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## RESEARCH ARTICLE

### Undergraduate Nursing Students Endorse Education Standards in Blended e-Learning Theory Teaching during COVID-19 Pandemic

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#### Abstract:

#### Aim:

The aim of this study was to survey student learning perspectives as measured by 'student satisfaction' following the rapid introduction of remote blended e-learning into the existing undergraduate nursing curriculum at Umm Al-Qura University, Saudi Arabia.

#### Background:

National legislation resulting from the spread of Covid-19 required all theoretical and practical nurse training to move immediately to online provision using an unfamiliar e-learning environment and associated tools.

#### Objective:

The objective of this study was to use a validated satisfaction questionnaire developed elsewhere, but within a similar educational context involving both theoretical and practical components, for the purpose of checking that educational objectives were being satisfactorily achieved across five relevant domains of educational enquiry, and to use survey findings to improve the online delivery of the nursing program in future academic years.

#### Methods:

A validated 35 item questionnaire was circulated online to all male and female nursing students in their 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> years of study. The questionnaire content was subdivided into the five domains of 'Interaction', 'Instruction', 'Instructor', 'Course Management' and 'Technology'. Descriptive and comparative statistics were used to compare levels of satisfaction between genders and among undergraduate years of study, and against findings from undergraduate information technology undergraduates.

#### Results:

199 female and 84 male students completed the questionnaire (response rate 59.2%). Mean satisfaction scores for male and female nursing undergraduates were significantly greater than 3 (neutral score) in all domains of enquiry, indicating good satisfaction with blended e-learning ( $p < 0.001$ ). However, multivariate regressions of domain satisfaction scores taking gender and year of study as explanatory variables had poor resolving power. Domain scores were also significantly greater than those of a comparator study in three of the five domains ( $p < 0.030$ ) and similar in the domains of course management ( $p = 0.717$ ) and technology ( $p = 0.677$ ). Levels of satisfaction in males and females were similar in 80% of the survey questions, but in females, satisfaction was significantly lower in some questions concerning technology ( $p < 0.003$ ), willingness to interrupt the instructor ( $p = 0.021$ ), comparison of blended learning and face-to-face teaching ( $p = 0.002$ ) and timely feedback on tests and assignments ( $p = 0.031$ ). Fourth-year students showed the highest levels of satisfaction across all five domains.

#### Conclusion:

Undergraduate nursing students reported above-average satisfaction levels across all five domains of education provision. Despite an unfamiliar blended e-learning curriculum environment, they demonstrated compatible technological skills, satisfactory interaction with teachers and other students and engagement in the learning process. A number of recommendations identified in the literature as underlying a successful program of blended e-learning are recorded for the benefit of readers.

**Keywords:** E-learning, Blended learning, Transition to e-learning, Remote e-learning, Nursing student satisfaction, Domains of education.

#### Article History

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## 1. INTRODUCTION

When the WHO declared a health Pandemic' status [1] following the outbreak of the Sar-C19 virus, immediate action was required in almost all sectors across the world to move to practices that enshrine safety in all activities. A rapid transition to blended-e-learning was undertaken within nurse education, taking advantage of the efficacy of state-of-the-art computer applications and the familiarity of staff and students in higher education with using the internet [2]. The potential and proven benefits of these approaches and their evolving capabilities are evidenced in the exponential growth in research publications [3]. These benefits include cost and time savings resulting from automated delivery, accurate scoring of students' grades, and providing faculty members with immediate feedback about students' performance and averages [4].

Educational curricula in nursing and in higher education are delivered using several teaching approaches such as traditional classroom lectures, laboratory and practical sessions, small group teaching and tutorials, all of which are increasingly using electronic means for promoting learning. This has led to another dimension of learning which has been described in the literature as 'blended e-learning'. There are numerous definitions of the term and much discussion of its emerging theoretical basis because of the various mixed learning assumptions and methods that are drawn upon [5]. Graham, however, provides a simple definition that is used frequently in the literature, namely that "Blended learning systems combine face-to-face instruction with computer-mediated instruction" [6]. While the term "blended e-learning" is generally applied to the practice of using both online and face-to-face learning experiences when teaching students, the balance of these constituents and how they are combined has received rather less attention. A recent overview of the concepts and components provides some guidance for curriculum planning [7] and a scoping review of the presence of the term 'blended' in undergraduate nursing education highlights the extent to which programs encompass such terminology in their descriptors [8].

## 2. LITERATURE REVIEW

Blended learning modalities combining traditional classroom methods of learning with online learning modalities have been present in higher education in different proportions over the previous 15-20 years [9] with a growing realization of the benefits of digital technologies and the internet to support the process in creating virtual reality and general usability [7, 8]. Blended e-learning is the broad term used to describe instructional approaches which combine elements of e-learning with the traditional classroom environment [10 - 12]. Based on sound and appropriate educational modalities, blended e-learning offers the benefits of e-learning and classroom environments allowing access to faculty staff, university learning resources and facilitating interactions with fellow students and online study in their own environment [13, 14].

In a large systematic review focused on identifying elemen

-ts leading to satisfaction in blended e-learning, Nortvig *et al.* [15] established that positive feedback and/or satisfaction was associated with 'educator presence in an online setting', 'the facilitation of student-student interactions', 'student identity and support', 'interest in students learning progress', 'respect for students', 'accurate specific feedback' and the need for 'clear connections' across 'online-offline activities', and where relevant, 'theory-practice' areas of learning. In further supporting research, Jaggars & Xu [16] found that quality blended e-learning courses shared characteristics of traditional face-to-face courses in that there were clearly written objectives, well-organized content, various opportunities for interpersonal interaction and the effective use of technology. The use of these robust educational practices is endorsed in a recent meta-analysis of e-learning conducted by Thalheimer [14], who highlighted the importance of maintaining sound educational principles, independently of the method of delivery.

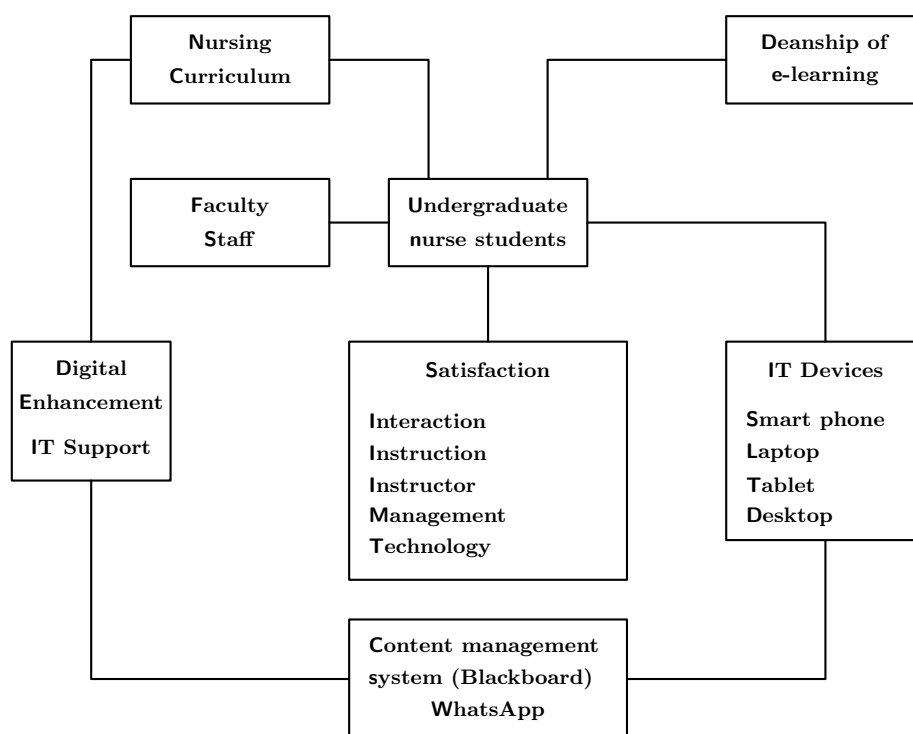
The presence or absence of the instructor in the online teaching environment is another variable. Ebner & Gegenfurtner [17] conducted a meta-analysis of the effectiveness of face-to-face teaching compared with either synchronous or asynchronous online learning. They concluded that student satisfaction with face-to-face teaching was marginally more effective than synchronous e-learning but that both were better than asynchronous e-learning. They further highlighted that in times of rapid transition to online e-learning, the direct transfer of lecture course materials to the online environment could often be too simplistic and inferior to face-to-face instruction. Such a strategy may lead to a lack of student engagement and could possibly compromise learning [18, 19]. Furthermore, it has been suggested that if e-learning content was focused on higher-order skills such as creative thinking and problem-solving, students are likely to engage more effectively. The format of the e-learning environment should facilitate and support such learning processes and should overcome students' lower rating and acceptance of asynchronous e-blended learning [20, 21].

The largest predictor for academic performance was the time learners spent on interactive communication activities that were theoretically designed communication tasks that aligned with learning objectives [22]. These findings strongly endorsed the importance of interactive learning processes, a robust educational basis and techniques for designing interactive online material.

Skilful design of technological applications, for example, the introduction of links and feedback loops, has been shown to foster student engagement through their ease of access, interactivity and learner control [23], and consequently enhance student performance and course satisfaction [24, 25].

The synchronous delivery of e-learning has been shown to correlate better with higher overall satisfaction than asynchronous e-learning [26]. Computer self-efficacy was reported to be related to satisfaction in online learning [27], but as user interfaces become more user-friendly and share more commonality, the skills gap in computer operation across users is being systematically reduced.

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**Fig. (1).** Schematic diagram illustrating the various components of the blended teaching environment in the context of nurse education and training.

Gender differences exist in how men and women use digital technologies and in their underlying proficiencies, for example, in the realms of social media and gaming [28, 29]. In addition, the learning content in some male dominated subjects like engineering has resulted in greater online learning activities for male students [30]. However, as technologies become more widely integrated into educational curricula, then their use has become more equitably distributed across disciplines for male and female students [31 - 33]. Given these historical differences, it is still worth checking when new technology is introduced into learning that both male and female students are equally able to manage within these new systems.

The creation of a better understanding of the impact of blended e-learning on stakeholders has been encouraged in further research before its large-scale expansion. This ambition has also led to an increasing number of investigations primarily focusing on students' perceptions of acceptability, effectiveness, personal experience and usefulness of the educational constructs within a blended e-learning curriculum [34 - 36]. An overview of outputs from these investigations is as follows: positive feedback was noted for game-designed interactivity [37], quizzes and fast feedback [21], interdisciplinary input [38], a flexible learning environment [39], ability to be self-directed [40] and options for greater interaction for introverts via text lines [33]. However, limitations were also described, including damage to health through inactivity and repetitive screen and keyboard time [39], technical disruptions [40], tutor capability [40], social isolation [41], lack of IT preparedness [40], being a new student, health issues [39], isolation from instructor [20], low levels of intellectual stimulation, high workload [9], poor

course structure design [40, 42] and technical problems [43]. These reports provide a wide range of general, subject-specific and practical insights into the student experience. By contrast, the current study aims to specifically examine undergraduate nursing students' perspectives of the integrity of the educational processes within their experiences of a rapid move to e-learning within a blended curriculum.

This investigation into student satisfaction of domains of learning arose following the rapid introduction of e-learning in Nursing Fundamental curricula, including theoretical lectures, clinical practice sessions, case presentations and critical discussions. Campus-based learning occurs within the presence of interacting people, structures and processes. When introducing changes to this learning environment, it is important to recognize their integration within the existing provision as rarely does the impact of change rely on one factor independently of other influencing factors. The integration of e-learning within the nursing program at Umm Al-Qura University was undertaken in collaboration with key stakeholders, as illustrated in Fig. (1).

The aim of this study is to understand and obtain feedback on the student experience through assessment of their satisfaction with the rapid introduction of blended e-learning to their curriculum (Fig. 1) as necessitated by the urgent requirement for social distancing due to the Covid-19 pandemic. A complementary survey of staff experiences is reported in the work by Ramaiah *et al.* [44]. Staff and students were no longer able to be present on campus, and consequently, online learning was introduced with almost immediate effect requiring faculty and students to make changes with minimal time for preparation or training. Online learning was facilitated using BlackBoard (<https://www.blackboard.com>).

board.com/teaching-learning) with support in project/group work from WhatsApp (<https://www.whatsapp.com>) according to methods described previously [45]. Blackboard is a multimedia curriculum-driven learning system operating in ‘real-time’ that allows the delivery of lecture material and facilitates student interactions via discussion tutorials, chat lines and access to educational resources and links provided by the instructor (e.g. PowerPoint presentations, video and audio materials, reference materials and other applications that have been created elsewhere and then delivered online). Instructors can select the learning processes considered to be most appropriate for the students and the subject being studied, thereby allowing key components of learning to be delivered online. The findings of this survey will give a clear insight into nursing students’ capability to engage with a new e-learning process within a blended curriculum.

### 3. METHODS

#### 3.1. Design

This is a cross-sectional descriptive survey using an online self-administered questionnaire.

#### 3.2. Questionnaire

The survey questionnaire was validated and developed previously at the College of Information Technology (CIT), UAE, for assessing student satisfaction with a blended learning course structurally similar to that introduced in the Faculty of Nursing following the immediate implementation of an e-learning format in response to the Covid-19 pandemic [12].

The questionnaire comprised 35 statements (S), of which 28 were positively framed and 7 were negatively framed. Each statement required a response on a 5-point Likert scale ranging from strongly agree (5), agree (4), neutral (3), disagree (2) to strongly disagree (1). The 35 statements were subdivided into the education domains of Interaction (n=9), Instruction (n=12), Instructor (n=5), Management (n=3) and Technology (n=6), each measuring various aspects of student satisfaction with blended learning. The survey was developed using Google Forms (<https://drive.google.com>).

#### 3.3. Ethical Considerations

The study was conducted in accordance with the methods and procedures for human research [46]. Ethical approval was granted by the Research Ethics Committee of the Faculty of Nursing. Students were informed that participation was voluntary, anonymous and separate from their academic studies. Online submission of a completed questionnaire was considered to be consent to participate in the research study. Ethical approval for this study may be inspected at <http://doi.org/10.5281/zenodo.5112053>

#### 3.4. Participants

The questionnaire was circulated to all male and female undergraduate nursing students enrolled in the 2<sup>nd</sup>-4<sup>th</sup> years of the B.Sc Nursing (Hons) program at Umm Al-Qura University (n=478). Students were advised that the survey was open only

to undergraduates 18 years of age and older. Fully completed responses were received from 199 females (58+66+75 from years 2-4 respectively) and 84 males (32+37+15 from years 2-4 respectively), giving a response rate of 59.2%.

#### 3.5. Data Collection

Data were collected online via a self-completed validated satisfaction questionnaire [47]. An information sheet was circulated to all nursing undergraduate students using WhatsApp describing the purpose of the study, what participation entailed and assuring them that data would be collected anonymously. An electronic link to the satisfaction questionnaire was included with the information sheet. The data are available for download at <http://doi.org/10.5281/zenodo.5112053>

#### 3.6. Study Period

Data were collected in June 2020, giving a retrospective evaluation of student’s blended e-learning experience during the period from March 2020-June 2020.

#### 3.7. Analysis

Descriptive statistics (mean +/- SD for parametric distributed data and median (inter-quartile range) for non-parametric distributed data) were computed for responses to each statement of the questionnaire for male and female students separately and together taking account of re-scoring for negative questions. The standard deviation of questionnaire responses was approximately 1.0-1.1, allowing a difference in mean responses of approximately 0.3 between CIT and nursing students to be resolved in either direction at 80% power and  $\alpha=0.05$ . Differences between male and female responses to questionnaire statements were tested for statistically significance at  $\alpha=0.05$  using t-tests.

#### 3.8. Education Domains

Statements (S) were then assigned to their appropriate domain and descriptive statistics for each domain were calculated separately for male and female participants and together by aggregating all scores in that domain. Student’s t-tests were used to assess gender differences in mean domain scores and differences in mean domain scores between different years of study and across domains within a year of study. A p-value < 0.05 was considered statistically significant.

### 4. RESULTS

The mean scores for nursing student responses by gender for each domain of satisfaction and their overall comparison with mean CIT responses are presented in Tables 2-6. The majority of mean nursing student responses significantly exceeded 3.0 (median response) at the 95% confidence level except in statements “My understanding is improved compared to similar courses I studied before” (S11) and “Compared to face-to-face course settings, I am less satisfied with this learning experience” (S20). In the latter, mean scores were below neutral for both genders, not significantly for men, but very significantly for women (p<0.001). Preliminary results are available in a pre-print publication [47].

**Table 1. Results of a multivariate regression of domain satisfaction taking gender and year of study as explanatory variables.**

Regression Coefficient	Interaction	Instruction	Instructor	Management	Technology
Coefficient $\alpha$	3.5548 (p<0.001)	3.4726 (p<0.001)	3.5005 (p<0.001)	3.5335 (p<0.001)	4.0203 (p<0.001)
Coefficient $\beta$	-0.0903 (p=0.333)	-0.1529 (p=0.101)	-0.1180 (p=0.206)	0.0494 (p=0.597)	-0.3397 (p<0.001)
Coefficient $\gamma$	0.0344 (0.519)	0.1394 (p=0.009)	0.1426 (p=0.008)	0.0157 (p=0.769)	0.1534 (p=0.004)
Coefficient $\sigma$	0.6117	0.6973	0.6966	0.7946	0.6737
R <sup>2</sup> (percentage)	0.55	2.93	2.77	0.12	6.74

**Table 2. Mean and standard deviations of nursing student responses to statements of the Interaction domain are presented by gender together with comparisons of the nursing and CIT student responses.**

Blended E-learning Student Satisfaction	Nurse Sample (n=283)	CIT 2012 (n=108)	Nurse Male (n=84)	Nurse Female (n=199)	Male/FemaleNurseComparison
Questions	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	p-value
<b>Interaction Domain (S1-S9)</b>	-	-	-	-	-
S1. A blended learning session keeps me always alert and focused.	3.43 (1.08)	2.60*** (1.25)	3.55 (1.07)	3.38 (1.08)	0.236
S2. Interaction is adequately maintained with the lecturer when he/she is on the other side of the blended learning classroom.	3.63 (1.02)	3.00*** (1.27)	3.67 (1.08)	3.62 (1.00)	0.724
S3. Having students from the opposite gender on the other side of the blended learning classroom listening to what I say might restrict my participation.	3.21 (1.23)	3.45 (1.35)	3.27 (1.26)	3.18 (1.22)	0.568
S4. A blended learning course makes it more important for students to visit the lecturer during office-hours.	3.30 (1.08)	3.45 (1.26)	3.11 (1.05)	3.30 (1.10)	0.954
S5. I cannot interrupt the lecturer to ask a question when he/she is on the other side of the blended learning classroom.	3.55 (1.16)	3.30 (1.52)	3.80 (1.17)	3.45** (1.15)	0.021
S6. I am satisfied with the quality of interaction between all involved parties.	3.68 (1.00)	3.10*** (1.17)	3.61 (1.12)	3.71 (0.94)	0.466
S7. I am dissatisfied with the process of collaboration activities during the course.	3.33 (1.15)	3.40 (1.31)	3.42 (1.19)	3.29 (1.13)	0.395
S8. I am satisfied with the way I interact with other students.	3.77 (0.99)	3.60 (1.13)	3.69 (1.09)	3.81 (0.95)	0.385
S9. I am satisfied with my participation in the class.	3.93 (0.96)	3.35*** (1.28)	4.05 (0.94)	3.88 (0.96)	0.186

\* p&lt;0.050, \*\*p&lt;0.010, \*\*\*p&lt;0.001

**Table 3. Mean and standard deviations of nursing student responses to statements of the instruction domain are presented by gender together with comparisons of the nursing and CIT student responses.**

Blended E-learning Student Satisfaction	Nurse Sample (n=283)	CIT 2012 (n=108)	Nurse Male (n=84)	Nurse Female (n=199)	Male/female Nurse comparison
Questions	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	p-value
<b>Instruction Domain (S10-S21)</b>	-	-	-	-	-
S10. The use of blended learning technology in this course encourages me to learn independently.	3.77 (1.12)	3.15*** (1.16)	3.80 (1.19)	3.75 (1.09)	0.772
S11. My understanding is improved compared to similar courses I studied before	2.89 (1.27)	2.70 (1.14)	2.93 (1.27)	2.87 (1.28)	0.743
S12. My performance in exams is improved compared to similar courses I studied before	3.49 (1.22)	2.75*** (1.18)	3.65 (1.21)	3.43 (1.22)	0.149
S13. I am satisfied with the level of effort this course required.	3.62 (1.06)	3.20** (1.15)	3.79 (1.07)	3.55 (1.06)	0.085
S14. I am dissatisfied with my performance in this course.	3.34 (1.20)	3.00* (1.31)	3.42 (1.33)	3.31 (1.14)	0.507
S15. I believe I will be satisfied with my final grade in the course.	3.59 (1.05)	3.40 (1.08)	3.74 (1.12)	3.53 (1.02)	0.138

(Table 5) contd....

Blended E-learning Student Satisfaction	Nurse Sample (n=283)	CIT 2012 (n=108)	Nurse Male (n=84)	Nurse Female (n=199)	Male/female Nurse comparison
Questions	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	p-value
S16. I am satisfied with how I am able to apply what I have learned in this course.	3.45 (1.04)	3.40 (1.18)	3.37 (1.21)	3.48 (0.97)	0.467
S17. Had I known this was a blended learning class, I would not have taken it.	3.91 (1.07)	3.00*** (1.33)	3.82 (1.18)	3.95 (1.02)	0.386
S18. I am willing to take another course using the blended learning delivery mode	3.80 (1.02)	2.55*** (1.29)	3.86 (1.04)	3.78 (1.01)	0.561
S19. I am satisfied enough with this course to recommend it to others.	3.62 (1.11)	2.90*** (1.26)	3.71 (1.20)	3.58 (1.07)	0.385
S20. Compared to face-to-face course settings, I am less satisfied with this learning experience.	2.65 (1.23)	2.50 (1.37)	3.01 (1.28)	2.50** (1.18)	0.002
S21. I enjoy working on assignments by myself.	3.76 (1.01)	3.55 (1.29)	3.75 (1.11)	3.77 (0.96)	0.892

\* p<0.050, \*\*p<0.010, \*\*\*p<0.001

#### 4.1. Multivariate Regression

Prior to investigating detailed student responses to individual questions in each domain of enquiry, a standard multivariate regression of domain satisfaction,  $S$ , versus gender  $G$  ( $M=0, F=1$ ) and year of study  $Y$  ( $Y=2, 3$  or  $4$ ) was conducted in which the mean domain satisfaction response  $S_k$  of student  $k$  ( $k=1 \dots n$ ) was proposed to satisfy  $S_k = \alpha + \beta * G_k + \gamma * Y_k + \sigma * Z_k$  in which  $\alpha$ ,  $\beta$ ,  $\gamma$  and  $\sigma$  are parameters to be determined and  $Z_1$  to  $Z_n$  are  $n$  independent normal deviates, or residuals, with mean value zero and unit variance. The analysis continued in two stages, the first stage of which involved the calculation of the parameters  $\alpha$ ,  $\beta$ ,  $\gamma$  and  $\sigma$  and the subsequent calculation of  $R^2$ . Results are presented in Table 1.

The results presented in Table 1 are disappointing. The very low  $R^2$  values indicate that domain satisfaction is badly modeled by a standard multivariate regression. In overview, the findings suggest that gender has no significant impact on satisfaction in the domains of Interaction, Instruction, Instructor and Management. Within the domain of technology, however, the significantly negative value of  $\beta$  suggests that female satisfaction is significantly below that of males. Table 1 also suggests that satisfaction in the domains of interaction and management is uncorrelated with the year of study, whereas the significantly positive values of  $\gamma$  in the domains of instruction, instructor and technology suggest that satisfaction in these domains increases significantly with more advanced years of study. Individual questions in each domain are now considered.

#### 4.2. Interaction Domain

Table 2 presents the responses of nursing students to the statements (S) of the interaction domain. Both nursing and CIT students report similar levels of satisfaction except that male nursing students are significantly more reluctant than female nursing students to interrupt an instructor during a blended learning session (S5).

#### 4.3. Instruction Domain

Table 3 presents the responses of nursing students to the

statements of the instruction domain. Nursing and CIT students both report similar levels of satisfaction with the exception that male students were neutral on blended e-learning, whereas female students significantly preferred the blended e-learning environment over face-to-face instruction ( $p=0.002$ ). Interestingly, nursing students highly rated not being 'put off' before undertaking the blended learning course (S17), showed a willingness to participate in future blended learning courses (S18), and also enjoyed undertaking assignments using this method (S21).

#### 4.4. Instructor Domain

Table 4 presents the responses of nursing students to the statements of the instructor domain. Nursing students expressed good satisfaction with how instructors created a class atmosphere, made appropriate use of technology, clearly communicated assignments and provided timely feedback, although women were significantly less satisfied than men with the instructor's use of blended learning technology and timeliness of feedback (S24, S26).

#### 4.5. Management

Table 5 presents the responses of nursing students to the statements of the management domain. Male and female nursing students were similarly well satisfied with the administrative aspects of blended learning courses and in particular the positive acceptance of the need for discipline in the remote e-learning environment.

#### 4.6. Technology

Table 6 presents the responses of nursing students to the statements of the technology domain. While nursing students were positively satisfied with all aspects of the technology domain, female satisfaction was lower than male satisfaction in 5 of the 6 facets of the domain, and demonstrated significantly less satisfaction with respect to the audibility of instructors' voices, the operability of instructors' microphones and the impact of adverse technical issues on the effectiveness of the remote e-learning session.

**Table 4. Mean and standard deviations of nursing student responses to statements of the instructor domain are presented by gender together with comparisons of the nursing and CIT student responses.**

Blended E-learning Student Satisfaction	Nurse Sample (n=283)	CIT 2012 (n=108)	Nurse Male (n=84)	Nurse Female (n=199)	Male/Female Nurse Comparison
Questions	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	p-value
<b>Instructor Domain (S22-S26)</b>	-	-	-	-	-
S22. The instructor makes me feel that I am a true member of the class	3.61 (1.01)	3.70 (1.29)	3.54 (1.10)	3.64 (0.97)	0.438
S23. I am dissatisfied with the accessibility and availability of the instructor	3.31 (1.17)	3.00* (1.36)	3.36 (1.20)	3.30 (1.16)	0.694
S24. The instructor uses blended learning technology appropriately.	3.89 (0.95)	4.00 (0.94)	4.12 (0.94)	3.80** (0.94)	0.009
S25. Class assignments were clearly communicated to me.	3.60 (1.16)	3.70 (1.22)	3.46 (1.24)	3.66 (1.12)	0.204
S26. Feedback on evaluation of tests and other assignments was given in a timely manner	3.30 (1.20)	3.70** (1.27)	3.54 (1.20)	3.20* (1.19)	0.031

\* p&lt;0.050, \*\*p&lt;0.010, \*\*\*p&lt;0.001

**Table 5. Mean and standard deviations of nursing student responses to statements of the Management domain are presented by gender together with comparisons of the nursing and CIT student responses.**

Blended E-learning Student Satisfaction	Nurse Sample (n=283)	CIT 2012 (n=108)	Nurse Male (n=84)	Nurse Female (n=199)	Male/female Nurse Comparison
Questions	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	p-value
<b>Management Domain (S27-S29)</b>	-	-	-	-	-
S27. Discipline is highly observed when the lecturer is on the other side of the blended learning	3.78 (1.01)	2.95*** (1.32)	3.82 (1.04)	3.77 (1.00)	0.695
S28. The lecturer/supervisor always takes attendance.	3.54 (1.02)	4.00** (1.39)	3.55 (1.09)	3.54 (0.99)	0.943
S29. I attend discussion board classes the same way I attend face-to-face classes	3.62 (1.27)	3.85 (1.39)	3.46 (1.32)	3.69 (1.25)	0.185

\* p&lt;0.050, \*\*p&lt;0.010, \*\*\*p&lt;0.001

**Table 6. Mean and standard deviations of nursing student responses to statements of the Technology domain are presented by gender together with comparisons of the nursing and CIT student responses.**

Blended E-learning Student Satisfaction	Nurse Sample (n=283)	CIT 2012 (n=108)	Nurse Male (n=84)	Nurse Female (n=199)	Male/female Nurse Comparison
Questions	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	p-value
<b>Technology Domain (S30-S35)</b>	-	-	-	-	-
S30. The instructor's voice is audible.	3.66 (1.04)	3.75 (1.28)	3.93 (0.93)	3.55** (1.07)	0.003
S31. Course content shown or displayed on the smart board is clear.	4.10 (0.86)	4.50*** (0.80)	4.10 (0.94)	4.10 (0.83)	0.998
S32. The microphone is in good working condition.	3.78 (1.06)	3.60 (1.31)	4.14 (0.89)	3.62*** (1.09)	<0.001
S33. The image is clear and comprehensive when the lecturer is on the other side of the blended learning classroom.	3.94 (0.90)	3.90 (1.27)	4.04 (0.86)	3.89 (0.92)	0.215
S34. Technical problems are not frequent and they do not adversely affect my understanding of the course.	3.13 (1.30)	3.65*** (1.21)	3.54 (1.19)	2.97*** (1.31)	<0.001
S35. The technology used for blended teaching is reliable	3.88 (0.91)	3.60* (1.11)	4.00 (0.93)	3.83 (0.90)	0.167

\* p&lt;0.050, \*\*p&lt;0.010, \*\*\*p&lt;0.001

#### 4.7. Comparison of Satisfaction between Nursing and CIT Students

Satisfaction among nursing students exceeded that for CIT students in the domains of interaction (p<0.001) and instruction

(p<0.001). On average, both cohorts of students positively enjoyed working independently on assignments, believed that they would be satisfied with their final grades and with their ability to apply what they had learned, and refuted the notion that blended learning was inferior to face-to-face instruction.

CIT students were significantly better satisfied with instructor performance particularly with reference to the timeliness of feedback and availability ( $p=0.030$ ). Nursing and CIT students were similarly satisfied with Course Management ( $p=0.717$ ) and Technology ( $p=0.667$ ), although the former were less tolerant of disrupted service caused by technological failures and issues with the smart notice board. However, these concerns were counterbalanced by better satisfaction with how technology was used in their blended e-learning program.

**4.8. Analysis of Domain Responses**

Fig. (2) illustrates the frequencies of nursing student satisfaction in the domains of enquiry.

These responses demonstrate consistent nursing student satisfaction across each domain of enquiry, with around 60%-65% of students showing good or very good satisfaction with blended learning, while 15%-20% responded neutrally and less than 20% disagreed or strongly disagreed. Table 7 reports and compares mean domain satisfaction within and across years of study.

The most significant finding in Table 7 is that 2<sup>nd</sup> and 3<sup>rd</sup> year nursing students report similar levels of satisfaction across all domains of enquiry, whereas 4<sup>th</sup> year nursing students report

the highest mean satisfaction across all domains, and statistically significantly higher in the instruction, instructor and technology domains ( $p\leq0.015$ ).

An investigation of domain satisfaction for 2<sup>nd</sup> year students alone found that paired comparisons of domain satisfaction were statistically significantly different except for the Interaction/Management domains ( $p=0.281$ ), the Instruction/Instructor domains ( $p=0.670$ ) and the Management/Technology domains ( $p=0.686$ ). A similar analysis for 3<sup>rd</sup> year students found similar satisfaction within the Interaction, Instruction and Instructor domains ( $0.159\leq p\leq 0.523$ ), each being statistically significantly inferior to satisfaction in the Management and Technology domains which were similarly rated ( $p=0.606$ ). Finally, 4<sup>th</sup> year students were similarly satisfied in the interaction, instruction, instructor and management domains ( $0.080\leq p\leq 0.908$ ), but all were statistically significantly less satisfactory than the Technology domain.

A similar comparison between Nursing and CIT students (Table 6) found that the former were statistically significantly better satisfied in the Interaction and Instruction domains, the reverse in the instructor domain with no significant difference in the management and technology domains.

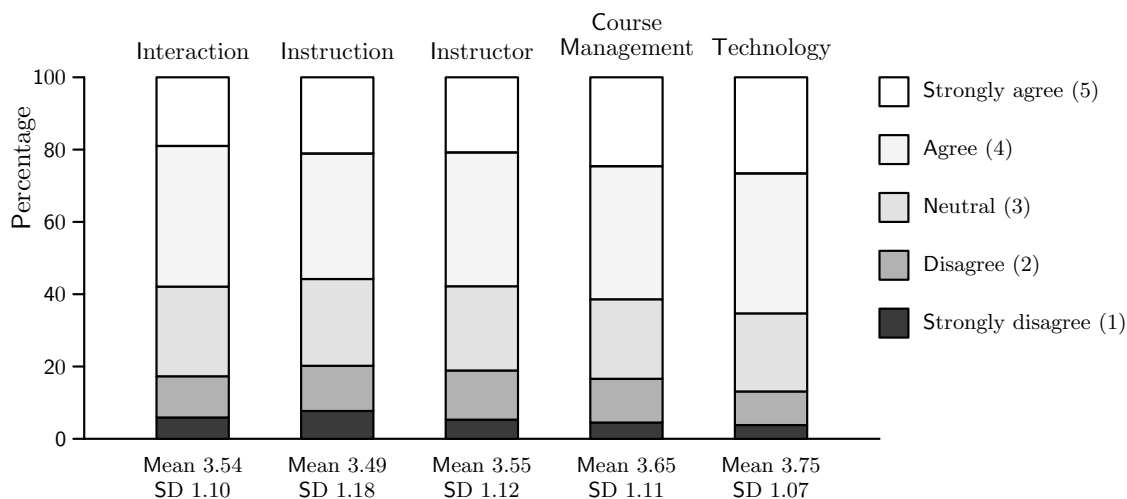


Fig. (2). Histogram of the percentages of responses from 1 to 5 within each domain of education, including the mean satisfaction response for each domain and its standard deviation.

Table 7. Mean and standard deviations of domain satisfaction responses are reported for nursing students by undergraduate year of study. Satisfaction levels between year groups are compared.

Domain	Undergraduate Year of Study			Inter-Year Comparisons of Mean Scores		
	Year 2 N=90 Mean (SD)	Year 3 N=103 Mean (SD)	Year 4 N=90 Mean (SD)	Years 2 & 3 p-Value	Years 2 & 4 p-Value	Years 3 & 4 p-Value
Interaction	3.56 (1.12)	3.48 (1.05)	3.58 (1.14)	0.174	0.660	0.069
Instruction	3.40 (1.25)	3.44 (1.14)	3.65 (1.13)	0.370	<0.001	<0.001
Instructor	3.42 (1.20)	3.52 (1.10)	3.69 (1.04)	0.189	<0.001	0.015
Management	3.64 (1.13)	3.63 (1.10)	3.68 (1.11)	0.889	0.672	0.560
Technology	3.67 (1.07)	3.67 (1.04)	3.92 (1.07)	0.905	< 0.001	< 0.001



## 5. DISCUSSION

Due to protective measures introduced for Covid-19, the face-to-face theoretical component of the nursing undergraduate curriculum was transferred to online learning. This study has reported nursing student satisfaction across five domains of enquiry (Tables 2-6 and Fig. 2) following the rapid introduction of a blended e-learning curriculum design. Student satisfaction provides an important measure of the effectiveness of curriculum changes and was assessed here using a previously validated student e-learning questionnaire [48]. Nursing student satisfaction in each of these important domains of education was statistically significantly above average (Table 7). This finding was particularly pronounced for 4<sup>th</sup> year students, and might be attributable to the increased diversity of the blended-learning experience, technological expertise combined with their increased maturity allowing them to adapt better to change.

Male and female nursing students both reported significantly above average satisfaction in respect of interactions with other students and lecturers, awareness of class participation and their ability to remain alert and focused despite the 'barrier' of the virtual classroom (S2). Interestingly, however, men were significantly more reluctant to interrupt instructors (S5). Mahmood *et al.* argue that teaching presence determines how students evaluate online learning and is a critical factor underlying successful programs [48]. Likewise, Kuo *et al.* argue that student-student and student-teacher interactions are important for successful face-to-face and online learning modalities [49]. Many studies have found that student satisfaction correlates strongly with the quantity and quality of student interactions in almost all learning environments [36, 40].

Within the instruction and instructor domains, women were significantly less satisfied than men with instructors' use of technology and the speed of feedback on work submitted for evaluation (S24, S26). Overall students believed that their efforts would be rewarded by improved examination performances by comparison with similar courses they had undertaken and reported strong self-motivation and a willingness to take further e-learning courses and recommend such courses to others (S10, S12, S18 and S19). Male and female nursing students believe that adherence to online discipline (S27) is important, a behavior that educationalists recognize as being essential for good student satisfaction [50]. Finally, satisfaction within the technology domain of the new learning environment was the most highly rated, particularly by 4<sup>th</sup> year students (Table 7). Interestingly, however, female students distinguished the technological delivery of education from its content, rating the former significantly lower than men (S30, S32 and S34).

The literature shows that the most promising trends in the development of blended-learning are the unbundling of academic programs and curricula in local institutions and the implementation of strategies that can respond to an accelerated and diverse change in technologies, *e.g.* bring your device [30, 51]. Importantly, nursing students seemed able to participate and interact in the new learning environment using technological skills acquired through other uses like social media. This nascent talent within the student population facilitated an instant transition to a remote (as opposed to

distance) e-learning structure without a formal training program, but with the support of the Deanship of e-learning and academic staff who were themselves learning new skills.

Historically, there was an association between computer culture, the internet and gender. Men and women were presumed to use technology differently and with differing levels of experience. Men were assumed to have greater proficiency with computers and were more likely than women to use online media [30]. However, this survey found few differences between male and female students in their use of e-learning and in their motivation and their levels of satisfaction. Historical evidence suggests that men and women displayed varying degrees of anxiety, acceptance and interest in new technologies over time, but that access and training have contributed to a progressive narrowing of the gender gap [32, 33]. Nevertheless, neither gender roles nor technology behaves as stable entities [31]. Women were thought to be more inclined than men to perceive computers as instruments of social media, and as such, tend to prefer communicative activities. Thus the development of web 2.0 with its focus on communication and social tools has increased female internet usage, which in turn significantly impacts e-learning scenarios [31]. Men tend to give longer and more frequent statements, whereas women show more openness for other's proposals and more willingness to cooperate. Consequently, female students tend to prefer group working, whereas men are more likely to solve problems on their own [52]. Overall, comparisons of male and female responses within this study showed few statistically significant differences. Particular differences were that male nursing students show more hesitancy in interrupting lecturers, prefer face-to-face instruction (S5 and S20) and rate instructors' use of technology significantly better (S30, S32 and S34) than female students. Less senior students reported lower satisfaction scores than more senior students, although all were statistically significantly above the average, particularly in the domain of Technology (Table 7). Fear of technology has been noted in this learning situation, particularly in newer learners [39, 40].

Learner satisfaction has received significant attention. Ke & Kwak identified learner relevance, active learning, authentic learning, learner autonomy and technological competence as key factors underlying learner satisfaction [53]. Several studies have found that positive student satisfaction correlates strongly with efficiently functioning technology together with the effective engagement of students with instructors and course content [49, 50]. However, others report that more than half of students in undergraduate medical programs prefer face-to-face learning [20, 21]. The use of techniques and instructor approaches that improve interaction and feedback like quizzes and 'gamification' designs was reported to be helpful to promote learning and enjoyed by classes [36, 40, 42]. Battalio used a criterion approach to argue that positive course satisfaction requires effective learner-instructor interaction [54]. Such a point of view has been endorsed in a more recent meta-analysis of blended e-learning effectiveness in a wide range of learning situations [13] and concluded that e-learning used in blended learning often uses more effective learning methods, and that it is research based teaching methods that are the critical factor in success. However, there are reports that some online teaching lacks reference to a sound pedagogical framework [38].

**Table 8. Recommendations for practice to motivate and promote learning in a blended e-learning environment.**

Learning Context	Learning Facilitation	Sources
A supported community	<ul style="list-style-type: none"> <li>Educational environment is not place-bound with physical presence of other learners. Time should be devoted to assistance in motivation, counselling, offering 'just-in-time support', monitoring their performance, and providing one-on-one and differentiated tutoring.</li> <li>Staff well-prepared and fully-supported instructors with capabilities in LMS</li> <li>Create a sense of online learning community with resource hubs, chat room, connectivity;</li> <li>Effective technology and infrastructure</li> <li>Student support</li> </ul>	Burns [57, 58] Wilcha [59] Sun & Chen [60] Jiang [61] Weerasnghe <i>et al.</i> [62]
Learning approaches	<ul style="list-style-type: none"> <li>Well-designed and adapted for 'e' use course content; motivated interaction between the instructor and learners;</li> <li>Strategies to elicit learners' beliefs and understandings to shape and promote interaction.</li> <li>Sound instructional design and learning pedagogy suitable for e-learning purposes.</li> <li>Clear intended learning outcomes and relevant current content</li> <li>Strong and skilled facilitation of knowledge, the learning process, and helping learners manage time and tasks. Different learning approaches according to the type of knowledge. Synchronous online preferred when possible.</li> <li>Utilise 'verbal immediacy' <i>i.e.</i> using examples of personal experiences of the subject, humour, encouraging students to talk; asking for students' input, addressing students by name, praising students' work, using 'us 'we', available for students outside of class for any questions; engaging in conversations with students before, after, or outside of class.</li> </ul>	Petrides [63] Song [64]; Burns [57, 58]; Ibrahims [42]; Regmi [40]; Weerasnghe <i>et al.</i> [62] Burns [58]; Thalheimer [14]; Motte-Signoret E [65] Goram [66] Burns [57] Muthuprasad [67] Price [68]
Promoting student self-learning	<ul style="list-style-type: none"> <li>Promote the use of self-testing leads to more complex and durable learning; introduce cases with certain difficulties/problem solving scenarios;</li> <li>Delay re-study of new material until some 'forgetting has set in';</li> <li>Interspaced practice of one skill or topic with another.</li> <li>Encourage professional behaviours.</li> <li>Commensurate course grades reflecting wider skills in e-learning</li> </ul>	Brown [69] Burns [57] Longhurst <i>et al.</i> [38] Skrbinjek & Dermol [70]
Student interaction and feedback	<ul style="list-style-type: none"> <li>Interactivity and promotion of collaboration with other students, particularly more junior and new students; taking regular breaks; gives more time for self-study</li> <li>Provide verbal immediacy, 'just-in-time' assistance and feedback.</li> <li>Use of quizzes with immediate feedback</li> <li>Game-like interface</li> <li>Highly realistic cases</li> <li>Repetition is used to encourage deepening of knowledge</li> <li>Use of e-learning functions to track monitor engagement</li> </ul>	Song [64]; Thompson [71] Dutta [41] Wilcha [59] Petrides [63] Rahn [37]
Health and wellbeing	<ul style="list-style-type: none"> <li>Promote health awareness and good wellbeing practices to avoid issues of eye strain; back, neck strain ; headaches; lack of concentration; isolation, stress and anxiety</li> </ul>	Singh [39] Regmi [40]
Technology and support	<ul style="list-style-type: none"> <li>Consider a learning management system that fulfills a comprehensive student-teacher interface, course administration and resource management.</li> <li>Support for standardized student devices as mobile phones which are often used by students may not be able to utilize all functions in the on line environment nor give optimal visuals and class communication.</li> <li>Technophobes or reluctant attitudes to IT use, maybe need additional IT training</li> <li>Ongoing educational support in evolving technology operating features.</li> </ul>	Ibrahims [42]; Regmi [40] Muthuprasad [67] Abassi [20] Ibrahims [42] Wilcha [59] Bennett & Maton [72] Gurung & Rutledge [73] Dahlstrom & Bichsel [74]
Staff practices and development	<ul style="list-style-type: none"> <li>Use of realistic practice situations, spaced repetitions, real-world contexts, and feedback.</li> <li>Professional development for online learning skills and course creation. Inter-disciplinary collaborative teaching</li> </ul>	Ferrer-Torregrosa [75]; Brown [69]; Longhurst <i>et al.</i> [38]

Dziuban *et al.* found that an enriched learning environment, well-defined rules of engagement, instructor commitment, reduced ambiguity, an engaging environment and reduced ambivalence about the value of the course are key components of learner satisfaction defining learner satisfaction with their learning context [55]. Students reported significantly above average satisfaction (Tables 2-4) in a synchronized e-learning environment, utilizing Blackboard and WhatsApp with their interface devices (desk PC, laptops and tablets) and with e-learning technical support as backup. Other investigators support these findings [18, 19], noting that students' expectations of the effectiveness of technology tools in online courses are critical to understanding satisfaction in online education. However, other systems of communication

such as Zoom meetings and Google Meet [41] may not have the breadth of resources to support learning as occurs with the Blackboard tool used in classes. In the literature, the asynchronous delivery of lectures *e.g.* pre-taped online lectures [35] and use of mobile phones [37, 39] and messaging services alone [41] were associated with lower satisfaction ratings by students. Furthermore, other surveys confirm that satisfaction was most impacted by learning convenience combined with effective e-learning tools [56].

The findings of this study provide endorsement for the acceptability of the new e-learning environment. Aspects of learning such as flexibility, self-direction [35, 36, 38] were welcome benefits but not from all students with some reports of feelings of isolation [18]. Nursing student responses indicate

that they are attentive to the contents of the remote e-learning sessions, recognize the importance of attending and participating in the blended learning process with the same level of diligence as they would in face-to-face learning.

## 6. LIMITATIONS

The questionnaire used in this study was developed with students of information technology in mind. Thus bias could be present in some responses due to the likely presence of high IT literacy by comparison with that of nursing students. However, the questionnaire remains relevant for nursing students, and results showed consistent agreement with those of the CIT study [11]. Some domains of investigation (*e.g.* Management) potentially included insufficient questions to adequately characterize the construct, although imposing a limit on the numbers of questions is a recognized necessity in order to minimize responder fatigue.

Some questions (20%) were negatively worded and were reverse scored. It cannot be assumed that all students will correctly interpret statements framed in this way, and therefore responses to these statements could introduce a confounding random effect.

## CONCLUSION

Nursing students reported statistically significantly above average satisfaction following their rapid transition to remote blended e-learning in the domains of education investigated in this survey. Their responses demonstrated resilience and fortitude in adapting to the new e-learning blended curriculum and exhibited nascent technological skills in managing unfamiliar technology while dealing simultaneously with the impact of the ongoing pandemic and the social restrictions imposed. Students endorse the presence of key pillars of learning in the nursing curriculum that was rapidly adapted to be delivered in an e-learning environment supported by Blackboard and student smart/PC devices. Learning technologies are generally beneficial in supporting learning [14].

This detailed and formal learning satisfaction feedback on course changes provides important feedback on the rapid transition of structural and process components of education delivery systems. It provides greater insight into student engagement in their new learning environment and their perspectives on the integrity of main domains of learning, reaching far beyond standard student end-of-course surveys.

## RECOMMENDATIONS

Education providers should take encouragement and be confident about enacting agile practices to meet student and staff needs when dealing with unprecedented disruption to practice. Multi-system action and intervention have been traced to the end-user and shown to be collectively powerful endorsements for the re-design of their learning and assessment processes and context. The merging of the best instructional principles into new blended e-learning can be achieved without loss of educational integrity and should form the backbone of any new designs. Suggestions from this study and the literature reviewed to improve practice are presented in Table 8.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Research Ethics Committee of the Faculty of Nursing with approval number: UQUFON0103.

## HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

## CONSENT FOR PUBLICATION

Students were informed that participation was voluntary, anonymous and separate from their academic studies. Online submission of a completed questionnaire was considered to be consent to participate in the research study.

## AVAILABILITY OF DATA AND MATERIALS

The data supporting the finding of the article is available in the Zenodo Repository at zenodo.org, reference number: <http://doi.org/10.5281/zenodo.5112053>.

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## CONFLICT OF INTEREST

The authors confirm that this article content has no conflicts of interest.

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