women in the Gulf and the narrative of change: The case of Qatar. *Interdisciplinary Political and Cultural Journal*, *16*(1), pp.51-64.

Gregory, M., 2020. How the pandemic is changing STEM education: How in person does science have to be? *Sierra Magazine,* [online] 28 September. Available at: <https://www.sierraclub.org/sierra/how-pandemic-changing-stem-education> [Accessed February 13 2021].

Guangul, F., Suhail, A., Khalit, M., & Khidhir, B., 2020. Challenges of remote assessment in higher education in the context of COVID-19: A case study of Middle East College. *Educational Assessment, Evaluation and Accountability, 32*(4), pp.519–535. https://doi.org/10.1007/s11092-020-09340-w.

Hair Jr, J. F., Hult, G. T. M., Ringle, C., & Sarstedt, M., 2016. *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage publications.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M., 2019. When to use and how to report the results of PLS-SEM. *European business review*, 31(1), 2-24. https://doi.org/10.1108/EBR-11-2018-0203.

Harvey, H., & Parahoo, S., 2017. Should gender differences be considered when assessing student satisfaction in the online learning environment for millennials? *Higher Education Quarterly*, 0951-5224. https://doi.org/10.1111/hequ.12116.

He, J. & Freeman, L., 2010. Are men more technology- oriented than women? The role of gender on the development of general computer self-efficacy of college students. *Journal of Information Systems Education, 21*(2), pp.203-212.

Hegeman, J., 2015. Using instructor-generated video lectures in online mathematics courses improves student learning. *Online Learning, 19*(3). http://dx.doi.org/10.24059/olj.v19i3.484.

Henseler, J., Dijkstra, T. K., Sarstedt, M., Ringle, C. M., Diamantopoulos, A., Straub, D. W., & Calantone, R. J., 2014. Common beliefs and reality about PLS: Comments on Rönkkö and Evermann. 2013. *Organizational research methods*, *17*(2), pp.182-209.

Henseler, J., Ringle, C. M., & Sinkovics, R. R. 2009. The use of partial least squares path modeling in international marketing. In: *New challenges to international marketing*. Emerald Group Publishing Limited.

Henseler, J., 2018. Partial least squares path modeling: Quo vadis? *Quality & Quantity*, *52*(1), pp.1-8.

Hodges, C. B., Moore, S., Lockee, B. B., Trust, T., & Bond, M. A., 2020. The difference between emergency remote teaching and online learning. *EDUCAUSE Review*. 27 March. Available at: < https://www.google.com/search?client=safari&rls=en&q=The+difference+between+emergency+remote+teaching+and+online+learning&ie=UTF-8&oe=UTF-8> [Accessed on 27 November 2020].

Hooper, D., Coughlan, J., & Mullen, M., 2008. Evaluating model fit: a synthesis of the structural equation modelling literature. In: *7th European Conference on research methodology for business and management studies*. Regent's College, June 2008. London, United Kingdom. (pp. 195-200). https://doi.org/10.21427/D79B73.

Hsiao, Y.C., 2021. Impacts of course type and student gender on distance learning performance: A case study in Taiwan. *Education and Information Technology 26*, pp. 6807–6822. https://doi.org/10.1007/s10639-021-10538-8.

Hsiao, Y.C., & Shiao, Y.T., 2018. Research on gender differences in the digital learning performance of university students. *Proceedings of the 9th International Conference on E-Education, E-Business, E-Management and E-Learning, 2018*. (pp. 26-30). ACM. https://dl.acm.org/doi/10.1145/3183586.3183593.

JISC., 2007. *Effective practice with e-assessment: An overview of technologies, policies and practice in further and higher education*. [pdf] Joint Information Systems Committee. Available at: https://goo.gl/4MA3ts [Accessed on 13 January 2021].

Kapilan, N., Vidhya, P., Gao, X. Z., 2020. Virtual laboratory: A boon to the mechanical engineering education during COVID-19 pandemic. *Higher Education for the Future*, 8. 10.1177/2347631120970757.

Karim, M., 2021. Hybrid and online synchronous delivery of environmental engineering during COVID-19 pandemic: A comparative study on perception, attitude, and assessment. *European Journal of STEM Education*, *6*(1). https://doi.org/10.20897/ejsteme/9688.

Lee, J., 2014. An exploratory study of effective online learning: Assessing satisfaction levels of graduate students of mathematics education associated with human and design factors of an online course. *International Review of Research in Open and Distributed Learning 15*(1), pp.111–132. https://doi.org/10.19173/irrodl.v15i1.1638.

Liloia, A., 2019. Gender and nation building in Qatar: Qatari women negotiate modernity. *Journal of Middle Eastern Women's Studies*, *15*(3), pp.344-367.

Lim, J. & Richardson, J. C., 2021. Predictive effects of undergraduate students' perceptions of social, cognitive, and teaching presence on affective learning outcomes according to disciplines. *Computers & Education*, 161 (2021). https://doi.org/10.1016/j.compedu.2020.104063.

Lin, M. C., Tutwiler, S., & Chang, C. Y., 2012. Gender bias in virtual learning environments: An exploratory study. *British Journal of Educational Technology 43*(2), pp.59– 63.

Means, B., & Neisler, J., with Langer Research Associates., 2020. *Suddenly Online: A National Survey of Undergraduates During the COVID-19 Pandemic.* San Mateo, CA: Digital Promise.

Mohmmed, A. O., Khidhir, B. A., Nazeer, A., & Vijayan, V. J., 2020. Emergency remote teaching during Coronavirus pandemic: the current trend and future directive at Middle East College Oman. *Innovative Infrastructure Solutions, 5(*72). https://doi.org/10.1007/s41062-020-00326-7.

Morante, A., Djenidi, V., Clark, H., & West, S., 2017. Gender differences in online participation: examining a history and a mathematics open foundation course. *Australian Journal of Adult Learning*, *57*(2), pp.267-293.

Nastasić, A. & Banjević, K. & Gardašević, D., 2019. Student Satisfaction as a Performance Indicator of Higher Education Institution. *Journal of Innovative Business and Management*. 11, pp.67-76. https://doi.org/10.32015/JIBM/2019-11-2-8.

Nelson Laird, T. F., McCormick, A., Sullivan, D., & Zimmerman, C., 2011. STEM/non-STEM differences in engagement at US institutions. American Association of American Colleges & Universities. 13(3). Available at: https://www.aacu.org/publications-research/periodicals/stemnon-stem-differences-engagement-us-institutions. [Accessed 16 February 2021].

O'Driscoll, F., 2012. What matters most: An exploratory multivariate study of satisfaction among first year hotel/hospitality management students. *Quality Assurance in Education*, *20*(3), pp. 237–258.

Placencia, G., & Muljana, P., 2019. The effects of online course design on student course satisfaction. *Proceedings of the 2019 American Society for Engineering Education Pacific Southwest Section Meeting*. Los Angeles, California. Available at: https://peer.asee.org/31845. [Accessed 23 January 2021].

Qatar Public Statistics Authority, 2018. *Woman and man in Qatar: A statistical profile*. [pdf] Available at: <https://www.psa.gov.qa/en/statistics/Statistical%20Releases/Social/GenrealSocialStatistics/MenWomenProfile/2018/Woman_Man_2018_EN.pdf> [Accessed 22 January 2021].

Qatar Public Statistics Authority, 2019. *Education Statistics*. [pdf] Chapter 4-2019, Table 78 & Table 84. Available at: <https://www.psa.gov.qa/en/statistics1/pages/topicslisting.aspx?parent=Social&child=Education> [Accessed 22 January 2021].

Rashid, S., & Yadav, S.S., 2020. Impact of COVID-19 pandemic on higher education and research. *Indian Journal of Human Development 14*(2), pp.340-343. https://doi.org/10.1177/0973703020946700.

Richards-Babb, M., Curtis, R., Georgieva, Z., & Penn, J. H., 2015. Student perceptions of online homework use for formative assessment of learning in organic chemistry. *Journal of Chemical Education 92*(11), pp.1813–1819. https://doi.org/10.1021/acs.jchemed.5b00294.

Schlesinger, W., Cervera, A. Y., & Pérez-Cabañero, C., 2016. Sticking with your university: The importance of satisfaction, trust, image, and shared values. *Studies in Higher Education* 4(1), pp.1-17.

Senel, S., & Senel, H., 2021. Remote assessment in higher education during COVID-19 pandemic. *International Journal of Assessment Tools in Education*, *8*(2), pp.181-199. https://doi.org/10.21449/ijate.820140.

Sharadgah, T., & Sa'di, R., 2020. Preparedness of institutions of higher education for assessment in virtual learning environments during the Covid-19 lockdown: Evidence of bona fide challenges and pragmatic solutions. *Journal of Information Technology Education: Research, 19*(1), pp.755–774.

Shieh, J., & Cefai, C., 2017. Assessment of learning and teaching in higher education: A case analysis of a university in the south of Europe. *Malta Review of Educational Research 11*(1), pp.29–47.

Smimou, K., & Dahl, D., 2012. On the relationship between students' perceptions of teaching quality, methods of assessment, and satisfaction, *Journal of Education for Business*, *87*(1), 22-35, DOI: 10.1080/08832323.2010.550339.

Smith, G. G., Torres-Ayala, A. T., & Heindel, A. J., 2008. Disciplinary differences in E-learning instructional design. *International Journal of E-Learning & Distance Education, 22*(3), pp.63–88.

Steiger, J. H., 2007. Understanding the limitations of global fit assessment in structural equation modeling. *Personality and Individual differences*, *42*(5), pp.893-898.

Sultan, P., & Wong, H. Y., 2012. Service quality in a higher education context: An integrated model. *Asia Pacific Journal of Marketing and Logistics*, *24*(5), pp.755–784.

Tucker, R., 2014. Sex does not matter: Gender bias and gender differences in peer assessments of contributions to group work. *Assessment & Evaluation in Higher Education 39*(3), pp.293-309. https://doi.org/10.1080/02602938.2013.830282.

Ullman, J. B., & Bentler, P. M., 2003. Structural equation modeling. *Handbook of psychology*, pp.607-634.

Vajravelu, K., & Muhs, T., 2016. Integration of digital technology and innovative strategies for learning and teaching large classes: A calculus case study. *International Journal of Research in Education and Science 2*(2), pp.379–395.

Wang, K. H., Wang, T. H., Wang, W. L., & Huang, S. C., 2006. Learning styles and formative assessment strategy: Enhancing student achievement in Web-based learning. *Journal of Computer Assisted Learning 22*(3), pp.207–217. https://doi.org/10.1111/j.1365-2729.2006.00166.x.

Watkins, J., & Mazur, E., 2013. Retaining students in science, technology, engineering, and mathematics (STEM) majors. *Journal of College Science Teaching, 42*(5), pp.36–41.