OPEN

PRS GLOBAL OPEN

ORIGINAL ARTICLE
Education

Integration of Virtual and Traditional Medical Education: Scholarship Pivots from the COVID-19 Pandemic

Ipek Berberoglu, BS*†
Sherry Y. Q. Tang, MD†
Jeffrey H. Kozlow, MD, MS†
Billur Sezgin, MD*
Gurjit Sandhu, PhD‡
Paul S. Cederna, MD†

Background: The coronavirus disease 2019 (COVID-19) pandemic required an unprecedented transformation of medical education, shifting from traditional, in-person learning to distanced, online learning. This study aimed to review changes to medical education and describe the advantages and disadvantages of virtual medical education experienced by medical students during the pandemic.

Methods: An online survey study was conducted at two medical schools, University of Michigan Medical School in the United States and Koc University School of Medicine in Turkey. Medical students completed questionnaires regarding their educational experience before and during the pandemic. Survey instruments were designed to assess differences in the educational curriculum, study methods, clinical skills self-evaluations, perceptions of the quality of in-person and online learning, and overall satisfaction.

Results: A total of 184 medical students completed the survey. There was an increase in the use of online study tools since the pandemic. There was no statistically significant difference in self-reported assessments of clinical preparedness and overall clinical competence during surgical clerkship. The percentage of students interested in pursuing a career in surgery has nearly doubled from 34% to 63%. A majority of students (83%) believed that the time available for self-study and research increased during the pandemic. Fifty-two percent of students believed that online education is less efficacious than in-person education, but 86% of students still preferred a blended approach.

Conclusions: Medical schools have continued to update their curricula following the COVID-19 pandemic. This study illustrates the transformations in medical education to ensure that the most effective and suitable teaching is delivered.
(Plast Reconstr Surg Glob Open 2024; 12:e5910; doi: 10.1097/GOX.0000000000005910; Published online 14 June 2024.)

INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 novel coronavirus disease 2019 (COVID-19) was declared a pandemic on March 11, 2020. It created an unprecedented and significant impact on medical education globally.[1,2] Traditional education models offer in-person, instructor-led lessons, and clinical rotations with bedside teaching that allows medical students to have direct patient contact.[3] When traditional education was halted during the COVID-19 pandemic due to the closure of educational institutions, a majority of medical schools withdrew their students from hospitals.[4] Concomitantly, uncertainty and concern about education and preparation of medical students emerged.[5] Medical schools responded to these challenges by rapidly implementing online curricula.[6] However, substituting the in-person training experience with online alternatives was an unprecedented challenge for many medical schools.[7]

*From the *Department of Plastic, Reconstructive and Aesthetic Surgery, Koc University Hospital, Istanbul, Turkey; †Section of Plastic Surgery, Department of Surgery, University of Michigan, Ann Arbor, Mich.; and ‡Department of Surgery, University of Michigan, Ann Arbor, Mich.*

Received for publication April 1, 2024; accepted April 17, 2024.

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Copyright © 2024 The Authors. Published by Wolters Kluwer Health, Inc. on behalf of The American Society of Plastic Surgeons. This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

DOI: 10.1097/GOX.0000000000005910

Disclosure statements are at the end of this article, following the correspondence information.

Related Digital Media are available in the full-text version of the article on www.PRSGlobalOpen.com.

Downloaded from http://journals.lww.com/prsgo by BhDMf5ePHKav1zEoum1tQfN4a+kJLhEZgbsIHo4XMi0hCywCX1AWnYQp/IlQrHD3i3D0OdRyi7TvSFl4Cf3VC1y0abggQZXdgGj2MwlZLeI= on 12/27/2024

Downloaded from http://journals.lww.com/prsgo by BhDMf5ePHKav1zEoum1tQfN4a+kJLhEZgbsIHo4XMi0hCywCX1AWnYQp/IlQrHD3i3D0OdRyi7TvSFl4Cf3VC1y0abggQZXdgGj2MwlZLeI= on 12/27/2024

Online education has historically been viewed as an alternative pathway, one that is particularly implemented to enhance independent learning and improve access to educational materials.[1,2,8] Norman[9] suggested that a substantial portion of the clinical curricula should transition to simulation-based learning, recognizing an increasing gap between the suitability of clinical settings for learning and the real environment medical students are exposed to. Over the last decade, there have been attempts to integrate online learning strategies to both preclinical and clinical medical education.[10] A number of theoretical frameworks have evolved that enhance active learning environments and encourage collaborative knowledge building, including the Community of Inquiry and Online Collaborative Learning theory.[11] Bosch[12] designed the Blending with Pedagogical Purpose model, suggesting that blending the objectives, activities, and approaches of multiple learning theories might be the most effective for students.[11] Through combining face-to-face and online education, blended learning evolves into the dominant form of instruction across all levels of education.[11]

Despite the progressive transformation in medical education, emergence of the COVID-19 pandemic, and the scale of the crisis, was unprecedented.[1] Because these epochal changes may thoroughly alter how future physicians are educated, a better understanding of reactive and current state of medical education will help us with planning more intentionally going forward. As the lingering effects of the pandemic abates, the world is faced with a dilemma regarding setting up the ideal medical education system where both in-person and online learning methods can be integrated effectively. Because the COVID-19 crisis has affected medical education globally, learning from others' experiences is crucial to accomplish this changeover.

This study aims to review changes to medical education curricula and describe the advantages and disadvantages of online medical education experienced by medical students during the COVID-19 pandemic. Evaluating the feasibility and effectiveness of online education in terms of curriculum, study methods, approaches to clinical skills self-evaluations, and perceptions of the quality of education will provide lasting information concerning the future of medical education.

Takeaways

Question: What are some common global reprecussions of the virtual shift in medical education curricula on student experiences?

Findings: An online survey study was conducted at two medical schools in the United States and Turkey. We evaluated the feasibility and effectiveness of online education in terms of curriculum, study methods, surgical skills self-evaluations, and perceptions of the quality of education. Although transition to online medical education resulted in substantial changes in the curricula, students' self-assessment of surgical skills did not differ.

Meaning: Despite the variations in medical education system, it is possible to implement high-quality, global virtual learning plans as an integral part of future medical education.

METHODS

Study Design

A cross-sectional online survey study was conducted at two medical schools: University of Michigan Medical School (UMMS) in the United States and Koc University School of Medicine (KUSOM) in Turkey. Two medical schools with different education curricula, healthcare systems, and infrastructure were selected to better reflect the global impact of the COVID-19 pandemic on medical students' experiences. Schools were selected as representatives of 4- and 6-year medical degree programs, respectively. An average of 165 and 40 students are accepted to UMMS and KUSOM ever year. Students enrolled in medical school during the 2020–2021 academic year and students who graduated in 2020, during the first year of the COVID-19 pandemic, were eligible to participate in the study. Students who graduated during the pandemic in 2020 were in their first year of residency at the time of the study. The study only pertained to their experience during medical school because students during this time were at different residency programs across the country, and each person's experience was vastly different based on their geographic location and specialty.

There were some key differences in the curricula at each medical school. UMMS curriculum features one preclinical year followed by one clinical year that includes seven core clerkships. The final 2 years of medical education include a wide variety of electives to refine clinical skills and explore subspecialties. KUSOM offers a 6-year undergraduate medical training, composed of a core program in the first year where students take required and elective courses in various subjects, two preclinical years, two clinical years that include core clerkships and electives, and a final year of internship.

A self-administered survey was developed following instructions of the International Association for Health Professions Education guide no. 87.[13] A literature review was conducted to clearly define the problem and identify related literature and surveys. After preliminary interviews with medical students from both institutions, survey components were drafted and tailored to the prospective respondents' conceptualization of the current problem. An online survey consisting of 32 items was developed with content validated by medical professionals. (**See survey, Supplemental Digital Content 1**, which displays the list of survey questions used in the study. **http://links.lww.com/PRSGO/D301**.) Survey components included identifying content from educational curriculum, self-assessment of clinical skills, engagement with online learning, and demographic characteristics. The survey items focused on the objectives, resources, teaching strategies, and practices of the educational curriculum.

Downloaded from http://journals.lww.com/prsgo by BhDMf5ePHKav1zEoum1tQfN4a+kJLhEZgbsIHo4XMi0hCywCX1AWnYQp/IlQrHD3i3D0OdRyi7TvSFl4Cf3VC1y0abggQZXdgGj2MwlZLeI= on 12/27/2024

Table 1. Characteristics of the Survey Respondents

	Koc University (N = 81)			University of Michigan (N = 103)			Total (N = 184)	
	n	%	M	n	%	M	n	%
Age			22.2			27.2		
Sex								
Male	39	48		41	40		80	43
Female	39	48		60	58		99	54
Nonbinary	3	4		1	1		4	2
Prefer not to say	0	0		1	1		1	1
Graduation year								
2020	3	4		11	11		14	8
2021	6	7		12	12		18	10
2022	15	19		24	23		39	21
2023	4	5		27	26		31	17
2024	17	21		26	25		43	23
2025	13	16		0	0		13	7
2026	19	23		1	1		20	11
2027	4	5		2	2		6	3

Table 2. Preferred Study Methods before and during the Pandemic

	Pre-COVID-19 (N = 153)		COVID-19 (N = 184)		*P*
	n	%	n	%	
Printed books	82	54	62	34	<0.001*
Electronic books, scientific papers	56	37	80	43	0.200
Online webinars	54	35	80	43	0.126
Virtual didactical tools (ie, online multimedia resources, simulations)	43	2	77	42	0.009*
Online learning platforms (ie, Amboss, Osmosis, Lecturio)	107	70	139	76	0.248
Real patient encounters	67	44	62	34	0.058
Others	10	66	13	7	0.848

*Statistically significant ($P < 0.05$).

Data Collection

The survey was administered online through Qualtrics (Provo, Utah) and advertised as an open-link survey to medical students between August 2021 and February 2022. Participants were recruited via a convenience sampling method through social media platforms (WhatsApp and GroupMe), and universities' listservs. Participation was voluntary and no incentives were provided. Participants were required to complete an online consent before entering the survey. Participants were informed before starting the survey that all data collected was anonymous and would only be used for research purposes.

All procedures performed in studies involving human participants were in accordance with the ethical standards of University of Michigan institutional review board (HUM00202336) and Koc University Institutional Ethic Research Board (2021.274.IRB3.121) and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Statistical Analysis

Data analysis was performed using SPSS V29. Demographic variables of the study were calculated as frequencies, mean, and absolute values. Independent *t* test, one-way analysis of variance (ANOVA), and chi-square analysis were used to understand changes in participants' preferences during the COVID-19 pandemic. A *P* value of less than 0.05 was considered statistically significant.

RESULTS

A total of 184 medical students (81 from Koc University and 103 from University of Michigan) completed the survey, with a response rate of 21%. Demographic data of the sample are shown in Table 1. At KUSOM, there was an equal distribution of male and female respondents (48% and 48%), whereas at UMMS, the greatest number of respondents were female (58%). Mean age of respondents at KUSOM was 22.23 and at UMMS was 27.28.

Use of Study Methods

Students used a diverse range of study methods during their preclinical year, including printed books, electronic books, and online learning platforms (Table 2). During the pandemic, there was a significant decrease in the use of printed books, from 54% to 34% ($P < 0.001$). We also found an increase in the use of electronic books, webinars, and online learning platforms, although these increases were not statistically significant. There was a significant increase in the use of virtual didactical tools from 28% before the pandemic to 42% during the pandemic ($P = 0.009$). We did not observe any significant difference between medical schools in the use of study methods ($P > 0.05$).

Class Attendance

Percentage of class attendance is shown in Table 3. Before the pandemic, only 32% of the students were

Table 3. Class Attendance and Practice Hours before and during the Pandemic

	Pre-COVID-19 (N = 123)		COVID-19 (N = 61)		*P*
Preclinical year attendance	n (%)	Mean ± SEM	n (%)	Mean ± SEM	0.0089*
Always (1)	40 (32)	2.08 ± 0.09	19 (32)	2.58 ± 0.17	
Sometimes (2)	44 (36)		10 (17)		
Rarely (3)	28 (23)		8 (13)		
Never (4)	11 (9)		23 (38)		
Cadaver dissection					<0.0001*
In person	121 (98)		42 (69)		
Virtual	2 (2)		19 (31)		

Preclinical year attendance was rated on a 4-point scale (1 = Always; 2 = Sometimes; 3 = Rarely; 4 = Never). Significance of difference in mean scores was calculated using Welch's *t* test. Differences in frequencies were calculated using the chi-square test.
One participant in the COVID-19 cohort was excluded from preclinical year attendance score analysis due to missing data.
*Statistically significant ($P < 0.05$).
SEM, standard error of mean.

Table 4. Differences in the Core Surgical Clerkship Curriculum during the COVID-19 Pandemic

	Before March 2020 (N = 41), n (%)	March 2020–2021 (N = 47), n (%)	After March 2021 (N = 27), n (%)	*P*
Theoretical classes/lectures				<0.001*
Mostly in person	41 (100)	5 (11)	4 (15)	
Mostly virtual	0 (0)	42 (89)	23 (85)	
Practical/patient care				0.004*
Mostly in person	41 (100)	38 (81)	26 (96)	
Mostly virtual	0 (0)	9 (19)	1 (4)	

Differences in frequencies were calculated using the chi-square test.
*Statistically significant ($P < 0.05$).

attending the majority of classes, with a mean attendance score of 2.08. The mean score significantly increased to 2.58 during the pandemic, showing that fewer students regularly attended in-person or synchronous lectures ($P = 0.009$). When attendance scores were analyzed for each school separately, UMMS medical students' mean attendance score significantly increased from 2.27 to 3.71 ($P < 0.0001$). However, no significant change was observed in KUSOM students' mean attendance scores ($P = 0.78$). The percentage of students attending in-person cadaver training significantly decreased from 98% to 69% during the pandemic ($P < 0.0001$).

Online Learning and Surgical Education

During the study period, the majority of the theoretical lectures during surgical clerkship transitioned to virtual learning. Additionally, we found that 81% and 96% of the students continued to perform in-person patient care during the first and second years of the pandemic, respectively (Table 4). Students' self-assessment of clinical skills after completion of surgical clerkship is shown in Table 5. We found no statistical difference across all categories. A significant association was noted between the interest in a surgical career and the time period of the core surgical clerkship. The percentage of students who were interested in surgery increased from 34% to 36% and 63% after the first and second years of the pandemic ($P = 0.04$). Eighty-three percent of medical students reported that online education did not influence their interest in surgery. Due to the relatively small sample size in the study groups (before March 2020, March 2020–2021, and after March 2021), we performed contingency analysis using chi-square test by combining the latter two groups and evaluated any difference between the pre-COVID-19 and COVID-19 groups. We did not find any changes in statistical significance in any of the categories.

Overall Perceptions of Online Learning

Students' perceptions of online learning are shown in Table 6. KUSOM students reported significantly higher levels of worry due to the dramatic shift in the curricula than UMMS students ($P < 0.001$). Similarly, 85% of KUSOM students suggested integration of emotional support to online curricula, whereas the demand was significantly lower at UMMS (59%, $P < 0.001$). In both cohorts, the majority (83%) could find more study and research time during online education. Regarding the efficacy of online education compared with traditional in-person education, 24% responded that online education is more effective, 24% responded that online education is equal to in-person education, and 52% responded that in-person education is more effective. When asked whether they have a strong preference for an entirely online medical education, or an entirely in-person medical curriculum, or a blended approach, 75% of KUSOM and 94% of UMMS students indicated preference for a blended format ($P < 0.001$).

DISCUSSION

This study aimed to provide insights into the digital transformation of medical education curricula and the consequent advantages and disadvantages of online medical education experienced by students during the COVID-19 pandemic. A multi-institutional approach was

Downloaded from http://journals.lww.com/prsgo by BhDMf5ePHKav1zEoum1tQfN4a+kJLhEZgbsIHo4XMi0hCywCX1AWnYQp/IlQrHD3i3D0OdRyi7TvSFl4Cf3VC1y0abggQZXdgGj2MwlZLeI= on 12/27/2024

Table 5. Self-assessment of Clinical Skills after Core Surgical Clerkship Training

	Before March 2020 (N = 41), n (%)	March 2020–2021 (N = 47), n (%)	After March 2021 (N = 27), n (%)	
Interviewing and communication				0.468
Poor (0–1)	1 (2)	4 (8)	0 (0)	
Average (2)	6 (15)	6 (13)	4 (15)	
Good (3–4)	34 (83)	37 (79)	23 (85)	
Physical examination				0.568
Poor (0–1)	0 (0)	2 (4)	1 (4)	
Average (2)	9 (22)	13 (28)	5 (18)	
Good (3–4)	32 (78)	32 (68)	21 (78)	
Humanistic qualities				0.726
Poor (0–1)	3 (7)	3 (6)	0 (0)	
Average (2)	3 (7)	4 (9)	2 (7)	
Good (3–4)	35 (86)	40 (85)	25 (93)	
Clinical judgment, making diagnosis				0.194
Poor (0–1)	3 (7)	1 (2)	0 (0)	
Average (2)	3 (7)	10 (21)	4 (15)	
Good (3–4)	35 (86)	36 (77)	23 (85)	
Planning treatment				0.621
Poor (0–1)	2 (5)	2 (4)	0 (0)	
Average (2)	20 (49)	20 (43)	10 (37)	
Good (3–4)	19 (46)	25 (53)	17 (63)	
Managing complications				0.828
Poor (0–1)	3 (7)	4 (9)	1 (4)	
Average (2)	20 (49)	26 (55)	13 (48)	
Good (3–4)	18 (44)	17 (36)	13 (48)	
Organization and efficiency				0.659
Poor (0–1)	2 (5)	1 (2)	0 (0)	
Average (2)	11 (27)	11 (23)	5 (19)	
Good (3–4)	28 (68)	35 (75)	22 (81)	
Writing medical records				0.692
Poor (0–1)	2 (5)	4 (8)	2 (7)	
Average (2)	11 (27)	7 (15)	5 (19)	
Good (3–4)	28 (68)	36 (77)	20 (74)	
Confidence in seeing surgical patient independently				0.186
Poor (0–1)	9 (22)	3 (6)	2 (7)	
Average (2)	14 (34)	23 (49)	11 (41)	
Good (3–4)	18 (44)	21 (45)	13 (48)	
Technical skills				0.656
Poor (0–1)	4 (10)	7 (15)	3 (11)	
Average (2)	17 (41)	24 (51)	12 (44)	
Good (3–4)	19 (46)	16 (34)	12 (44)	
Overall clinical competency				0.333
Poor (0–1)	1 (2)	2 (4)	0 (0)	
Average (2)	12 (29)	11 (24)	3 (11)	
Good (3–4)	28 (69)	34 (72)	24 (99)	

Significance was calculated using the chi-square test. A *P* value of less than 0.05 was accepted as statistically significant.

used to better represent the global transition in multiple components of medical education. Although it is well known that major changes in curricula have occurred after the pandemic, a clear conceptualization is essential for developing theoretical frameworks for online medical education and blended learning experience. Conducting this study within two disparate systems could be a significant contribution to conceptualization of these future frameworks.

Transition to online medical education resulted in substantial changes in preferred study materials, including a significant decrease in the use of printed books from 54% to 34% ($P < 0.001$) and an increase in the use of virtual didactical tools from 28% to 42% ($P = 0.009$). Class attendance, whether in-person or synchronous, did not show any significant change. Theoretical lectures in the core surgical clerkship curriculum switched from 100% in-person to 85% virtual ($P < 0.001$). Following completion of the surgical clerkship before or during the pandemic, students' self-assessment of clinical skills showed no statistical difference. Overall, 86% of the students indicated preference for a blended format for future medical education curricula.

Preclinical years play a significant role in providing a foundation for the knowledge needed to train future

Downloaded from http://journals.lww.com/prsgo by BhDMf5ePHKav1zEoum1tQfN4a+kJLhEZgbsIHo4XMi0hCywCX1AWnYQp/IlQrHD3i3D0OdRyi7TvSFl4Cf3VC1y0abggQZXdgGj2MwlZLeI= on 12/27/2024

Table 6. Overall Perception of Online Learning versus Traditional In-person Learning

	KUSOM (N = 81)	UMMS (N = 103)	Total (N = 184)	
	n (%)	n (%)	n (%)	*P*
I feel worried that I have not experienced traditional system-oriented clerkships during the pandemic				<0.001*
Yes	42 (52)	26 (25)	68 (37)	
No	39 (48)	77 (75)	116 (63)	
Pedagogical methods are just as educational as physically interacting with patients				<0.001*
Yes	27 (33)	10 (10)	37 (20)	
No	54 (67)	93 (90)	147 (80)	
The time available for self-study and research per day is more during online learning.				0.004*
Yes	60 (74)	93 (90)	153 (83)	
No	21 (26)	10 (10)	31 (17)	
Does online learning hinder your ability to interact with your peers and build camaraderie?				0.221
Not at all	11 (14)	14 (14)	25 (14)	
A little	32 (39)	53 (51)	85 (46)	
A lot	38 (47)	36 (35)	74 (40)	
Are you more likely to actively participate in class during in-person learning or online learning?				<0.001*
More likely during in-person learning	59 (723)	50 (49)	109 (59)	
More likely during online learning	14 (17)	21 (20)	35 (19)	
No difference	8 (10)	32 (31)	40 (22)	
Does online learning have an impact on communication between students and instructors?				0.01*
Positive impact	4 (5)	4 (4)	8 (5)	
No impact	5 (6)	23 (22)	28 (15)	
Negative impact	72 (89)	76 (74)	148 (80)	
Emotional support should be part of online education				<0.001*
Yes	69 (85)	61 (59)	130 (71)	
No	12 (15)	42 (41)	54 (29)	
How would you interpret the efficacy of online education compared with traditional education?				0.003*
More efficient than traditional education	20 (25)	25 (24)	45 (24)	
Equal to traditional education	10 (12)	34 (33)	44 (24)	
Less efficient than traditional education	51 (63)	44 (43)	95 (52)	
What would be your preference for future medical education curriculum?				<0.001*
Entirely E-learning	2 (2)	1 (1)	3 (2)	
Blended approach	61 (75)	97 (94)	158 (86)	
Traditional learning	18 (22)	5 (5)	23 (12)	

Differences in frequencies were calculated using chi-square and one-way ANOVA tests.
*Statistically significant ($P < 0.05$).

Downloaded from http://journals.lww.com/prsgo by BhDMf5ePHKav1zEoum1tQfN4a+kJLhEZgbsIHo4XMi0hCywCX1AWnYQp/IlQrHD3i3D0OdRyi7TvSFl4Cf3VC1y0abggQZXdgGj2MwlZLeI= on 12/27/2024

physicians.[8] Adaptation to the "new normal" during the COVID-19 pandemic has brought challenges for both educators and students.[14] Many preclinical year students had to lay the foundations of their medical education without touching a cadaver, having clinical experience, or even without enjoying the university campus and meeting their colleagues in-person. Despite these challenges, educators were provided a tremendous opportunity to use technology to improve learning resources, enhance student motivation, and develop networking activities.[14] Integration of technology provided more effective and appealing experience to students, including access to educational materials at their own convenience and pace.[15] Furthermore, the flexibility of online learning helped students to be more academically productive, as 83% of the students reported in our survey that the time available for self-study and research per day was more during online learning.

Trends in preclinical education also shifted away from traditional lecture-based classroom teaching to more engaging small group sessions and problem-based learning.[8] Although COVID-19 kept students away from a classroom environment and raised concerns regarding the quality of the online education, our data showed that even before the pandemic, less than a third of the students were attending the majority of classes. Convenient utilization of virtual education prevented a dramatic decrease in class attendance during the pandemic. In addition, the pandemic caused a concerning decline in in-person cadaver training and other hands-on laboratory practices.[14] According to our data, the percentage of students attending in-person cadaver training decreased from 98% to 69% during the pandemic. However, studies have shown that virtual teaching resources were well accepted by most of the students and did not impact their academic performance.[14] In fact, virtual didactical tools (eg, virtual microscopy) are more convenient alternatives to enhance active student participation and test performance.[14]

During the COVID-19 pandemic, there was concern for clinical competencies of medical students as a result of reduced direct patient care activities.[16,17] The concern was especially for surgical education because engagement with patients, operative experience, and walking in the footsteps of senior medical staff are among the key elements of surgical training. Widely implemented social distancing measures, limited personal protective equipment, and reduced number of elective procedures set

Downloaded from http://journals.lww.com/prsgo by BhDMf5ePHKav1zEoum1tQfN4a+kJLhEZgbsIHo4XMi0hCywCX1AWnYQp/IlQrHD3i3D0OdRyi7TvSFl4Cf3VC1y0abggQZXdgGj2MwlZLeI= on 12/27/2024

significant barriers to in-person clinical exposure.[18] We observed a general trend of a slight decrease in the self-assessment scores of clinical skills during the first year of the pandemic. Surprisingly, skills that require an in-person encounter like communication and humanistic qualities were not significantly affected despite the strict measures of social distancing. Institutions rapidly adopted strategies to preserve the quality of the education. Building upon the experience with the use of technology in the preclinical years, surgery clerkship curriculum was revised, and a virtual curriculum was integrated into the in-person training program. Flipped classroom lectures, virtual skills labs, and surgical videos to simulate operating room experience contributed to the depth of learning, helped with time management, and increased confidence levels.[19,20] Subsequently, the trend in our results was followed by an increase in the self-assessment scores.

A final point to consider is the impact that online education will have on students' interest in pursuing a career in a surgical field. Clinical clerkships offer students a range of experiences, inspiration, and help with deciding their future career trajectories.[21,22] Given the limited opportunities to engage with faculty and patients during the pandemic, medical students may not be as confident in their decision to pursue a 5- to 7-year surgical residency.[21–23] Our results were reassuring because the percentage of students interested in pursuing a career in surgery has nearly doubled from 34% to 63% during the pandemic. In addition, the majority of the students reported that online education did not impact their future career plans. Therefore, substantial transformations and disruptions in curricula were not significant factors influencing medical students' decision to pursue a surgical career.

Our survey results demonstrated that online learning can be an adjunct to, but not a substitute for, in-person interaction. First, 80% of students felt that online learning methods are not as educational as physically interacting with patients. Regarding communication between students and instructors, 80% believe that online learning had a negative impact on their communication with the instructor and 59% reported that they are more likely to participate in class during in-person learning. To address these barriers, Schumm et al[20] suggested one-on-one regular meetings with an assigned faculty mentor through teleconferencing. Receiving formative feedback and career guidance could greatly enhance student-faculty communication, increase confidence, and positively impact mental health.[20] According to our data, 71% of the students reported that emotional support should be a part of medical education. Because students faced various stressors during the pandemic, they became more vulnerable to mental health problems.[24,25] Thus, efforts should be made to support the wellness of medical students.[24,25] Finally, our study showed that students have a strong preference of a blended approach. Despite some drawbacks associated with online learning, most students would still prefer that online learning be a part of the curriculum.

Our study had several limitations. First, as a cross-sectional design, this study could only evaluate the students' medical education perspective at the time of the survey. Although we collected data from students who graduated from medical school during the pandemic in 2020, we only asked questions pertaining to their medical education experience. Second, this study was based on the self-reported evaluation of students to assess the confidence, readiness, and skill levels, which may have led to a response bias and recall bias. Additionally, we were not able to accurately use objective metrics, such as standardized examination scores, to assess the impact on online education because the timing of the pandemic coincided with the transition of United States Medical Licensing Exam step 1 being scored numerically to being scored pass/fail. Furthermore, students took standardize examinations at various points in their education, some before, some during, and some after core clerkships. Third, medical students' preference on study methods, class attendance, and surgical career preference may result from many factors, and we explored only COVID-19 as an intermediary factor. Finally, the study was only conducted at two medical schools in two countries that have vastly different medical education systems. As a result, we only had a small sample size of some of the survey groups. Future studies involving more medical schools is warranted to increase the sample size and better represent medical education at the global level.

CONCLUSIONS

To design the ideal curriculum for future medical students, learning from our experiences and transforming educational models is crucial. Our findings showed that it is possible to implement high-quality online learning plans as an integral part of medical education. Institutions can provide in-person cadaver training, laboratory experiences, and networking opportunities blended into the online preclinical curriculum to enhance the educational activities and early hands-on exposure, and build camaraderie. Benefiting from technology and digitalization of education, a novel surgical clerkship can be implemented effectively. Institutions should work together to address the barriers to widespread and effective implementation of such an approach.

Paul S. Cederna, MD
Section of Plastic Surgery
The University of Michigan Health System
1500 E. Medical Center Drive
2130 Taubman Center
Ann Arbor, MI 48109-5340
E-mail: cederna@med.umich.edu

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

ACKNOWLEDGMENT

The authors thank medical students participating in this study.

ETHICAL APPROVAL

All procedures performed in studies involving human participants were in accordance with the ethical standards of University

of Michigan institutional review board (HUM00202336) and Koc University Institutional Ethic Research Board (2021.274. IRB3.121) and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. All participants provided full informed consent to participate in this study.

REFERENCES

1. Lockee BB. Online education in the post-COVID era. *Nat Electron.* 2021;4:5–6.
2. Kaplan T, Tarolli C, Doughty CT. Integrating virtual teaching in a new era of medical education: lessons from a neurology course. *Adv Med Educ Pract.* 2023;14:1147–1156.
3. Franklin G, Martin C, Ruszaj M, et al. How the COVID-19 pandemic impacted medical education during the last year of medical school: a class survey. *Life (Basel).* 2021;11:294.
4. Kaul V, Gallo de Moraes A, Khateeb D, et al. Medical education during the COVID-19 pandemic. *Chest.* 2021;159:1949–1960.
5. Al Samaraee A. The impact of the COVID-19 pandemic on medical education. *Br J Hosp Med (Lond).* 2020;81:1–4.
6. Motte-Signoret E, Labbé A, Benoist G, et al. Perception of medical education by learners and teachers during the COVID-19 pandemic: a cross-sectional survey of online teaching. *Med Educ Online.* 2021;26:1919042.
7. Hilburg R, Patel N, Ambruso S, et al. Medical education during the coronavirus disease-2019 pandemic: learning from a distance. *Adv Chronic Kidney Dis.* 2020;27:412–417.
8. Gaur U, Majumder MAA, Sa B, et al. Challenges and opportunities of preclinical medical education: COVID-19 crisis and beyond. *SN Compr Clin Med.* 2020;2:1992–1997.
9. Norman G. Medical education: past, present and future. *Perspect Med Educ.* 2012;1:6–14.
10. Guze PA. Using technology to meet the challenges of medical education. *Trans Am Clin Climatol Assoc.* 2015;126:260–270.
11. Picciano AG. Theories and frameworks for online education: Seeking an integrated model. *Online Learn.* 2017;21:166–190.
12. Bosch, C. Promoting Self-directed Learning through the Implementation of Cooperative Learning in a Higher Education Blended Learning Environment *[dissertation].* Johannesburg, South Africa: North-West University; 2017.
13. Artino AR, Jr, La Rochelle JS, Dezee KJ, et al. Developing questionnaires for educational research: AMEE guide no. 87. Med Teach. 2014;36:463–474.
14. Nikas IP, Lamnisos D, Meletiou-Mavrotheris M, et al. Shift to emergency remote preclinical medical education amidst the Covid-19 pandemic: a single-institution study. *Anat Sci Educ.* 2022;15:27–41.
15. Walters M, Alonge T, Zeller M. Impact of COVID-19 on medical education: perspectives from students. *Acad Med.* 2022;97:S40–S48.
16. Dost S, Hossain A, Shehab M, et al. 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.
17. Hall L, Binks S, Heal C. The effect of COVID-19 on medical student clinical skill practice and self-perceived proficiency. *MedEdPublish (2016).* 2023;13:10.
18. Gareev I, Gallyametdinov A, Beylerli O, et al. The opportunities and challenges of telemedicine during COVID-19 pandemic. *Front Biosci (Elite Ed).* 2021;13:291–298.
19. Zern NK, Yale LA, Whipple ME, et al. The impact of the COVID-19 pandemic on medical student education: Implementation and outcome of a virtual general surgery curriculum. *Am J Surg.* 2022;224(1 Pt B):612–616.
20. Schumm MA, Dacey MJ, Moore AM, et al. A hybrid remote surgery clerkship curriculum during the COVID-19 pandemic: lessons learned and future perspectives. *Am J Surg.* 2022;223:1017–1018.
21. De SK, Henke PK, Ailawadi G, et al. Attending, house officer, and medical student perceptions about teaching in the third-year medical school general surgery clerkship. *J Am Coll Surg.* 2004;199:932–942.
22. Musunuru S, Lewis B, Rikkers LF, et al. Effective surgical residents strongly influence medical students to pursue surgical careers. *J Am Coll Surg.* 2007;204:164–167.
23. Sell NM, Qadan M, Delman KA, et al. Implications of COVID-19 on the general surgery match. *Ann Surg.* 2020;272:e155–e156.
24. Chandratre S. Medical students and COVID-19: challenges and supportive strategies. *J Med Educ Curric Dev.* 2020;7:238212052093505.
25. Peng P, Hao Y, Liu Y, et al. The prevalence and risk factors of mental problems in medical students during COVID-19 pandemic: a systematic review and meta-analysis. *J Affect Disord.* 2023;321:167–181.

Downloaded from http://journals.lww.com/prsgo by BhDMf5ePHKav1zEoum1tQfN4a+kJLhEZgbsIHo4XMi0hCywCX1AWnYQp/IlQrHD3i3D0OdRyi7TvSFl4Cf3VC1y0abggQZXdgGj2MwlZLeI= on 12/27/2024