




Article

# The Effectiveness of Online Education in Basic Medical Sciences Courses during the COVID-19 Pandemic in Saudi Arabia: Cross-Sectional Study

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**Abstract:** Coronavirus-19 (COVID-19) is an emerging pandemic that has caused significant disruptions to education, resulting in marked scholar closures across the world. The present study documents the student perception of the online educational process at six universities in Saudi Arabia during the COVID-19 lockdown period. The individual variable factors, i.e., institution, sex, and blended learning, that might influence student perception were also investigated. In this respect, a questionnaire that assessed the impact of COVID-19 on the online learning process and student perception was emailed to a total of 17,230 students from 3 institutions (medical, applied health and dental students) affiliated with six universities in Saudi Arabia. Principal component analysis (PCA) was performed to determine the validity of the questionnaire. A total of 4850 (28%) students responded to the questionnaire and 46.9% ( $n = 2275$ ) of the respondents were highly satisfied with their online education. Analyses of the scores from the students showed a highly significant difference ( $p = 0.000$ ) between the male and female students. Applied health students (highly satisfied score = 63.13) were the most satisfied with their online education, while medical students (highly satisfied score = 39.3) were the least satisfied with this education. In addition, applied health, dental and medical students showed a significantly higher score in favor of blended learning after schools re-open ( $p = 0.000$ ). Collectively, student satisfaction with online education was common, and blended learning was preferred over the traditional format by both genders and all the students. The present data provide interesting contributions and evidence for policy makers and implementers, which might be helpful for the judgment side of decision making.

**Keywords:** COVID-19; online education; basic medical sciences; Saudi Arabia

## 1. Introduction

Coronaviruses are a group of single-stranded RNA viruses that infect a wide range of mammals and birds [1]. Severe acute respiratory syndrome (SARS-CoV-2), or coronavirus-19 (COVID-19), is a member of this family that can provoke seasonal colds and possibly some serious complications, including bronchitis and pneumonia, particularly in vulnerable subjects [2]. Importantly, the COVID-19 pandemic forced governments across the world to close academic institutions, including medical and other healthcare-related institutions. The government of the Kingdom of Saudi Arabia decided upon the complete closure of all academic activities from March to August 2020 [3,4]. At the start of the lockdown, the system of teaching and learning was shifted abruptly from its traditional classroom format, which requires a physical presence, to a virtual classroom setting with its own peculiar and novel dynamics. Furthermore, each institution scrambled to ensure maximum use of educational platforms, in order to prevent a loss of education time. However, this step was hindered by multiple challenges that included not only the concern of initiating the virtual teaching process, but there were also the issues of ensuring connectivity to all students and faculties who may be in remote parts of the country. The training of faculties and students by the IT departments/sections had to be planned and implemented, and technical and academic support had to be ensured. Consequently, faculties had to quickly adopt and adapt to a new system. More importantly, the learners had a set of challenges, despite being far more tech savvy than the faculty [5]. In addition, the challenges to institutions dealing with the training of health professionals were much more complicated. Institutions had to devise quick, effective and educationally feasible means of virtual clinical training, and the basic sciences had their fair share of tribulations [6,7]. Literature started to appear about the student and faculty perception of their virtual educational experiences. The literature also explored the influence of this pandemic on the global education system and the response of educational institutions to deal with this crisis [8–11]. Despite this fact, limited multicenter studies involved the assessment of learner satisfaction with online instructions, and the perception of students in relation to the virtual educational experience, with special reference to basic medical sciences, particularly in the Kingdom of Saudi Arabia [3,4]. Given the above information, the present study explored the perception of health professional students at six universities in Saudi Arabia, and their experience with the online educational process during the COVID-19 lockdown period, combined with an investigation of the possible influence of individual variable factors on this perception.

## 2. Methodology

### 2.1. Ethical Approval

This study was approved by the Taif University Institutional Review Board number 1-441-45.

### 2.2. Study Area and Participants

This cross-sectional study included a total of 17,230 male and female students from six universities in Saudi Arabia during the period from July to August 2020. These six universities belonged to the public sector and included Taif University, Umm Al Qura University, King Abdulaziz University, Jeddah University, and Rabigh University. Universities have several faculties, but our focus was on those colleges related to health professionals, including college of medicine, college of dentistry and college of applied medical sciences. Students in their 2nd year onwards from the three colleges were included in the study, but those of preparatory year were excluded.

### 2.3. Methodology

A preliminary questionnaire was formed, pilot tested and modified following a thorough literature search and interviews of fifteen male and female students regarding their experience of using technology for online education. This self-administered questionnaire was developed using Google Forms® (Google LLC, Mountain View, CA, USA). The questionnaire contained a summary of information about the study, assurance that their identities would be kept confidential and that they were free to withdraw from the study at any time without any negative implications. After due permission from respective affiliated institutions, email contacts were taken from the admissions section. Students were emailed the questionnaire, the consent form and a detailed explanation about the research and its purpose. Student anonymity was ensured since there was no identifying information on the questionnaire. The names of the respondents were not noted from the emails. Only gender, year of study and institution title were asked in demographic data. The final questionnaire had twenty-nine items (Table S1).

### 2.4. Sub-Scales Assumptions

Factor analyses were conducted at baseline on the full data set of participants. The total variance shows that the loading of statements was mentioned and extraction method was performed using principal component analysis (PCA), which was also used to identify and compute composite scores for the factors underlying the questionnaire. The initial three statements were close-ended questions and the rest were 26 statements requiring the respondent to respond to a Likert scale. In the results, scores of 5 (strongly agree) and 4 (agree) were grouped, as were frequencies of 2 (disagree) and 1 (strongly disagree). This was performed for the sake of facilitating the summarisation process. Frequencies and percentages were calculated for the responses. On the other hand, exploratory factor analysis was performed to determine how well the statements were able to assess the construct/s of interest.

### 2.5. Statistical Analysis

Data were checked for normality using Shapiro–Wilk and Kolmogorov–Smirnov tests at 0.05 level to check whether data were parametric or non-parametric. Validity and reliability of the questionnaire were assessed using Cronbach's alpha. Five different professors in the field changed and assessed the questions to provide comments on their clarity, appropriateness, and capacity to elicit meaningful information. The descriptive statistic included number, percentage (%), mean, standard deviation, minimum, maximum, scale mean, skewness, and kurtosis. Scores were assessed using the chi-square test; the difference between males and females was assessed by independent samples *t*-test or corresponding statistical analysis for non-parametric data. To evaluate the relationship between TSES and EE, and DP and PA, a Pearson correlation was applied at 0.05 levels. \*, \*\*, and \*\*\* were significant at  $p < 0.05$ , 0.01, and 0.001, respectively, and non-significant at  $p > 0.05$ . Differences between medical, applied health and dental institutes were identified by chi-square test statistics. MANOVA was applied to assess the overall effect of various factors.

## 3. Results

In the present work, the questionnaire was emailed to a total of 17,230 male and female students from the different participating institutions, as follows: a total of 6500 students from the college of medicine, 500 from the college of dentistry, and 10,230 from the college of applied medical sciences. The sample size was 332 students; it was calculated online using OpenEpi and the overall reliability (Cronbach's alpha) was 0.964. A total of 4850 (28%) students responded to the emailed questionnaire. The overall reliability (Cronbach's alpha) was 0.964.

Table 1 represents the distribution and criteria of the respondents, including gender, academic year, experience, and the use of an online educational platform. The gender differences of the participants between the three studied institutes were highly significant

( $p < 0.001$  \*\*\*), as revealed by chi-square test statistics. Female participants constituted 58% of the participants in the medical institute, 50.8% in the applied health institute, and 0.0% in the dental institute (Figure 1). Additionally, there was a highly significant difference between the participants from different academic levels (year). Concerning the use of online education platforms, 72% of the participants significantly used online education platforms and 75.2% noted that their institute has its own online platforms. Furthermore, Table 2 depicts the responses (%) by item and the subscale of the full data ( $n = 4850$ ). The item responses were coded as follows: not applicable = 0; strongly disagree = 1; disagree = 2; neither agree nor disagree = 3; agree = 4; strongly agree = 5. The next four variances explained 9, 5, 4.5 and 3.5% of the variances, respectively. Solutions for factors one to five were examined using varimax and oblimin rotations of the factor loading matrix. The five-factor solution, which explained 78.5% of the variance, was preferred due to the following reasons: (a) its previous theoretical support; (b) the ‘leveling off’ of eigenvalues on the scree (Figure 2) after five factors; (c) the insufficient number of primary loadings and the difficulty of interpreting the subsequent factors.

**Table 1.** Distribution of gender, academic year, experience and use of online educational platform.

Variables		Medical ( $n = 2600$ )		Applied Health ( $n = 1830$ )		Dental ( $n = 420$ )		Chi-Square
		$n$	%	$n$	%	$n$	%	
Gender	Male	1095	42.1	1230	49.2	420	100.0	<0.001 ***
	Female	1510	58.1	600	50.8	0	0.0	
Academic year	1	375	14.4	0	0.0	190	45.2	<0.001 ***
	2	330	12.7	400	21.9	110	26.2	
	3	380	14.6	310	16.9	40	9.5	
	4	285	10.9	310	16.9	80	19.0	
	5	700	26.9	385	21.0	0	0.0	
	6	530	20.3	425	23.2	0	0.0	
Have you ever used online platforms for online education before the COVID-19 pandemic?	Yes	1880	72.3	1445	79.0	420	100.0	<0.001 ***
	No	720	27.7	385	21.0	0	0.0	
Does your college have its own online platform for online education?	Yes	1965	75.5	1605	87.7	270	64.3	<0.001 ***
	No	635	24.4	225	12.3	150	35.7	
Experience in using electronic platforms for online education	No–	0	0.0	30	1.6	0	0.0	<0.001 ***
	Poor	400	15.4	350	19.1	0	0.0	
	Unsatisfactory	285	10.9	20	1.1	150	35.7	
	Satisfactory	855	32.8	935	51.1	210	50.0	
	Good	1060	40.7	495	27.0	60	14.3	

Note: \*\*\*, significant at  $p < 0.001$ .

**Table 2.** Responses (%) by item and subscale of the full data ( $n = 4850$ ).

Item	Question	N/A (%)	Strongly Disagree (%)	Disagree (%)	Neither Agree, nor Disagree (%)	Agree (%)	Strongly Agree (%)	$\chi^2$
Q1	I am satisfied with the quality of education by online method	-	13.9	7.1	12.3	44.6	22.1	<0.001 ***
Q2	I find it easy to ask my teachers questions during online sessions	-	6.7	1.1	10.3	41.4	40.5	<0.001 ***
Q3	I am satisfied with the quality of pictures, graphs and images during online education	-	8.3	9.7	9.0	38.4	34.6	<0.001 ***
Q4	I think the online system of learning basic sciences is more useful than the traditional system of learning them	-	16.3	9.0	17.2	32.6	24.9	<0.001 ***
Q5	I think I have the skills needed to study basic sciences well during online sessions	-	3.3	2.0	16.2	52.2	26.4	<0.001 ***
Q6	I think the online system of learning basic sciences is more enjoyable than the traditional system of learning them	-	7.4	17.7	13.5	34.3	27.1	<0.001 ***
Q7	It is easy for me to use the online system to learn basic sciences	-	7.1	2.8	14.7	39.3	36	<0.001 ***
Q8	I find it easy to understand information in online education as compared to during face-to-face sessions	-	9.6	10.6	18.2	34.7	26.9	<0.001 ***
Q9	In my institution, I have a facility to learn anatomy by 3D models available online	4.8	7.5	23.5	19.6	23.4	21.2	<0.001 ***
Q10	I learn better by online anatomy method than by traditional teaching of anatomy	5.3	9.2	10.9	42.1	16	16.6	<0.001 ***
Q11	I like online system of lectures because, in this case, I can re-visit the saved lectures	-	6.7	1.2	4.5	50.7	36.9	<0.001 ***
Q12	I like online education system because there are interactive softwares	4.6	7.4	6.6	29.8	24.2	27.4	<0.001 ***
Q13	I have been able to learn practical skills in basic sciences (laboratory-related work) by online sessions just as nicely as during face-to-face	-	19.2	9.1	17	36.4	18.4	<0.001 ***

Table 2. Cont.

Item	Question	N/A (%)	Strongly Disagree (%)	Disagree (%)	Neither Agree, nor Disagree (%)	Agree (%)	Strongly Agree (%)	$\chi^2$
Q14	Through online system of education I am easily able to learn how to apply knowledge of basic sciences to understand diseases	-	9	3.8	31.6	26.9	28.7	<0.001 ***
Q15	The course content during the COVID-19 pandemic is suitable for online education	-	8.9	9.7	20.4	14.6	46.4	<0.001 ***
Q16	Online education is a suitable method for basic science education	5.7	9.1	1.3	20.7	23	40.3	<0.001 ***

Note: \*\*\*, significant at  $p < 0.001$ .

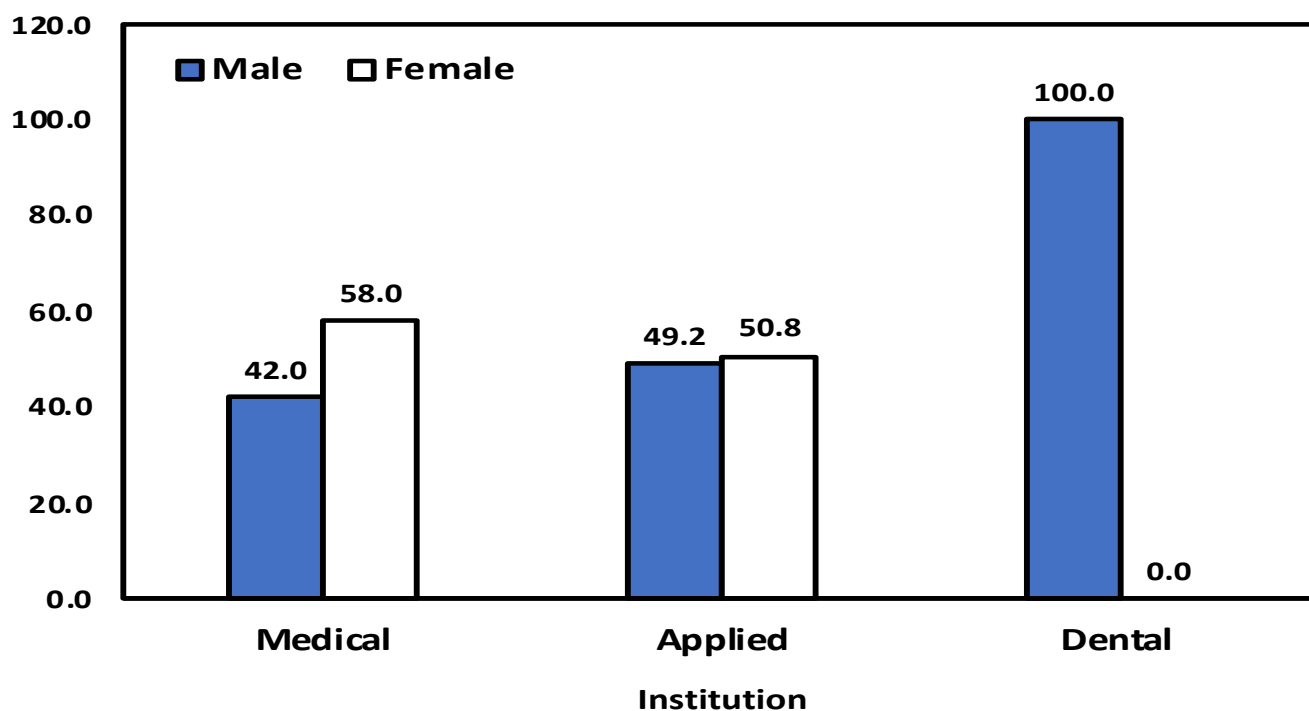
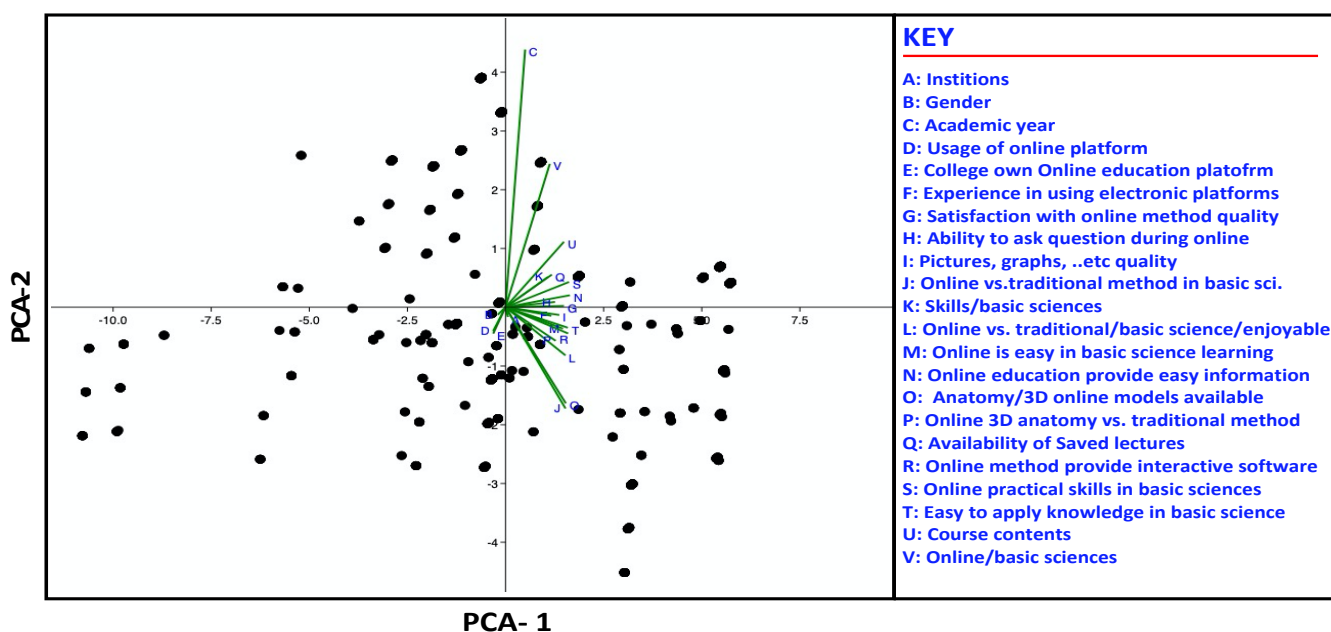


Figure 1. Bar chart presenting the gender distribution among participants belonging to different institutions.

The rotated component matrix showed that, out of a total of 28 statements, 16 statements loaded onto component 1 and 9 statements loaded onto component 2. On the other hand, three statements did not significantly load onto any component, and, hence, were deleted from the final analysis. The major component was labeled as ‘student satisfaction with online education’. The ratings given for this construct ranged from a maximum of 80 to a minimum of zero. This range was divided into the following three equal categories: highly satisfied (80–54), moderate satisfaction (53–28), and low satisfaction (27–0). An average of 1465 (30.2%) students out of the total 4850 students claimed that they had never used an online learning platform before the COVID-19 pandemic. Furthermore, 1335 (27.5%) students thought their college did not have its own platform.



**Figure 2.** Biplot of the PCA ordination performed on study data. A: institutions; B: gender; C: academic year; D: usage of online platform; E: college has its own online education platform; F: experience in using electronic platforms; G: satisfaction with online method quality; H: ability to ask questions during online session; I: quality of pictures, graphs, etc.; J: online vs. traditional method in basic science; K: skills/basic sciences; L: online vs. traditional/basic science/enjoyable; M: online is easy for basic science learning; N: online education provides easy information; O: anatomy/3D online models available; P: online 3D anatomy vs. traditional method; Q: availability of saved lectures; R: online method provides interactive software; S: online practical skills in basic sciences; T: easy to apply knowledge in basic science; U: course contents; V: online/basic sciences. Axis 1: eigenvalue = 16.13; percent of variance explained is 52.66. Axis 2: eigenvalue = 4.09; percent of variance explained is 13.36.

Analysis of the combined data (i.e., student responses from all three institutions) showed that 46.9% ( $n = 2275$ ) of the students were highly satisfied with their online education, 39.7% ( $n = 1925$ ) were moderately satisfied, and 13.4% ( $n = 650$ ) had low satisfaction. Analyses of the scores from medical, applied health and dental students showed a significant difference ( $p = 0.000$ ). The maximum satisfaction was reported among the applied health students (highly satisfied score = 63.13) and the minimum among the medical students (highly satisfied score = 39.3). Furthermore, a highly significant difference ( $p = 0.000$ ) was found between the male and female students. In this respect, the females showed a higher satisfaction score than their male counterparts (Table 3). The last two statements in the questionnaire were about whether the students would opt for the traditional form of education after the COVID-19 lockdown, or a blended form (Table 4). The results showed that the students preferred a blended approach of education. There was a slightly significant difference in the scores of the males and females ( $p = 0.047$ ) in this regard. The average scores of the females and males (combined) who preferred the traditional formats were  $2.57 \pm 1.1$  and  $2.67 \pm 1.1$ , respectively. The females showed a higher average score for blended learning ( $3.99 \pm 1.00$ ) than for traditional learning formats ( $2.57 \pm 1.1$ ). The males showed a similar trend, with an average score of  $2.67 \pm 1.15$  for the traditional learning format and  $4.09 \pm 0.898$  for the blended format. The applied health students had a mean score of  $4.14 \pm 0.94$  supporting blended learning after schools re-open, as compared to the score of  $2.48 \pm 1.05$  obtained by those in favor of traditional, face-to-face learning. The dental students had a mean score of  $2.7 \pm 1.2$  in favor of blended learning, as compared to a mean score of  $4.2 \pm 1.1$  for the traditional learning format. The medical students showed exactly the same trend, with a mean score of  $2.79 \pm 1.16$  for traditional



learning versus  $3.84 \pm 0.80$  for blended learning. This difference was found to be highly significant ( $p = 0.000$ ). MANOVA was applied to assess the overall effect of various factors, and the results are presented in Table 5.

**Table 3.** Pattern of scores showing student satisfaction with the online teaching method.

<b>I am Satisfied with the Quality of Education by Online Method</b>			
Scores (%)	High	Moderate	Low
Combined	46.9	39.7	13.4
I am satisfied with the quality of education by online method			Significance (chi-square)
Medical	39.3	55.7	5
Allied	63.13	18.69	18.18
Dental	45	45	1
Male	46.16	39.42	14.4
Female	57.6	26	16.4

**Table 4.** Mean scores regarding student preference about traditional or blended learning.

Mean (SD) Scores		Significance (chi-Square)
	After the COVID-19 pandemic is over, I would like to go back to the face-to-face, traditional method of Education	After the COVID-19 pandemic is over, I would like to go back to a mix between traditional and online learning system
Medical	2.79 (1.16)	3.84 (0.80)
Allied	2.48 (1.05)	4.1 (0.94)
Dental	2.7 (1.2)	4.2 (1.1)
Male	2.67 (1.15)	4.09 (0.89)
Female	2.57 (1.1)	3.9 (1.0)



**Table 5.** Multivariate analysis of variance (MANOVA) table showing the interaction between studied variables.

Tests of Between-Subjects Effects	Corr. Model	Institute	Gender	Acad. Year	D	E	Instit. * Gender	Institu * Acad. Year	Gender * Acad. Year	Instit. * D	Institution * E	Gender * Acad. Year	Gender * D	Gender * E	Acad. Year * D	Acad. Year * E	D * E	Instit * Gender * Acad. Year	Gender * Acad. Year * D
How was your experience of using electronic platforms for online education?	30.6 ***	1.1 ns	1.7 ns	26.1 ***	257.3 ***	3.3 ns	3.4 ns	27.4 ***	12.3 ***	82.7 ***	56.3 ***	12.3 ***	66.8 ***	35.5 ***	4.4 **	1.9 ns	48.9 ***	3.8 **	9.5 ***
I am satisfied with the quality of education by online method	20.1 ***	4.4 *	23.7 ***	17.2 ***	68.1 ***	37.6 ***	1.1 ns	12.3 ***	2.1 ns	13.0 ***	31.9 ***	2.1 ns	0.0ns	18.1 ***	1.3 ns	1.1 ns	17.6 ***	1.7 ns	1.1 ns
I find it easy to ask my teachers questions during online sessions	17.9 ***	1.8 ns	47.8 ***	9.3 ***	10.5 ***	18.4 ***	0.1 ns	12.6 ***	1.6 ns	4.8 *	1.6 ns	1.6 ns	4.1 *	12.2 ***	1.3 ns	0.5 ns	1.9 ns	1.2 ns	1.2 ns
I am satisfied with the quality of pictures, graphs and images during online education sessions	19.0 ***	7.5 ***	6.3 *	14.0 ***	3.0 ns	29.9 ***	1.7 ns	1.9 ns	5.8 ***	0.2 ns	11.4 ***	5.8 ***	0.2 ns	9.3 **	1.3 ns	0.5 ns	2.1 ns	0.6 ns	6.4 **
I think the online system of learning basic sciences is more useful than the traditional system of learning them	24.0 ***	0.7 ns	5.8 *	93.5 ***	42.1 ***	0.0 ns	0.6 ns	21.7 ***	3.3 **	21.5 ***	9.8 **	3.3 **	7.9 **	14.3 ***	1.4 ns	0.1 ns	0.2 ns	2.2 ns	5.1 **
I think I have the skills needed to study basic sciences well during online sessions	31.5 ***	37.2 ***	31.3 ***	9.6 ***	56.1 ***	51.2 ***	2.2 ns	18.5 ***	2.1 ns	31.7 ***	28.9 ***	2.1 ns	3.6 ns	4.4 *	1.5 ns	0.4ns	0.3 ns	3.8 **	1.1 ns
I think the online system of learning basic sciences is more enjoyable than the traditional system of learning them	31.1 ***	25.3 ***	23.5 ***	71.9 ***	37.5 ***	0.5 ns	4.9ns	21.7 ***	6.4 *	27.6 ***	22.3 ***	6.4 ***	13.8 ***	35.5 ***	1.2 ns	0.6 ns	0.7 ns	3.2 *	8.5 ***
It is easy for me to use the online system to learn basic sciences	53.3 ***	29.8 ***	76.9 ***	71.9 ***	82.4 ***	26.1 ***	5.8 *	32.8 ***	7.9 **	38.7 ***	15.1 ***	7.9 ***	0.2 ns	29.1 ***	3.0 *	0.2 ns	3.4 ns	0.8 ns	8.8 ***
I find it easy to understand information in online education as compared to during face-to-face sessions	46.8 ***	7.2 ***	19.0 ***	26.6 ***	202.6 ***	5.0*	36.6 ***	17.7 ***	10.6 ***	62.6 ***	25.9 ***	10.6 ***	43.8 ***	74.4 ***	3.8 *	1.8 ns	45.6 ***	0.3 ns	12.7 ***

Table 5. Cont.

Tests of Between-Subjects Effects	Corr. Model	Institute	Gender	Acad. Year	D	E	Instit. * Gender	Institu * Acad. Year	Gender * Acad. Year	Instit. * D	Institution * E	Gender * Acad. Year	Gender * D	Gender * E	Acad. Year * D	Acad. Year * E	D * E	Instit * Gender * Acad. Year	Gender * Acad. Year * D
In my institution, I have a facility to learn anatomy by 3D models available online	28.6 ***	0.3 ns	1.8 ns *	87.4 ***	15.6 ***	1.0 ns	3.2 ns	14.8 ***	5.8 *	27.3 ***	12.9 ***	5.8 ***	36.1 ***	4.6 *	0.6 ns	0.7 ns	23.9 ***	0.3 ns	14.0 ***
I learn better by online anatomy method than by traditional teaching of anatomy	40.4 ***	8.6 ***	6.5 *	48.7 ***	0.1 ns	0.5 ns	0.9 ns	12.3 ***	4.8 *	15.7 ***	9.7 ***	4.8 ***	3.5 ns	6.6 *	3.0 *	1.4 ns	32.8 ***	2.1 ns	0.9 ns
I like online system of lectures because, in this case, I can re-visit the saved lectures whenever I need to	26.1 ***	28.2 ***	35.7 ***	8.2 ***	8.2 **	57.0 ***	0.5 ns	2.1 ns	2.1 ns	2.2 ns	0.0 ns	1.6 ns	0.0 ns	21.3 ***	1.2 ns	0.5 ns	24.3 ***	4.3 **	0.5 ns
I like online education system because there are interactive softwares that can simulate reality	16.8 ***	10.4 ***	12.1 ***	25.4 ***	0.9 ns	27.7 ***	2.1 ns	6.1 *	2.1 ns	13.0 ***	2.7 ns	1.3 ns	1.6 ns	7.0 *	1.2 ns	0.1 ns	9.1 **	0.8 ns	0.6 ns
I have been able to learn practical skills in basic sciences (laboratory-related work) by online sessions just as nicely as during face-to-face sessions	36.0 ***	9.0 ***	29.8 ***	11.0 ***	57.9 ***	19.9 ***	14.0 ***	25.0 ***	8.4 **	22.7 ***	0.1 ns	8.4 ***	0.2 ns	11.2 ***	1.2 ns	0.3 ns	0.1 ns	1.7 ns	6.1 **
Through online system of education, I am easily able to learn how to apply knowledge of basic sciences to understand diseases	29.7 ***	7.1 ***	34.7 ***	41.9 ***	93.6 ***	5.4 *	1.0 ns	28.8 ***	2.1 ns	121.5 ***	47.1 ***	2.6 ns	4.1 *	13.1 ***	4.3 *	0.4 ns	5.4 *	0.9 ns	0.9 ns
The course content during the COVID-19 pandemic is suitable for online education	55.6 ***	7.7 ***	8.0 **	5.3 ***	41.1 ***	197.8 ***	5.0 *	26.7 ***	6.0 *	50.0 ***	11.9 ***	6.0 ***	23.3 ***	5.2 *	1.2 ns	0.9 ns	9.9 **	1.6 ns	19.4 ***

Table 5. Cont.

Tests of Between-Subjects Effects	Corr. Model	Institute	Gender	Acad. Year	D	E	Instit. * Gender	Institu * Acad. Year	Gender * Acad. Year	Instit. * D	Institution * E	Gender * Acad. Year	Gender * D	Gender * E	Acad. Year * D	Acad. Year * E	D * E	Instit * Gender * Acad. Year	Gender * Acad. Year * D
Online education is a suitable method for basic science education	33.4 ***	31.1 ***	44.3 ***	45.7 ***	6.8 **	27.8 ***	7.0 **	24.2 ***	11.4 ***	34.1 ***	0.0 ns	11.4 ***	0.1 ns	11.5 ***	1.2 ns	0.3 ns	9.1 **	3.8 *	2.1 ns
Through online system of education, I am easily able to learn how to apply knowledge of basic sciences to understand diseases	39.6 ***	11.6 ***	37.4 ***	40.1 ***	50.4 ***	35.2 ***	4.9 ns	15.3 ***	6.3 *	31.5 ***	5.1 *	6.3 ***	5.6 *	28.4 *	1.2 ns	0.3 ns	0.0 ns	1.7 ns	7.4 **
The course content during the COVID-19 pandemic is suitable for online education	75.5 ***	0.6 ns	883.2 ***	30.7 ***	0.8 ns	5.9 *	4.9 ns	41.3 ***	40.3 ***	0.0 ns	0.0 ns	40.3 ***	2.2 ns	8.1 **	1.2 ns	1.1 ns	0.0 ns	59.5 ***	0.8 ns

\*, \*\*, \*\*\*, significant at  $p < 0.05$ ,  $< 0.01$ ,  $0.001$ , respectively; ns, non-significant at  $p > 0.05$ .

#### 4. Discussion

The investigation of school and/or university students' perceptions of online education, through various empirical and theoretical approaches, seems very important to provide feedback about the learning process, particularly during global pandemics [12–18]. In the present study, the questionnaire assessed the impact of COVID-19 on the online learning process and student perception, and PCA was performed. Furthermore, the perceptions of 4850 students from six institutions in the public sector were compared on the basis of gender and institution type. Interestingly, the present study provides interesting information about student satisfaction in relation to online education during the COVID-19 lockdown.

Reviewing the available literature, several previous reports investigated the influence and effectiveness of remote education during the COVID-19 pandemic [9,19–21]. As shown in our study, 46.99% of the students were highly satisfied with their online education and 39.7% were moderately satisfied. Similar results were reported in a previous study carried out by Abbasi et al. in 2020 [22]. The possible explanation for this could be that the current generation of students is used to obtaining information from online sources. However, we should not ignore the fact that 13.4% of the students were not satisfied with this system. In regards to this concern, several studies documented that students might face multiple challenges with online education, which are potentiated by limited technology experience and connectivity issues [3,23–25]. As shown in the present work, students prefer a blended approach to learning for the future. In the same line, a previous study [26] assessed the attitudes and concerns of students ( $n = 2520$ ) of health sciences in Croatia in relation to a full switch to e-learning during the COVID-19 pandemic. In this survey, the authors found that 1403 (55.7%) students preferred blended or hybrid learning, which involves traditional learning with e-learning [26]. In another UK-based national survey [27], which included 2721 students, the authors recommended a mix of online and on-campus teaching. Our findings are in harmony with another previous study in Nigeria, which concluded similar recommendations [28]. These findings might reflect the strengths of both the teaching and blended/hybrid modes, which can augment learning [29]. However, it should be borne in mind that the faculty, students, and administration teams were comfortable with an on-campus style of education [30]. Furthermore, there are a number of challenges associated with the complete switch to online learning, particularly in healthcare disciplines, such as difficulties in the designing and development of online learning programs, and the fact that many students have no access to online platforms and/or they are not able to use them [18,31].

Regarding the validation of the instrument, several reports revealed the role of PCA and the rotated component matrix in simplifying the complexity of high-dimensional data, without losing important traits and patterns [32–36]. Clearly, PCA could be used for the identification of patterns in a data set, and to determine its applicability to the specific population. Moreover, Cronbach's alpha was performed to assess the overall reliability, or internal consistency, of a set of scale or test items, and, therefore, to check the sub-scale assumptions and completeness of the collected data [36–38]. In accordance with the studied variables, several previous studies documented the influence of gender on distance-learning performance [3,39,40]. In the present work, females showed a higher satisfaction score with online education during the COVID-19 pandemic, as compared to males, which is consistent with several reports [41–43]. Similarly, several previous studies concluded that online education performance was significantly better in females than males [3,39,40]. In stark contrast, other studies revealed that gender differences do not influence the learning outcomes in e-learning [44,45], while others suggest the possible influence of class level or course subject/design [13,46–48]. As depicted in our results, the maximum satisfaction score for e-learning was reported among the applied health students and the minimum among the medical students. In the same line, some previous studies revealed that the maximum satisfaction score was reported among the applied health students and the

minimum among the medical students. However, it should be borne in mind that some of these students had never used an online learning platform.

As shown in Table 4, the study explored whether the students would opt for the traditional form of education or a blended form following the COVID-19 lockdown. Interestingly, our study showed that the students preferred a blended approach of education over the traditional method, which is consistent with several previous reports [43,49,50]. However, the applied health students had a higher mean score supporting blended learning over traditional learning after schools re-open, as compared to other students, who preferred traditional learning. Furthermore, our present data reveal that there was a slight significant difference between the scores of male and female students ( $p = 0.047$ ) in relation to the traditional or blended form of education after the COVID-19 lockdown. Furthermore, the female students showed a higher average score for blended learning than for traditional learning in comparison with the males, which is consistent with several previous reports [3,41,51]. However, it should be borne in mind that the large discrepancy between the number of females and males participating in the present study might be due to the fact that most of the medical students in Saudi Arabia are females, and the active participation of females in research and volunteering activities is higher than males. These findings are in harmony with some previous studies [52,53].

## 5. Conclusions

Collectively, the present study reports that e-learning could be an acceptable method for teaching and learning, with various degrees of satisfaction and gender differences. In addition, the present findings could be of promising potential for the future of medical education at the national level, but they should be combined with regular and rigorous evaluation and monitoring of their effectiveness. Our study also provides evidence for policy makers to design the most suitable and contextually relevant academic interventions, particularly during pandemics. The limitations of the study include the limited number of participating universities and respondents for the pilot study. Furthermore, the present data were gathered through an online electronic questionnaire, which might hinder the participation of several students who have connection troubles. Similarly, the study was focused on basic medical courses; extending the study to more courses would be much more interesting. Further future research is warranted to explore the same topic at a large scale and national level, in order to obtain a more holistic and accurate picture.

**Supplementary Materials:** The following are available online at <https://www.mdpi.com/article/10.3390/su14010224/s1>: Table S1: the full details of the questionnaire contained twenty-nine items.

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## References

- Jordan, P.C.; Stevens, S.K.; Deval, J. Nucleosides for the treatment of respiratory RNA virus infections. *Antivir. Chem. Chemother.* **2018**, *26*, 2040206618764483. [\[CrossRef\]](#) [\[PubMed\]](#)
- Beigel, J.H.; Nam, H.H.; Adams, P.L.; Krafft, A.; Ince, W.L.; El-Kamary, S.S.; Sims, A.C. Advances in respiratory virus therapeutics—A meeting report from the 6th isirv Antiviral Group conference. *Antivir. Res.* **2019**, *167*, 45–67. [\[CrossRef\]](#) [\[PubMed\]](#)
- Khalil, R.; Mansour, A.E.; Fadda, W.A.; Almisnid, K.; Aldamegh, M.; Al-Nafeesah, A.; Alkhalifah, A.; Al-Wutayd, O. The sudden transition to synchronized online learning during the COVID-19 pandemic in Saudi Arabia: A qualitative study exploring medical students' perspectives. *BMC Med. Educ.* **2020**, *20*, 1–10. [\[CrossRef\]](#) [\[PubMed\]](#)
- Tanveer, M.; Bhaumik, A.; Hassan, S.; Haq, I.U. COVID-19 pandemic, outbreak educational sector and students online learning in Saudi Arabia. *J. Entrep. Educ.* **2020**, *23*, 1–14.
- Haroon, Z.; Azad, A.A.; Sharif, M.; Aslam, A.; Arshad, K.; Rafiq, S. COVID-19 Era: Challenges and Solutions in Dental Education. *J. Coll. Physicians Surg. Pak.* **2020**, *30*, 129–131.
- Edginton, A.; Holbrook, J. A blended learning approach to teaching basic pharmacokinetics and the significance of face-to-face interaction. *Am. J. Pharm. Educ.* **2010**, *74*, 88. [\[CrossRef\]](#) [\[PubMed\]](#)
- Gaur, U.; Majumder, M.A.A.; Sa, B.; Sarkar, S.; Williams, A.; Singh, K. Challenges and opportunities of preclinical medical education: COVID-19 crisis and beyond. *SN Compr. Clin. Med.* **2020**, *2*, 1–6. [\[CrossRef\]](#)
- Bozkurt, A.; Sharma, R.C. Education in normal, new normal, and next normal: Observations from the past, insights from the present and projections for the future. *Asian J. Distance Educ.* **2020**, *15*, i–x.
- Peters, M.A.; Rizvi, F.; McCulloch, G.; Gibbs, P.; Gorur, R.; Hong, M.; Hwang, Y.; Zipin, L.; Brennan, M.; Robertson, S. Reimagining the new pedagogical possibilities for universities post-COVID-19: An EPAT Collective Project. *Educ. Philos. Theory* **2020**, *1–44*. [\[CrossRef\]](#)
- Bozkurt, A.; Sharma, R.C. Emergency remote teaching in a time of global crisis due to CoronaVirus pandemic. *Asian J. Distance Educ.* **2020**, *15*, i–vi.
- Zhuo, H. Learning from Global Education Arrangement during COVID-19 Pandemic Period. *Int. J. Manag. Educ. Hum. Dev.* **2021**, *1*, 80–85.
- Smart, K.; Cappel, J. Students' Perceptions of Online Learning: A Comparative Study. *JITE* **2006**, *5*, 201–219. [\[CrossRef\]](#)
- Gopal, R.; Singh, V.; Aggarwal, A. Impact of online classes on the satisfaction and performance of students during the pandemic period of COVID 19. *Educ. Inf. Technol.* **2021**, *26*, 6923–6947. [\[CrossRef\]](#)
- El Said, G.R. How Did the COVID-19 Pandemic Affect Higher Education Learning Experience? An Empirical Investigation of Learners' Academic Performance at a University in a Developing Country. *Adv. Hum. Comput. Interact.* **2021**, *2021*, 6649524. [\[CrossRef\]](#)
- Hjelsvold, R.; Bahmani, A.; Lorås, M. *First Impressions from Educators as NTNU Transitions to an Online only Mode of Learning*; Norwegian University of Science and Technology's: Trondheim, Norway, 2020.
- Butnaru, G.I.; Niță, V.; Anichiti, A.; Brînză, G. The Effectiveness of Online Education during COVID 19 Pandemic—A Comparative Analysis between the Perceptions of Academic Students and High School Students from Romania. *Sustainability* **2021**, *13*, 5311. [\[CrossRef\]](#)
- Joshua, O.; Bekele, A. Implementation of Innovative Educational Technologies in Teaching of Anatomy and Basic Medical Sciences During the COVID-19 Pandemic in a Developing Country: The COVID-19 Silver Lining? Video abstract. *Adv. Med. Educ. Pract.* **2021**, *12*, 619–625. [\[CrossRef\]](#)
- Kim, J.W.; Myung, S.J.; Yoon, H.B.; Moon, S.H.; Ryu, H.; Yim, J.J. How medical education survives and evolves during COVID-19: Our experience and future direction. *PLoS ONE* **2020**, *15*, e0243958. [\[CrossRef\]](#)
- Toquero, C.M. Emergency remote education experiment amid COVID-19 pandemic. *Int. J. Educ. Res. Innov.* **2021**, *15*, 162–176. [\[CrossRef\]](#)
- Bond, M.; Bedenlier, S.; Marín, V.I.; Händel, M. Emergency remote teaching in higher education: Mapping the first global online semester. *Int. J. Educ. Technol. High. Educ.* **2021**, *18*, 1–24. [\[CrossRef\]](#) [\[PubMed\]](#)
- Natarajan, J.; Joseph, M.A. *Impact of Emergency Remote Teaching on Nursing Students' Engagement, Social Presence, and Satisfaction during the COVID-19 Pandemic*; Wiley Periodicals, LLC: Hoboken, NJ, USA, 2021.
- Abbasi, M.S.; Ahmed, N.; Sajjad, B.; Alshahrani, A.; Saeed, S.; Sarfaraz, S.; Alhamdan, R.S.; Vohra, F.; Abduljabbar, T. E-Learning perception and satisfaction among health sciences students amid the COVID-19 pandemic. *Work* **2020**, *67*, 1–8. [\[CrossRef\]](#)
- Al-Balas, M.; Al-Balas, H.I.; Jaber, H.M.; Obeidat, K.; Al-Balas, H.; Aborajoo, E.A.; Al-Taher, R.; Al-Balas, B. Distance learning in clinical medical education amid COVID-19 pandemic in Jordan: Current situation, challenges, and perspectives. *BMC Med. Educ.* **2020**, *20*, 1–7.
- García-Morales, V.J.; Garrido-Moreno, A.; Martín-Rojas, R. The transformation of higher education after the COVID disruption: Emerging challenges in an online learning scenario. *Front. Psychol.* **2021**, *12*, 196. [\[CrossRef\]](#) [\[PubMed\]](#)



25. Rajab, M.H.; Gazal, A.M.; Alkattan, K. Challenges to online medical education during the COVID-19 pandemic. *Cureus* **2020**, *12*, e8966. [[CrossRef](#)] [[PubMed](#)]
26. Puljak, L.; Čivljak, M.; Haramina, A.; Mališa, S.; Čavić, D.; Klinec, D.; Aranza, D.; Mesarić, J.; Skitarelj, N.; Zoranić, S. Attitudes and concerns of undergraduate university health sciences students in Croatia regarding complete switch to e-learning during COVID-19 pandemic: A survey. *BMC Med. Educ.* **2020**, *20*, 1–11. [[CrossRef](#)]
27. Dost, S.; Hossain, A.; Shehab, M.; Abdelwahed, A.; Al-Nusair, L. Perceptions of medical students towards online teaching during the COVID-19 pandemic: A national cross-sectional survey of 2721 UK medical students. *BMJ Open* **2020**, *10*, e042378. [[CrossRef](#)]
28. Opeyemi, O.Z.; Adeyemi, A.A.; Olajuwon, T.D.; Nike, O.; Oloruntosin, B.S.O. Perception of nursing students towards online learning: A case study of Lautech open and distance learning centre, Ogbomoso, Oyo State, Nigeria. *Galore Int. J. Health Sci. Res.* **2019**, *4*, 23–30.
29. Pelletier, K.; Brown, M.; Brooks, D.C.; McCormack, M.; Reeves, J.; Arbino, N.; Bozkurt, A.; Crawford, S.; Czerniewicz, L.; Gibson, R. 2021 *EDUCAUSE Horizon Report Teaching and Learning Edition*; EDUCAUSE: Boulder, CO, USA, 2021; pp. 2–50.
30. Rapanta, C.; Botturi, L.; Goodyear, P.; Guàrdia, L.; Koole, M. Online University Teaching During and After the COVID-19 Crisis: Refocusing Teacher Presence and Learning Activity. *Postdigital Sci. Educ.* **2020**, *2*, 923–945. [[CrossRef](#)]
31. Regmi, K.; Jones, L. A systematic review of the factors—Enablers and barriers—Affecting e-learning in health sciences education. *BMC Med. Educ.* **2020**, *20*, 91. [[CrossRef](#)]
32. Forkman, J.; Josse, J.; Piepho, H.-P. Hypothesis Tests for Principal Component Analysis When Variables are Standardized. *J. Agric. Biol. Environ. Stat.* **2019**, *24*, 289–308. [[CrossRef](#)]
33. Jolliffe, I.T. Springer series in statistics. In *Principal Component Analysis*; Springer: Berlin/Heidelberg, Germany, 2002; Volume 29.
34. Gupta, V. Principal Components Analysis of Educational Resources Usage among Undergraduate Medical Students during the COVID-19 Pandemic in Southern Haryana, India. *J. Sci. Soc.* **2020**, *47*, 99–104. [[CrossRef](#)]
35. Sam, C.; Naicker, N.; Adebiyi, M. Dimensionality Reduction of Social Media Application Attributes for Ubiquitous Learning Using Principal Component Analysis. *Mob. Inf. Syst.* **2021**, *2021*, 6633223. [[CrossRef](#)]
36. Siddiquei, M.I.; Kathpal, S. Challenges of online teaching during COVID-19: An exploratory factor analysis. *Hum. Behav. Emerg. Technol.* **2021**. [[CrossRef](#)]
37. Adnan, M.; Anwar, K. Online Learning amid the COVID-19 Pandemic: Students' Perspectives. *Online Submiss.* **2020**, *2*, 45–51. [[CrossRef](#)]
38. Kulsum, K.; Suryadi, T. Validity And Reliability Test For Research Instruments Regarding Health Professional Student Satisfaction Towards Online Learning During The COVID-19 Pandemic. *Eur. J. Mol. Clin. Med.* **2021**, *7*, 2802–2817.
39. Rovai, A.P.; Baker, J.D. Gender differences in online learning: Sense of community, perceived learning, and interpersonal interactions. *Q. Rev. Distance Educ.* **2005**, *6*, 31.
40. Hsiao, Y.-C.; Shiao, Y.-T. Research on gender differences in the digital learning performance of university students. In Proceedings of the 9th International Conference on E-Education, E-Business, E-Management and E-Learning, San Diego, CA, USA, 11–13 January 2018; pp. 26–30.
41. Yu, Z. The effects of gender, educational level, and personality on online learning outcomes during the COVID-19 pandemic. *Int. J. Educ. Technol. High. Educ.* **2021**, *18*, 14. [[CrossRef](#)] [[PubMed](#)]
42. Khawar, M.B.; Abbasi, M.H.; Hussain, S.; Riaz, M.; Rafiq, M.; Mehmood, R.; Sheikh, N.; Amaan, H.N.; Fatima, S.; Jabeen, F.; et al. Psychological impacts of COVID-19 and satisfaction from online classes: Disturbance in daily routine and prevalence of depression, stress, and anxiety among students of Pakistan. *Heliyon* **2021**, *7*, e07030. [[CrossRef](#)] [[PubMed](#)]
43. Sebbani, M.; Adarmouch, L.; Mansouri, A.; Mansoury, O.; Michaud, S.; ElAdib, A.R.; Bouskraoui, M.; Amine, M. Implementation of Online Teaching in Medical Education: Lessons Learned from Students' Perspectives during the Health Crisis in Marrakesh, Morocco. *Educ. Res. Int.* **2021**, *2021*, 5547821. [[CrossRef](#)]
44. Astleitner, H.; Steinberg, R. Are there gender differences in web-based learning? An integrated model and related effect sizes. *AACE Rev.* **2005**, *13*, 47–63.
45. Yukselturk, E.; Bulut, S. Predictors for student success in an online course. *J. Educ. Technol. Soc.* **2007**, *10*, 71–83.
46. Wladis, C.; Wladis, K.; Hachey, A.C. The Role of Enrollment Choice in Online Education: Course Selection Rationale and Course Difficulty as Factors Affecting Retention. *Online Learn.* **2014**, *18*, 3. [[CrossRef](#)]
47. Jaggars, S. Beyond flexibility: Why students choose online courses in community college. In Proceedings of the American Educational Research Association Annual Meeting, Vancouver, BC, USA, 16 April 2012; Volume 13, pp. 11–14.
48. Lorenzo-Alvarez, R.; Rudolphi-Solero, T.; Ruiz-Gomez, M.J.; Sendra-Portero, F. Medical student education for abdominal radiographs in a 3D virtual classroom versus traditional classroom: A randomized controlled trial. *Am. J. Roentgenol.* **2019**, *213*, 644–650. [[CrossRef](#)]
49. Dalmolin, A.; Mackeivicz, G.; Pochapski, M.; Pilatti, G.; Santos, F. Learning styles preferences and e-learning experience of undergraduate dental students. *Revista Odontologia UNESP* **2018**, *47*, 175–182. [[CrossRef](#)]
50. Sadeghi, R.; Sedaghat, M.M.; Shaahmadi, F. Comparison of the effect of lecture and blended teaching methods on students learning and satisfaction. *J. Adv. Med. Educ. Prof.* **2014**, *2*, 146–150.
51. Tayyib, N.; Alsolami, F.; Lindsay, G.; Alshhmemri, M.; Asfour, H.; Ramaiah, P.; Alsulami, S.; Ali, H. *Undergraduate Nursing Students' Satisfaction with Blended e-Learning following the COVID-19 Pandemic*; Creative Commons: Mountain View, CA, USA, 2020.



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52. McDonald, B.; Haardoerfer, R.; Windle, M.; Goodman, M.; Berg, C. Implications of attrition in a longitudinal web-based survey: An examination of college students participating in a tobacco use study. *JMIR Public Health Surveill.* **2017**, *3*, e7424. [[CrossRef](#)]
  53. Alsoufi, A.; Alsuyihili, A.; Msherghi, A.; Elhadi, A.; Atiyah, H.; Ashini, A.; Ashwieb, A.; Ghula, M.; Ben Hasan, H.; Abudabuos, S. Impact of the COVID-19 pandemic on medical education: Medical students' knowledge, attitudes, and practices regarding electronic learning. *PLoS ONE* **2020**, *15*, e0242905. [[CrossRef](#)]