Original article

Exploring the pharmacy students' perspectives on off-campus online learning experiences amid COVID-19 crises: A cross-sectional survey

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ABSTRACT

Background: The pandemic of COVID-19 has placed many challenges for pharmacy students' learning experiences via the online e- system. There is paucity of studies that addresses this in colleges of pharmacies in United Arab Emirates (UAE).
Objective: We have explored the preparedness, attitudes, experiences, and barriers/facilitators, and delineated factors that may affect the pharmacy students' e-learning process amid the COVID-19 crises.
Methods: The current study was cross-sectional, and survey-based (anonymously self-administered) that utilized theoretical domains framework. The survey (multiple statements) was comprised of four domains (based on theoretical domain framework) that has elaborated on the preparedness, attitudes, experiences and barriers for the pharmacy students' e-learning (all years and interns). The validated (Cronbach Alfa 0.821) and piloted survey posted to the Google form and a link distributed to the pharmacy students. The survey was comprised of four domains (34 statements), distributed as five in preparedness, eleven in attitude, eleven in the experiences, and seven in the barriers/facilitators (theoretical domains framework).
Outcome measure: The primary outcome was the total sum of scores of individual statements and each individual four domain of the questionnaire (preparedness, attitude, experiences, and barriers/facilitators).
Results: Two hundred thirty respondents participated in the survey (230/400, response rate 57.5%), of which 193 were females (83.9%) versus 37 males (16.1%). The mean age (years) was 19.9 ± 1.9 (males 19.8 ± 1.6 and females 20.0 ± 1.9). The mean total score for **preparedness** Q1 to Q5 (domain maximum score 25); and for the **attitude** Q6 to Q16 (domain maximum score of 60) were 14.9 ± 3.8 (95% CI 14.4 – 15.4; P < 0.05), 29.5 ± 7.4 (95% CI 28.6 – 30.5; P < 0.05) respectively. While for the **experiences** Q17 to Q27 (domain maximum score 55); and for the **barriers/facilitators** Q28 to Q34 (domain maximum score 30) 40.1 ± 8.0 (95% CI 39.1 – 41.1; P < 0.0001), and 20.9 ± 4.9 (95% CI 20.3–21.5;P < 0.05) respectively.

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Conclusion: Our pharmacy students support the use of e-learning in pharmacy education, and seems prepared for the future technology moves in education. The colleges of pharmacies need to conduct further research on versatile innovative models such as virtual learning/artificial intelligence that fits with their students' perspectives.

1. Background

The last two years has witnessed the spread of COVID-19 and the subsequent shutdown of universities worldwide. Consequently, higher educational institutions have adopted e-learning as the teaching strategy, to continue the learning process. The COVID-19 pandemic has placed many challenges for pharmacy students' learning experiences via the e-learning system. The utilization of e-learning software technology dictates many responsibilities for teachers, students and information technologists at various university levels. E-learning (distance learning and computer-assisted learning, web-based learning, Internet-based learning), online, distance, virtual, and remote, are used interchangeably. It denote that both the instructor and the student engaged remotely through an Internet (technology driven) with computers (audio/visual) that facilitated the learning process [CH. Wang et al. 2013; Martínez-Torres MR, et al. 2011; Ruiz JG, et al. 2006]. The e-learning can be delivered either entirely online or partially as blended with traditional pedagogic method of face-to-face learning [DR. Garrison 2011].

In an early COVID-19 pandemic, a survey (response rate of 75.0%) conducted in Saudi Arabia indicated that 61.4% of the responded pharmacy students (n = 309) agreed that the college of pharmacy was well prepared and ready for the online education [MS. Shawaqfeh, et al 2020]. Another Saudi Arabia survey of 232 out of 460 pharmacy students (response rate of 50.43%) has indicated positive attitude towards the COVID-19 pandemic. However, 54.3% indicated that the COVID-19 pandemic had either no effect or just a limited effect on their studies. Nevertheless, 38.5% indicated that they always felt or frequently felt nervous or anxious during the pandemic [AA. Alrasheedy, et al. 2021]. A mixed-method approach survey and discussion group conducted on pharmacy students (response rate of 65.0%) revealed positive experiences towards distance education (e-learning). The qualitative findings from the focus group discussions revealed the strengths, weaknesses, opportunities, and challenges, with highlighting on the areas for development [N Altwaijry, et al. 2021].

The advantages of e-learning includes the less time, less cost, stress-free accessibility and suppleness, augmented student participation, and enhanced learning outcomes[A Dedeilia, et al 2020; BM da Silva 2020; R Roskvist, et al. 2020; N Kaur, et al 2020]. The major drawbacks reported include technological barriers [R Roskvist, et al 2020], rise in isolation and anxiety issues [GJ Longhurst, et al 2020], and minimized development of communication skills [Lee ICJ, Koh H, Lai SH, NC Hwang 2020]. In addition to; lack of professional progress, absence of in-person role models, reduced interaction, and discussion with peers [PK Sahi, et al 2020], inability to virtualize every feature of learning (e.g., hands-on laboratory experience) [S Ahmady, et al. 2020]. Other limitations may include home spatial setting, Internet bandwidth, and financial resources. There is paucity of studies that addresses this in colleges of pharmacies in the United Arab Emirates (UAE). Exploring the pharmacy students' perspectives may provide close insights on the early experiences of e-learning in the region.

A thematic analysis study in Canada/Alberta has examined perception of changes brought about by the COVID-19 pandemic revealed that the most prevalent contributor to pharmacy students' learning were switch to remote delivery of classes and students' mental health [DK Nagy, et al. 2021]. The study emphasized on the need for long-term follow for pharmacy students and to compare to past cohorts, their performance on the licensing exam, professional success (including the utilization of full scope of practice, development of leadership skills, and achievement of work-life balance) [A Ward and J Hall, et al. 2019]. A recent research (during 2020) has supported e-learning in pharmacy education. For instance, a survey study conducted on 1873 students from 29 schools of pharmacy in United States revealed that they preferred a blend of traditional classroom and online learning methods [LA Hamilton, et al. 2020].

1.1. Rationale

Almost all colleges of pharmacy in United Arab Emirates (UAE) has adopted e-learning during COVID-19 pandemic and has created content for the e-learning delivery of lectures, continuous assessment, and exams. Our college of pharmacy has initiated e-learning very early during COVID-19 pandemic with limitless support from information technology, faculties and the management of the university. The pharmacy students' e learning experiences supported with e-learning platform from Microsoft teams, and Moodle with lockdown browser. The current study was among the first of its kind that explored the pharmacy students' preparedness, attitude, experiences and barriers/facilitators for e-learning during COVID-19 pandemic in UAE.

Despite the fact that immense literature has supported e-learning during the COVID-19 pandemic worldwide, however there is a scarce of such studies in the region. Furthermore, exploring the pharmacy students' preparedness, attitude, experiences, and barriers/facilitators to e-learning is crucial to delve deeper the opportunities and challenges of e-learning in this part of the world.

1.2. Objective

The current study objective to survey the pharmacy students' perspectives towards learning experiences amid the COVID-19 crises. We have explored the preparedness, attitudes, experiences, and barriers/facilitators for e-learning process. We have delineated the factors that may affect the pharmacy students' e-learning process.

1.3. Ethics approval

The study approved by the Al Ain University (AAU) research ethics committee at the College of Pharmacy in AAU, UAE dated 18 January 2021.

2. Methods

The current study was cross-sectional, and survey-based (anonymously, voluntarily, and self-administered) conducted on

the consented pharmacy students (year 1 to year 4) and interns. The survey (multiple statements) was comprised of four domains that has elaborated on the preparedness, attitudes, experiences, and barriers/facilitators to the pharmacy students' e-learning. Each domain was comprised of multiple statements that made up a score which reflects the preparedness, attitude, experiences, and barriers/facilitators to the e-learning amid COVID-19 pandemic.

2.1. The survey

We have not adopted any questionnaire, this survey was developed by the researchers and tested for validity. However, we reviewed the literature to enrich our background about the topic and explore our ideas on building the survey. Therefore, the survey developed based on in depth literature review (theoretical domain framework [TDF]), constructed, and modified to meet the objective of the current study. The survey administered in English language only. We have tested the survey instrument with pilot method (20 students from the same college), modified, and further validated (undertaken at two levels of face and content validities). The face and content validity involved peer-peer double checking of the survey by expert pharmacy professors (number 4) to ensure the relevancy, reasonability, rationale, easiness, understand ability and clarity of the instrument. The main objective was to assess the internal consistency and reliability of the survey instrument, rather than its construct validity. Therefore, we decided to use Cronbach's alpha coefficient as a measure of internal consistency. While factor analysis is a commonly used technique to assess the construct validity of a survey instrument. In our case, we believe that the reliability analysis based on Cronbach's alpha is sufficient to establish the internal consistency of the survey instrument. Furthermore, we conducted an in-depth literature and expert opinion review in order to establish face and content validity for our survey instrument. We also pilot-tested the survey among a small sample of participants to ensure its clarity and comprehensibility.

We computed Cronbach's alpha using the statistical software SPSS, following its standard procedure involved calculating mean and standard deviation values for every item on a scale as well as correlation coefficients between individual items and overall scores before using these values to compute Cronbach's alpha coefficient value. The reliability analysis of the survey demonstrated a Cronbach Alfa of 0.821, which revealed strong internal consistency. Further, reliability of each individual domain showed values of Cronbach's alpha values of 0.813, 0.846, 0.868 and 0.791 for the preparedness, attitude, experiences and barriers/facilitators domains, respectively.

The survey multiple statements was consisted of four domains that has elaborated on the preparedness, attitudes, experiences and barriers fir the pharmacy students' e-learning. The four domains was comprised of 34 statements, distributed as five in preparedness domain (Q1 to Q5), eleven in the attitude domain (Q6 to Q16), eleven in the experience domain (Q17 to Q27) and seven in the barriers/facilitators domain (Q28 to Q34). The associated individual statements with each of the four survey domains outlined in [Appendix 1]. Each domain consists of multiple statements (Likert scale 1 to 5 sum scores) that reflects the preparedness, attitude, experiences, and barriers/facilitators relevant to pharmacy students' e-learning. The survey responses reported on a five graded Likert scale (strongly disagree/disagree/neutral/agree/strongly agree). The students' responses on each statement were scored from 1 to 5 (strongly disagree = 1; disagree = 2; neutral = 3; agree = 4; strongly agree = 5) for positively worded statements and the reversed scoring for the negatively worded ones. **Preparedness** Q1 to Q5 (domain maximum score 25); **Attitude**: Q6 to Q16 (domain maximum score of 60); **Experiences**: Q17 to Q27 (domain maximum score 55); **Barriers/Facilitators**: Q28 to Q34 (domain maximum score 30). The four domains was comprised of 34 statements which were positively worded, except for (Q8, Q9, Q12, Q13, Q15, Q16) in the attitude domain, (Q24, Q25, Q27) in the experience domain, and (Q34) in the barriers/facilitators domain which were negatively worded (scores were reversed). We have calculated the individual statement sum of scores and the final total scores of each domain (validated during the pilot phase). Where higher scores represented students' positive in each domain and vice versa.

The final version of the survey posted to the Google drive (google forms) and a link distributed (officially via the University's main documentation office) to all the pharmacy students across the two university campuses (Al Ain and Abu Dhabi campuses) at the pharmacy college in AAU-UAE. We have included pharmacy students who have consented, responded, and completed the online survey. We have collected the pharmacy students' age, gender, and city of residence (Al Ain or Abu Dhabi), academic year, and source of knowledge about COVID-19. In addition we have asked participants to report their body weight (in kilograms) before e-learning (prior to March 2020), 6 months during COVID-19 pandemic (between September to December 2020), and currently (post February 2021). We have calculated the needed sample size by using an online sample size calculator. We have N = 400 students at the 2 campuses with confidence level of 95% (z-score 1.96) and margin of error 5% (percent in decimal form), a sample size of 220 students was required. We have received 230 responses from the pharmacy students, which deemed satisfactory for the analysis.

2.2. Outcome measures

The outcome measure was the responses to the four domains (preparedness, attitude, experiences, and barriers/facilitators) measured on five-point Likert scale to assess the responses of pharmacy students towards e-learning.

2.3. Statistical analysis

We have downloaded the filled questionnaire from the google form as an Excel sheet, cleaned, coded the data, and transferred them to the Statistical package for Social Sciences (SPSS) version 27 (IBM, Armonk, NY, USA) for both descriptive and inferential statistical analyses. The pharmacy students' demographic and anthropometric data (weight) reported as frequencies, percentages, means with standard deviations. We used parametric statistical tests (sample tested normally distributed) to determine the effect of the independent variables (the pharmacy students personal data: gender, academic year, weight) on the dependent variables (score of each of the individual and total score of the four domains). We used ANOVA test for the differences in weight at the three assessment intervals and paired samples-t test. A one-way repeated-measures ANOVA was calculated comparing the mean body weight in kilograms of participants at three different intervals: prior to e-learning (prior to March 2020), 6 months after COVID-19 pandemic (after September 2020), and currently or in the last 3 months (after February 2021). A chi-square test of independence was performed to investigate the relationship between a lack of motivation and the negative effects of e-learning on grades. The correlation between the following independent variables (age, gender, academic year, and weight), and the dependent variables (preparedness, attitude, experience, and barriers/facilitators) were investigated using Pearson correlations. The statistical significance difference between the sums of scores of the reported domains was at $P < 0.05$.

3. Results

3.1. Demographics and anthropometric data of the population

Two hundred thirty respondents participated in the survey (230/400, response rate 57.5%), of which 193 were females (83.9%) versus 37 males (16.1%). The mean age (years) was 19.9 ± 1.9 (males 19.8 ± 1.6 and females 20.0 ± 1.9). The majority of pharmacy student's sample were respondents from Abu Dhabi campus (171, 74.3%), while (59, 25.7%) were based at Al Ain campus. Respondents were in first year (64, 27.8%), second year (36, 15.7%), third year (71, 30.9%), fourth year (47, 20.4%), and pharmacy interns (12, 5.2%). Combined official governmental websites and social media comprise the most knowledge sources of COVID-19 making (85, 36.0%), and (83, 36.1%) respectively [Table 1].

The respondents' body weight in kilogram (kg) was reported at the three different assessment intervals, prior to e-learning (prior to March 2020), 6 months during COVID-19 pandemic (between September to December 2020), and currently (post February 2021). At those three intervals, the majority of respondents' weights were reported to be between 50 and 59 kg (30.9%, 29.6%, and 31.3%), and 60–69 kg (29.6%, 26.1%, and 25.2%) respectively [Table 1]. In the same sequence, the mean body weight (±SD) of the population at those intervals were 62.9 ± 13.8 (95% CI: 61.1 – 64.7), 64.1 ± 14.3 (95% CI: 62.2 – 65.9), and 64.3 ± 14.1 (95% CI: 62.5 – 66.1) respectively.

A one-way repeated-measures ANOVA was calculated comparing the mean body weight in kilograms of participants at three different intervals: prior to e-learning (prior to March 2020), 6 months after COVID-19 pandemic (after September 2020), and currently or in the last 3 months (post February 2021). The difference in body weight between the three assessment intervals was statistically significant (P < 0.001) [Table 2]. Follow-up protected t tests (paired t-sample test) revealed that body weight increased significantly from before online learning (62.9 ± 12.6) to 6 months after COVID-19 pandemic (64.1 ± 14.3; P = <0.0001), while it was not significant from 6 months after pandemic and at a recent date (64.42 ± 13.2; P = 0.157) [Table 2].

3.2. The participants' responses to the survey individual domains

In the preparedness domain (Q1 to Q5), more than half of the respondents (130; 56.5%) strongly disagreed/disagreed that prior to the pandemic, the institution supported e-learning. A total of (106, 46.1%) of the respondents strongly disagreed/disagreed that they were able to continue their education with the e-learning strategy rather than the pedagogic traditional educational approach (face-to-face). Slightly less than half of the respondents (112, 48.7%) strongly agreed/agreed that faculty members were successful in overcoming e-learning obstacles. When compared to on-campus learning, (97, 42.2%) of the respondents strongly disagreed/disagreed about feeling comfortable with e-learning. Slightly mora than half of the respondents (120, 52.1%) were able to use e-learning without any technical difficulties [Table 3].

In the attitude domain (Q6 to Q16), slightly more than half of the respondents (118, 51.3%) strongly disagree/disagree that e-learning should become the new normal. Nearly one third of the respondents (87, 37.9%) reported that they have a positive attitude towards e-learning. More than half of the respondents (135, 58.7%) strongly agreed/agreed that the quality of e-learning does not provide them with enough skills and knowledge for their future pharmacy practice employment. In addition, over half of the

Table 1
Demographics and anthropometrics of the pharmacy students (N = 230 respondents).

Demographics and anthropometrics		F (%)
Age (years)	16–18	60 (26.1)
	19–21	143 (62.2)*
	22–24	23 (10.0)
	≥ 25	4 (1.7)
Gender	Female	193 (83.9)*
	Male	37 (16.1)
City of residence (Abu Dhabi Emirate)	Abu Dhabi	171 (74.3)*
	Al Ain	59 (25.7)
Student's academic year	First year	64 (27.8)
	Second year	36 (15.7)
	Third year	71 (30.9)*
	Fourth year	47 (20.4)
	Interns	12 (5.2)
Source of knowledge	Social media	83 (36.1)
	Official governmental websites	85 (36.9)*
	Family and friends	23 (10.0)
	News media	36 (15.7)
	Television and radio	3 (1.3)
Body weight (kg) assessment intervals↓ Baseline: prior to online learning (prior to March 2020)	**Body weight (Kg)**	**F (%)**
	40–49	29 (12.6)
	50–59	71 (30.9)*
	60–69	68 (29.6)
	70–79	33 (14.3)
	≥80	29 (12.6)
6 months post COVID-19 pandemic (September 2020 – December 2020)	40–49	28 (12.2)
	50–59	68 (29.6)*
	60–69	60 (26.1)
	70–79	43 (18.7)
	≥80	31 (13.4)
Body weight (Kg) currently (post February 2021)	40–49	27 (11.8)
	50–59	72 (31.3)*
	60–69	58 (25.2)
	70–79	38 (16.5)
	≥80	35 (15.2)

Keys: **F**: Frequency; **N**: population; **(%)**: Percent; *The highest percent achieved in rows. **Nota Bene**: Assessment intervals: **Baseline**: Your body weight (Kg) prior to e-learning (prior to March 2020); **6 months post baseline**: 6 months post COVID-19 pandemic (September 2020 to December 2020); **Currently**: Your body weight (Kg) now or in the last 3 months (post February 2021).

Table 2
Variability in **the** respondents' mean body weight (Kg), and paired t-sample test at the Three assessment intervals (N = 230 respondents).

Parameter	Mean ± SD	95% Confidence interval of the difference	P-value
Baseline: body weight (Kg) before e-learning (prior to March 2020)	62.9 ± 13.8	61.1–64.7	< 0.0001*
6 months post baseline: body weight (Kg) 6 months post COVID-19 pandemic (September 2020 to December 2020)	64.1 ± 14.3	62.2–65.9	
Current: body weight (Kg) now or in the last 3 months (post February 2021)	64.3 ± 14.1	62.5–66.1	
Parameter	**Mean difference**	**P-value**	
Pair 1. Baseline and 6 months post baseline (September 2020 to December 2020)	−1.26435	< 0.0001*	
Pair 2. 6 months post baseline and post February 2021	-0.25261	0.157	
Pair 3. Baseline and post February 2021	−1.51696	< 0.0001*	

Keys: Kg: Kilogram; **N**: population; **P-value**: <0.05*; **SD**: standard deviation. **Nota Bene**: Assessment intervals: **Baseline**: Your body weight (Kg) prior to e-learning (prior to March 2020); **6 months post baseline**: 6 months post COVID-19 pandemic (September 2020 to December 2020); **Currently**: Your body weight (Kg) now or in the last 3 months (post February 2021).

respondents (123, 53.5%) strongly agreed/agreed that e-learning does not reflect their true selves and they were misrepresented. In comparison to on-campus learning, (111, 48.3%) of the respondents strongly disagree/disagree that e-learning allowed them to be more active with their colleagues and teachers. Only (103, 44.8%) strongly agreed/agreed that e-learning enabled them managed their time better to do their homework and assignments. A total of (99, 43.0%) of the respondents strongly disagreed/disagreed that they had given up attending lectures due to a poor internet connection, to permit their siblings get connected. Because of better communication with faculties/instructors and colleagues, nearly two thirds of the respondents (152, 66.1%) preferred e-learning. A total of (84, 36.5%) respondents strongly agreed/agreed that e-learning allows instructors to respond more quickly. Nearly half of the respondents, (112, 48.7%) strongly agreed/agreed that e-learning has had a negative impact on their grades. While (135, 58.7%) of the respondents strongly agree/agree that, their education hampered by their interaction with experts in the pharmaceutical field [Table 3].

In terms of the respondents' experiences, over two third of the respondents (170, 3.9%) strongly agree/agree that their e-learning experiences have influenced their mental health. Two thirds of the respondents (154, 66.9%) strongly agreed/agreed that exams were far more difficult and complicated during e-learning. Less than half of the respondents (98, 42.6%) strongly agreed/agreed that the COVID-19 pandemic had a detrimental impact on their grades, and 151 (65.6%) felt that e-learning makes it difficult to concentrate. While the majority of the respondents (187, 81.3%) stated that COVID-19 had an impact on their university life, and (167, 72.6%) strongly agree/agree that COVID-19 had an impact on their daily routines. Furthermore, nearly two third of the respondents (148, 64.3%) indicated that e-learning made them lethargic and inactive, and slightly more than two third (156, 67.8%), strongly agreed/agreed that this experience helped them adapt and adjust to diverse situations. A total of (103, 44.8%) of the respondents strongly disagree/disagree that e-learning made them gain confidence since there were no direct interactions. In addition to the mental health implications, the majority of the respondents (178, 77.3%) strongly agreed/agreed that e-learning has harmed their physical health, including effects on their eyes, back, and feeling headaches. A total of (99, 43.0%) of the respondents strongly disagreed /disagreed that e-learning has had no impact on their teamwork or synergy with their peers [Table 3].

Regarding the barrier's/facilitator's domain (Q28 to Q34) more than half of the respondents (128, 55.7%) strongly disagreed/disagreed that they had to miss lectures for their siblings to attend their classes due to a poor internet connection. More than half of the respondents (136, 59.2%) strongly disagreed/disagreed that lack of online tool experience was a hindrance to their e-learning experiences. A total of (129, 56.1%) of respondents strongly agreed/agreed that a lack of motivation was a barrier during their e-learning experience. Regarding the difficulty of the e-learning material, (98, 42.6%) of the respondents felt that e-learning materials were challenging and acted as a hindrance. A total of (87, 37.8%) of the respondents strongly agreed/agreed that internet access has hampered their ability to participate in lectures. More than half (130, 56.5%) of the respondents strongly agreed/agreed that their classes were disrupted as result of their family members' classes or online meetings. Less than half (101, 43.9%) of the respondents strongly agreed/agreed that they had no difficulty using the internet for their studies. The facilitators to e-learning were fast internet, and use of interactive e-learning technology.

3.3. The mean total sum scores of the four domains

The mean total score in the preparedness domain (Q1 to Q5) was 14.9 ± 3.8 (95% CI 14.4 – 15.4) out of 25 maximum score. The mean total score in the attitude domain (Q6 to Q16) was 29.5 ± 7.4 (95% CI 28.6 – 30.5) out of 55 maximum score. In the attitude domain, six out of eleven questions responses were statistically significant (Q7, and Q10-Q14; P < 0.05). The mean total score in the experience domain (Q17 to Q27) was 40.1 ± 8.0 (95% CI 39.1 – 41.1) out of 55 maximum score, where all responses were statistically significant (P < 0.0001). The mean total sum score in the barriers/facilitators domain (Q28 to Q34) was 20.9 ± 4.9 (95% CI 20.3–21.5) out of 35 maximum score, where all responses were statistically significant (Q29-Q34, [P < 0.05]), except for (Q28, [P = 0.28]) [Table 4].

3.4. Pearson correlations between the age, gender, academic year, and body weight versus the four domains

The correlation between the independent variables (age, gender, academic year, and weight), and the dependent variables (preparedness, attitude, experience, and barriers) were investigated using Pearson correlations. Age possessed significant correlation with all domains; it was positively correlated with preparedness, and attitude, but negatively correlated with experience, and barriers (r_s 0.199 [P 0.002]; r_s 0.251 [P < 0.0001]; r_s −0.205 [P 0.002]; and r_s −0.142 [P 0.031]) respectively [Table 5]. Gender also displayed significant correlations with both preparedness and attitude domains; it was positively correlated with preparedness, and attitude, but negatively correlated with experience, and barriers (r_s 0.161 [P 0.014]; r_s 0.143 [P 0.031]; r_s −0.097 [P 0.144]; and r_s −0.030 [P 0.655]) respectively [Table 5]. Academic year displayed significant correlation only with attitude domain; it was positively correlated with preparedness, and attitude, but negatively correlated with experience, and barriers (r_s 0.059 [P 0.370]; r_s 0.167 [P 0.011]; r_s −0.070 [P 0.288]; and r_s −0.058 [P 0.384]) respectively [Table 5].

Body weight prior to e-learning (prior to March 2020) was positively correlated with preparedness, experience and barriers, (r_s 0.013 [P 0.849]; r_s 0.054 [P 0.416]; and r_s 0.040 [P 0.549]) but negatively correlated with attitude (r_s −0.013 [P 0.849]) respectively

Table 3
Pharmacy students' responses to the four domain statements based on the Likert scale (N = 230 respondents).

Survey domain statements	Likert scale				
	Preparedness (Q1 – Q5)				
	Strongly disagree F (%)	Disagree F (%)	Neutral F (%)	Agree F (%)	Strongly agree F (%)
Q1. The university supported e-learning before the pandemic:	50 (21.7)	80 (34.8)*	64 (27.8)	22 (9.6)	14 (6.1)
Q2. I was able to continue my education online better than the traditional educational approach:	52 (22.6)	54 (23.5)	61 (26.5)*	39 (17.0)	24 (10.4)
Q3. The faculty members (instructors) of the College of Pharmacy were able to overcome the challenges of e-learning:	9 (3.9)	21 (9.1)	88 (38.3)*	75 (32.6)	37 (16.1)
Q4. I feel comfortable learning online compared to on-campus:	44 (19.1)	53 (23.0)	54 (23.5)*	45 (19.6)	34 (14.8)
Q5. I was able to easily use e-learning without any technical difficulties:	19 (8.3)	32 (13.9)	59 (25.7)	79 (34.3)*	41 (17.8)
	Attitude (Q6 – Q16)				
Q6. I would prefer distant learning to become the new normal:	83 (36.1)*	35 (15.2)	43 (18.7)	42 (18.3)	27 (11.7)
Q7. I had a positive attitude towards e-learning	31 (13.5)	40 (17.4)	72 (31.3)*	59 (25.7)	28 (12.2)
Q8. I feel like the quality of e-learning provided did not fulfill the skills and knowledge required for my future career:**	61 (26.5)	74 (32.2)*	55 (23.9)	32 (13.9)	8 (3.5)
Q9. I feel like e-learning did not reflect my true self and I was misrepresented:**	48 (20.9)	75 (32.6)*	61 (26.5)	35 (15.2)	11 (4.8)
Q10. I was more active with my colleagues and instructors in e-learning rather than on-campus:	46 (20.0)	65 (28.3)*	57 (24.8)	35 (15.2)	27 (11.7)
Q11. E-learning helped me manage my time better for homework and assignments:	46 (20.0)	37 (16.1)	44 (19.1)	62 (27.0)*	41 (17.8)
Q12. I feel more comfortable sharing my thoughts in an e-learning environment rather than on-campus:**	41 (17.8)	34 (14.8)	56 (24.3)*	53 (23.0)	46 (20.0)
Q13. I prefer on-campus learning as I can interact with my instructors and students more:**	110 (47.8)*	42 (18.3)	44 (19.1)	19 (8.3)	15 (6.5)
Q14. I can ask my teachers questions and receive a quick response online:	20 (8.7)	34 (14.8)	92 (40.0)*	57 (24.8)	27 (11.7)
Q15. E-learning has negatively affected my grades:**	46 (20.0)	66 (28.7)*	64 (27.8)	44 (19.1)	10 (4.3)
Q16. My inability to interact with experts in the pharmaceutical field has affected my education: **	61 (26.5)	74 (32.2)*	55 (23.9)	32 (13.9)	8 (3.5)

Survey domain statements	Likert scale				
	Experiences domain (Q17 – Q27)				
	Strongly disagree F (%)	Disagree F (%)	Neutral F (%)	Agree F (%)	Strongly agree F (%)
Q17. The e-learning experience has affected my mental health (e.g. stress, worried, memory, leisure, etc..) specially during the pandemic:	10 (4.3)	12 (5.2)	38 (16.5)	73 (31.7)	97 (42.2)*
Q18. Exams are a lot harder and more complicated during the COVID-19 e-learning experience:	10 (4.3)	11 (4.8)	55 (23.9)	58 (25.2)	96 (41.7)*
Q19. COVID-19 affected my marks negatively:	20 (8.7)	48 (20.9)	64 (27.8)*	45 (19.6)	53 (23.0)
Q20. I find it hard to concentrate during my e- learning:	14 (6.1)	13 (5.7)	52 (22.6)	44 (19.1)	107 (46.5)*
Q21. COVID-19 affected my university life:	7 (3.0)	9 (3.9)	27 (11.7)	52 (22.6)	135 (58.7)*
Q22. COVID-19 has affected my daily routine:	7 (3.0)	22 (9.6)	34 (14.8)	58 (25.2)	109 (47.4)*
Q23. E-learning made me a lazy and inactive person:	11 (4.8)	30 (13.0)	41 (17.8)	58 (25.2)	90 (39.1)*
Q24. This experience taught me how to adjust to different circumstances and situations:**	58 (25.2)	98 (42.6)*	60 (26.1)	7 (3.0)	7 (3.0)
Q25. E-learning made me gain confidence since there were no direct interactions:**	19 (8.3)	29 (12.6)	79 (34.3)*	60 (26.1)	43 (18.7)
Q26. E-learning has negatively affected my health (eyes, back, headaches):	9 (3.9)	11 (4.8)	32 (13.9)	79 (34.3)	99 (43.0)*
Q27. E-learning did not affect teamwork and synergy with my colleagues:**	25 (10.9)	50 (21.7)	56 (24.3)	63 (27.4)*	36 (15.7)
	Facilitators/Barriers domain (Q28 – Q34)				
Q28. I had to give up my lectures so my siblings are able to attend their e-classes due to weak internet connection:	69 (30.0)*	59 (25.7)	52 (22.6)	38 (16.5)	12 (5.2)
Q29. My lack of experience on using online tools (Microsoft Teams/ Zoom) was a barrier to my e-learning experience:	62 (27.0)	74 (32.2)*	62 (27.0)	20 (8.7)	12 (5.2)
Q30. My lack of motivation was a barrier to my e-learning journey:	13 (5.7)	29 (12.6)	59 (25.7)	68 (29.6)*	61 (26.5)
Q31. E-learning material were a barrier because they were too challenging:	12 (5.2)	38 (16.5)	82 (35.7)*	68 (29.6)	30 (13.0)

Table 3 (*continued*)

Survey domain statements	Likert scale				
	Experiences domain (Q17 – Q27)				
	Strongly disagree F (%)	Disagree F (%)	Neutral F (%)	Agree F (%)	Strongly agree F (%)
Q32. The internet access was a problem that affected my participation in lectures:	23 (10.0)	48 (20.9)	72 (31.3)*	60 (26.1)	27 (11.7)
Q33. Many of my family members also had online classes/meetings which interrupted successful classes for me due to noise:	33 (14.3)	33 (14.3)	34 (14.8)	80 (34.8)*	50 (21.7)
Q34. I had no problems with the internet for my studies:**	46 (20.0)	55 (23.9)*	46 (20.0)	55 (23.9)*	28 (12.2)

Keys: F: frequency; **N**: population; **%**: percent; **Q**: statement; **e.g.: etc**.: other similar examples are included; *The highest percent achieved in rows. **Nota Bene**: The four domains was comprised of 34 statements which were positively worded, except** for (Q8, Q9, Q12, Q13, Q15, Q16) in the attitude domain, (Q24, Q25, Q27) in the experience domain, and (Q34) in the facilitators/barrier's domain which were negatively worded (scores were reversed).

Table 4
The mean scores for each statement of the four domains (N = 230 respondents).

S.N	Survey domain statements	Mean score (±SD)	P-value
Preparedness domain (Q1 – Q5)			
Q1.	The university supported online learning before the pandemic:	2.4 ± 1.1	0.376
Q2.	I was able to continue my education online better than the traditional educational approach:	2.7 ± 1.3	0.024*
Q3.	The faculty members (teachers) of the College of Pharmacy were able to overcome the challenges of online learning:	3.5 ± 0.9	< 0.0001*
Q4.	I feel comfortable learning online compared to on-campus:	2.9 ± 1.3	< 0.0001*
Q5.	I was able to easily use online learning without any technical difficulties:	3.4 ± 1.2	< 0.0001*
Total score (25)	14.9 ± 3.8 (95% CI 14.4 – 15.4)		
Attitude domain (Q6 – Q16)			
Q6.	I would prefer distant learning to become the new normal:	2.5 ± 1.4	0.645
Q7.	I had a positive attitude towards online learning:	3.1 ± 1.2	< 0.0001*
Q8.	I feel like the quality of distance learning provided did not fulfil the skills and knowledge required for my future career:**	2.4 ± 1.1	0.053
Q9.	I feel like distance learning did not reflect my true self and I was misrepresented:**	2.5 ± 1.1	0.953
Q10.	I was more active with my colleagues and instructors in online learning rather than on-campus:	2.7 ± 1.3	0.016*
Q11.	Distant learning helped me manage my time better for homework and assignments:	3.1 ± 1.4	< 0.0001*
Q12.	I feel more comfortable sharing my thoughts in an online learning environment rather than on-campus:**	3.1 ± 1.4	< 0.0001*
Q13.	I prefer on-campus learning as I can interact with my instructors and students more:**	2.1 ± 1.3	< 0.0001*
Q14.	I can ask my teachers questions and receive a quick response online:	3.2 ± 1.1	< 0.0001*
Q15.	Distance learning has negatively affected my grades:**	2.6 ± 1.1	0.224
Q16	My inability to interact with experts in the pharmaceutical field has affected my education:**	2.4 ± 1.1	0.053
Total score (55)	29.5 ± 7.4 (95% CI 28.6 – 30.5)		

Experience domain (Q17 – Q27)

S.N	Survey domain statements	Mean (±SD)	P-value
Q17.	The online learning experience has affected my mental health (e.g. stress, worried, memory, leisure, etc..) specially during the pandemic:	4.0 ± 1.1	< 0.0001*
Q18.	Exams are a lot harder and more complicated during the COVID-19-online learning experience:	4.0 ± 1.1	< 0.0001*
Q19.	COVID-19 affected my marks negatively:	3.3 ± 1.3	< 0.0001*
Q20.	I find it hard to concentrate during my online learning:	3.9 ± 1.2	< 0.0001*
Q21.	COVID-19 affected my university life:	4.3 ± 1.0	< 0.0001*
Q22.	COVID-19 has affected my daily routine:	4.0 ± 1.1	< 0.0001*
Q23.	E-learning made me a lazy and inactive person:	3.8 ± 1.2	< 0.0001*
Q24.	This experience taught me how to adjust to different circumstances and situations:**	2.2 ± 0.9	< 0.0001*
Q25.	E-learning made me gain confidence since there were no direct interactions:**	3.3 ± 1.2	< 0.0001*
Q26.	E-learning has negatively affected my health (eyes, back, headaches, etc..):	4.1 ± 1.1	< 0.0001*
Q27.	E-learning did not affect teamwork and synergy with my colleagues:**	3.2 ± 1.2	< 0.0001*
Total score (55)	40.1 ± 8.0 (95% CI 39.1 – 41.1)		
Facilitators/Barriers domain (Q28 – Q34)			
Q28.	I had to give up my lectures so my siblings are able to attend theirs due to weak internet connection:	2.4 ± 1.2	0.282
Q29.	My lack of experience on using online tools (Microsoft Teams/ Zoom) was a barrier to my e-learning experience:	2.3 ± 1.1	0.022*
Q30.	My lack of motivation was a barrier to my e-learning journey:	3.6 ± 1.2	< 0.0001*
Q31.	E-learning material were a barrier because they were too challenging:	3.3 ± 1.1	< 0.0001*
Q32.	The internet access was a problem that affected my participation in lectures:	3.1 ± 1.2	< 0.0001*
Q33.	"Many of my family members also had online classes/meetings which interrupted successful classes for me due to noise":	3.4 ± 1.3	< 0.0001*
Q34.	"I had no problems with the internet for my studies":**	2.8 ± 1.3	< 0.0001*
Total score (35)	20.9 ± 4.9 (95% CI 20.3–21.5)		

Keys: CI: confidence interval; **Q**: statement; *P: <0.05; **etc**.: other similar examples are included; **maximum score at each statement (Q)**: total 5 scores; **N**: population; **S.N**: serial number. **Nota Bene**: The four domains was comprised of 34 statements which were positively worded, except** for (Q8, Q9, Q12, Q13, Q15, Q16) in the attitude domain, (Q24, Q25, Q27) in the experience domain, and (Q34) in the barrier's domain which were negatively worded (scores were reversed).

Table 5
Pearson correlations between the age, gender, academic year, and body weight versus the survey domains.

Parameters (age, gender, academic year)↓	Preparedness domain	Attitude domain	Experience domain	Facilitators/Barriers domain
Age	0.199	0.251	−0.205	−0.142
P value	0.002*	< 0.0001*	0.002*	0.031*
Gender	0.161	0.143	−0.097	−0.030
P value	0.014*	0.031*	0.144	0.655
Academic year	0.059	0.167	−0.070	−0.058
P value	0.370	0.011*	0.288	0.384
Body weight at three assessment intervals				
Baseline: Your body weight (Kg) prior to e-learning (prior to March 2020)	0.013	−0.013	0.054	0.040
P value	0.849	0.849	0.416	0.549
6 months post baseline: Your body weight [Kg] (September 2020 to December 2020)	0.013	−0.064	0.093	0.076
P value	0.846	0.337	0.159	0.249
Current: Your body weight (Kg) now or in the last 3 months (post February 2021)	−0.003	−0.086	0.108	0.073
P value	0.962	0.195	0.101	0.270

Keys: *P: <0.05; correlation is significant at < 0.05 level (two tailed).

Table 6
The relationship between the lack of motivation and the negative effects of e-learning on students' grades.

Lack of Motivation was a barrier		Disagree (%)	Neutral (%)	Agree (%)	Row total (%)	P value
E learning Negatively affected my grades	Disagree	15	7	18	40 (19.0)	< 0.0001*
	Neutral	4	27	32	63 (30.0)	
	Agree	8	24	75	107 (51.0)	
Column total		27 (12.9)	58 (27.6)	125 (59.5)	210 (100.0)	

Keys: **%**: percent; *P: <0.05; chi-square test of independence; **Disagree**: strongly disagree and disagree; = **Agree**: strongly agree and agree.

[Table 5]. Similarly, body weight six months post pandemic (September to December 2021) was positively correlated with preparedness, experience, and barriers (r_s 0.013 [P 0.846]; r_s 0.093 [P 0.159]; and r_s 0.076 [P 0.249]), but negatively correlated with attitude (r_s −0.064 [P 0.337]) respectively [Table 5]. While body weight at a recent date (post February 2021) was negatively correlated with preparedness and attitude (r_s −0.003 [P 0.962]; and r_s −0.086 [P 0.195]), and positively correlated with experience and barriers (r_s 0. 0.108 [P 0.101]; r_s 0.073 [P 0.270]) respectively [Table 5].

A chi-square test of independence was performed to investigate the relationship between lack of motivation and the negative effects of e-learning on grades. A significant relationship was found (P < 0.05). 60% of those who claimed that their online learning journey was hampered by a lack of motivation also said that e-learning had a negative impact on their grades [Table 6].

4. Discussions

The COVID-19 pandemic has led to disruptions in various sectors, including education, resulting in increased adoption of e-learning by universities to prepare for lockdowns and outbreaks. It has been well known that blending pedagogy with e-learning can improve academic performance in students. However, the effectiveness of using e-learning as the sole mode of instruction in pharmacy education during the pandemic remains unclear in the region. Moreover, the extent to which e-learning delivered over a whole academic year affects pharmacy students' academic performance is also unknown. Therefore, there is a need to investigate the impact of e-learning on pharmacy education in the context of the pandemic. The aim of this study is to investigate the influence of e-learning on pharmacy education in the midst of the pandemic and to offer guidance on how e-learning can be effectively implemented in this particular context. To achieve this goal, the study evaluates pharmacy students' readiness, attitudes, experiences,

and barriers to and facilitators of e-learning during the pandemic. Furthermore, the study aims to gather the views of students regarding the impact of the pandemic on their e-learning experience. The main findings of the current study show that pharmacy students felt more comfortable during e-learning, encountered few technological problems, and their instructors showed skills to overcome difficulties in e-learning. Nevertheless, lack of engagement with peers and bad academic performance remained an issue in e-learning. The perception of students regarding a new learning technique influenced by their academic performance. As e-learning was not fully implemented at Al Ain University before the pandemic, most students in this study experienced a decline in their academic performance, leading to negative experiences with e-learning. Furthermore, the adoption of the new e-learning system has been associated with adverse effects on the mental and physical health of the students. The shift to e-learning presented various challenges for students, such as issues with learning materials, lack of motivation, internet connectivity, and environmental distractions. Despite these hurdles, students persevered, and their unfamiliarity with digital tools did not impede their ability to engage in e-learning. Notably, students identified several facilitators of e-learning, including the use of Microsoft Teams chats for communication with course instructors, access to high-speed internet, the availability of recorded lectures on Moodle, and interactive e-learning technologies. The latter was recently reported by a study conducted in King Saudi Arabia where a Twitter chat was created for 790 pharmacy students with their instructors [M Ali and Allihyani, et al. 2021].

The study comprised 230 participants from both campuses, with the majority falling in the age bracket of 19 to 21 years. Notably, the female-to-male ratio was 5:1, potentially contributing to a greater representation of women in pharmacy colleges in both the UAE [AM Tawfiq, et al 2020], as well as globally [M Barakat, et al 2022; MJ Witry, et al 2021]. The pharmacy students from all years participated in this study, most of them were from the Abu Dhabi campus (researchers' campus). The body weight of the respondents

measured at three different time points displayed significant fluctuations. This suggests that e-learning has an impact not only on mental health [W Al-Qerem, et al 2021, A Etando, et al 2021, MS Abbasi, et al 2020], but also on physical health. The decline in students' physical activity levels could be one of the contributing factors to the changes in body weight. E-learning was introduced in response to the COVID-19 pandemic to facilitate and promote learning in pharmacy education. Adequate preparation for this new mode of learning is therefore critical for successful outcomes. Many studies displayed the importance of preparedness in improving learning quality [A Etando, et al 2021, N Altwaijry, et al 2021, M Ebner, et al 2020. For example, a study revealed that students with prior knowledge and aptitude for e-learning had better performance compared to others [N Altwaijry, et al 2021]. Prior to the pandemic, Al Ain University had only partially implemented e-learning (e.g., Moodle course management), which could explain the students' lack of preparedness and acceptance of e-learning. Therefore, our students found it difficult to complete their studies using e-learning. This was also observed in Panda and her colleagues' study (Saudi Arabia and India) [DS Panda, et al 2020]. Nevertheless, the current study showed that technological problems were not a problem for students during e-learning, in contrast to two studies carried out in Saudi Arabia and Poland [N Altwaijry, et al 2021, M Bączek, et al 2021. Attributed to the facilitators provided by the university's information technology center, including the ease of delivery, use of Microsoft Teams, and constant technical support. These facilitators align with the recommendations outlined in the 2020–2021 report by the American College of Clinical Pharmacy (AACP) Academic Affairs Committee for pharmacy education during the COVID-19 pandemic [AS Bzowyckyj, et al 2020]. Students from one American university and Saudi pharmacy students both approved of e-learning [N Altwaijry, et al 2021, A Hussain, et al 2021, S Alghamdi and M Ali 2021]. However, in other studies performed in Australia, China, and other American universities [L Liu, et al 2021, C Wang, et al 2020, DK Nagy, et al. 2021], pharmacy students appeared to have negative attitudes toward e-learning. Poor academic performance, lack of clinical training, and inadequate communication identified as potential reasons for negative attitudes among students. The findings of the current study indicate that a majority of pharmacy students prefer on-campus learning, especially when it comes to communication and engagement. These results are consistent with those of Hussain et al., who observed a similar trend among pharmacy students in general [A Hussain, et al 2021]. Pharmacy education, as with other medical education, heavily depends on practical experience to prepare students for professional practice. For instance, in the university where this research was conducted, pharmacy students are required to complete seven training courses, totaling 24 h of the program, to be eligible for graduation. This highlights the significance of practical experience in the field. The acquisition of strong clinical and social skills is essential for success in pharmacy. Despite the challenges posed by the COVID-19 pandemic and the shift towards e-learning, practical training was still conducted on-site with minor disruptions. In some instances, practical wet/dry labs were also continued on campus. However, some students faced obstacles such as contracting COVID-19 at the training site. This raises questions regarding the adequacy of e-learning and its associated practices during pandemics in providing pharmacy students with the requisite practical and clinical experiences to excel in their profession. Therefore, for example, a study on Polish medical students has shown that e-learning can provide students with knowledge that is comparable to traditional learning. However, it was found to be ineffective in enhancing their clinical and social skills [M Bączek, et al 2021]. Another study showed that e-learning [MS Abbasi, et al 2020], hinders acquiring knowledge and practical skills for health sciences students. These studies align with the findings of our own research, which revealed that e-learning was not sufficient in equipping our pharmacy students with the necessary skills and knowledge for their future practice. Therefore, it is reasonable for students to express reluctance towards fully embracing e-learning, as it may not fully address their profession needs. These findings emphasize the importance of providing extensive practical training alongside e-learning to ensure a well-rounded education for students pursuing a career in pharmacy. E-learning has been shown to have adverse effects on personal traits, as highlighted in various studies [MS Abbasi, et al 2020, N Altwaijry, et al 2021, S Alghamdi and M Ali 2021, L Liu, et al. 2021].

For instance, a study conducted in Australia on pharmacy students revealed that e-learning promoted procrastination and negatively impacted time management [L Liu, et al 2021]. Students' mental health was also impacted by e-learning as concluded by several studies [W Al-Qerem, et al 2021, A Etando, et al 2021, MS Abbasi, et al 2020, L Liu, et al 2021, DK Nagy, JJ Hall, T Charrois 2021, Adebisi YA, Agboola P, M Okereke 2020, N Kaur, et al 2020, Alsoufi A, et al 2020]. The current study's findings are consistent with these studies, demonstrating that e-learning has negative impacts on pharmacy students' mental health, including stress and worry. Additionally, altering exam dates due to the COVID-19 crisis has influenced students' academic performance, as reported by another study [YA Adebisi, et al. 2020]. Despite the negative effects of e-learning on pharmacy education highlighted in previous studies, there have been some positive outcomes for pharmacy students as well. Specifically, studies have found that pharmacy students experienced less stress during e-learning [S Alghamdi and M Ali 2021], and had an increase in self-confidence [DK Nagy, et al. 2021].

In the current study, pharmacy students found that course examinations were more challenging during e-learning, which could be attributed to the efforts of instructors to maintain academic integrity, as well as students' deteriorating mental health and dissatisfaction with e-learning [OL Holden, et al. 2021]. The findings of the current study revealed that students had divergent viewpoints on the effect of e-learning on peer interaction, which was an unanticipated outcome, given that several studies have indicated that e-learning adversely impacts students' engagement and interaction with peers [N Kaur, et al, 2020, J Strawbridge, et al 2022]. While e-learning provides the convenience of attending lectures from any location [Singh V and A Thurman 2019], this benefit is not without limitations. In agreement with numerous other studies [Ali M, Allihyani, et al 2021, MS Abbasi, et al 2020, M Ebner, et al 2020, YA Adebisi, et al 2020, A Alsoufi, et al 2020] our students reported that poor internet connectivity is a common obstacle to e-learning. Other challenges highlighted in previous studies include the inadequacy of the academic staff [YA Adebisi, et al 2020], ineffective communication [N Altwaijry, et al 2021, L Liu, et al 2021, C Wang, et al 2020, DK Nagy, et al. 2021, YA Adebisi, et al 2020, N Kaur, et al 2020]. In addition to poor time management [Altwaijry N, et al 2021, Alghamdi S, M Ali 2021, L Liu, et al 2021], and lack of familiarity with online tools [A Etando, et al. 2021]. In addition, students' motivation was also a challenge in the present study. Contrary to the findings of Panda et al., the e-learning experience was not associated with a noise-free environment in the current study due to the presence of students' families attending classes and meetings. Nevertheless, this finding was consistent with the results of Etando et al.'s study [A Etando, et al 2021].

4.1. The relationship between the age, gender, academic year, and body weight versus the survey domains

Previous research has highlighted the influence of demographics on e-learning effectiveness [L Boyte-Eckis, et al 2018; S Rizvi,

et al. 2019]. Our study supports these findings, indicating that age significantly affects various aspects of e-learning. Older students showed increased preparedness and positive attitudes toward e-learning which can be attributed to the similarity between coping with e-learning as with real-world situations. However, age was also associated with negative experiences and barriers. Gender was found to correlate with preparedness and attitudes, consistent with other studies [W Al-Qerem, et al 2021; A Alsoufi, et al 2020]. Differences between male and female students' perceptions were observed, with some studies reporting equivalent impressions and others noting lower satisfaction among male students [S Alghamdi, Ali M 2021; C Wang, et al 2020]. Additionally, nearing graduation positively influenced students' attitudes towards e-learning, potentially due to the novelty it offered compared to their previous on-campus experiences.

4.2. The relationship between lack of motivation and student grades

We found a relationship between pharmacy students' lack of motivation and the impact of e-learning on their grades. This correlation sheds light on the role of motivation in academic performance. Previous studies have emphasized the importance of student motivation in academic achievement [SA Almalki 2019; RA Kusurkar, et al 2013, Kim KJ, TW Frick 2011; Alkış N, TT Temizel 2018] Our findings suggest that motivation may have a stronger influence on the negative effects of e-learning on grades compared to e-learning itself. Hoskins and her team have noted variations in students' use of online tools, highlighting the significance of motivation in academic performance [Hoskins SL, JC Van Hooff 2005].

4.3. Study value

Firstly, we acknowledge the relevance of the COVID-19 pandemic and its impact on education systems worldwide. We also recognize that many studies have analyzed the effect of e-learning on students. However, our study focuses on exploring pharmacy students' perspectives on e-learning specifically in the United Arab Emirates (UAE), where literature on this topic is scarce. We believe that multinational studies can provide more robust and precise insights into the effects of distance learning on students' learning. Our study provides early experiences of e-learning in our region, and future studies could expand upon this research to examine its impacts more extensively.

Our research findings contribute to the experiences of UAE as the first study to investigate the students learning during COVID-19. The study was done amid COVID-19 crises which furnish early experiences and provide benchmarking for future studies. The impact of use of technology has been emphasized in the paper.

4.4. The study strengths and weaknesses

The main strength of the current study relies on the fact that our findings proved that pharmacy students e-learning experiences is as valuable as on campus learning, which indicates a greater opportunity for future advanced pharmacy education. Understanding the pharmacy student's perspectives on e-learning has the prospective to improves the educational deliverables, assessment, understand the student's physical and mental-health issues, and enhance the development of pharmacy curriculum. Studying the impact of COVID-19 pandemic and repercussion on the learning of pharmacy students has brought many advantages to the new roles of e-learning which will have enormous future prospects in pharmacy education.

The study has some weakness on the number of variables examined to delineate the factors that may affect the pharmacy

students' e-learning process. The long-term impact of e-learning deserve further exploration with more emphasis of the student's summative assessment, exams, students' grade point average (GPA), experiential pharmacy training, and the quality measures of pharmacy education (blue print, mapping of program outcomes, etc...). Further analysis such as regression could be beneficial to understand the associations between the domains and the outcomes We did not conduct regression analysis to build a model with the variables which are significantly and independently associated with the study outcome. Qualitative research may provide more in-depth insights into the factors explored in study.

4.5. Limitations

The current study had some limitations, firstly, despite the fact that students from all academic years participated in the study, the majority of them were from Abu Dhabi campus (researchers' campus) which might affected the generalizability of the findings. Secondly, because the survey was self-administered, the outcomes could be arbitrary. Moreover, although the students acknowledged that e-learning had a detrimental impact on their grades, more studies are required to confirm this conclusion. Additionally, the level of technological expertise of the academic staff not evaluated in the current study, which may have had an impact on the outcome. Further study involving a broader consideration is necessary in light of these restrictions.

4.6. Future prospects

Further analysis such as regression could be beneficial to understand the associations between the domains and the outcomes. Therefore, we plan to perform a regression analysis in future studies to provide more insight into the factors that influence pharmacy students' e-learning process. Further research is required to examine the impact of e-learning on the students' academic performance particularly improvement in their GPA. Research directed to the use of e-learning technology such as Cyber-patient, audience response system (e.g. Kahoot, Socrative), artificial intelligence, and virtual learning would shape the future in pharmacy education. The e-learning provided great opportunity for the students, faculty and colleges of pharmacy to invest in technology in order to face the challenges in learning amid COVID-19 pandemic. Further, pharmacy education instructors need to develop tools for evaluation of the impact of e-learning that ensure the alignment with course learning outcomes, program attributes, and accreditation standards.

5. Conclusions

Our pharmacy students support the use of e-learning in pharmacy education, and seems prepared for the future technology moves in education. The colleges of pharmacies need to conduct further research on versatile innovative models such as virtual learning/artificial intelligence that fits with their students' perspectives.

6. Authors' contributions

We declare that all authors have made substantial contributions to the conception, design of the work; the acquisition, analysis, interpretation of data, drafted the work, and revised it critically for important intellectual content. In addition to approval of the version to be published; and agreed to be accountable for all aspects of the work in ensuring that questions related to the accu-

racy or integrity of any part of the work are appropriately investigated and resolved.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jsps.2023.05.024.

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