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Experience with forced transition to online learning during the COVID-19 pandemic: Students' cognitive performance and their perceptions of teaching

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Abstract

Introduction: The forced transition to online learning due to the COVID-19 pandemic has impacted medical education significantly.

Methods: In this paper, the authors compare the performance of Year 1 and 2 classes of medical students who took the same courses either online (2019-2020) or face-to-face (2018-2019), and compare their evaluation of these courses. The authors also present results of three survey questions delivered to current Year 1 medical students on the perceived advantages and disadvantages of online learning and suggestions for improvement.

Results: Performance and evaluation scores of Year 1 and 2 classes was similar irrespective of the mode of delivery of the course in question. 30 current (2019-2020) Year 1 students responded to the survey questions with a response rate of 25.4%. Some of the cited disadvantages had to do with technical, infrastructural and faculty know-how and support. But the more challenging limitations had to do with the process of learning and what facilitates it, the students' ability to self-regulate and to motivate themselves, the negative impact of isolation, loss of socialisation and interaction with peers and faculty, and the almost total lack of hands-on experiences.

Conclusion: Rapid transition to online learning did not affect student knowledge acquisition negatively. As such, the sudden shift to online education might not be a totally negative development and can be harnessed to drive a more progressive medical education agenda. These results are particularly important considering the several disadvantages that the students cited in relation to the online delivery of the courses.

Keywords: *Online Learning, COVID-19 Pandemic, Medical Students*

Practice Highlights
- The authors report on the forced transition to online learning due to the COVID-19 pandemic.
- The performance and evaluation scores were similar in online delivery vs face-to face.
- The sudden shift to online education might not be a totally negative development despite the several disadvantages that students cited.

I. INTRODUCTION

The COVID-19 pandemic has impacted medical education significantly. Students were sent home and many schools were forced to shift their teaching, almost overnight, from face-to-face encounters to virtual, online delivery, in many cases without having had substantial previous experience with this mode of delivery. This disruption spanned the clinical and preclinical years. In previous events, researchers prioritised the synthesis of available evidence in terms of training medical students to respond and mitigate the effects of different types of disasters (Ashcroft et al., 2020). While there was more

attention to find solutions for medical education in difficult settings (McKimm et al., 2019), including few examples that came to light after the outbreaks of H1N1 and H5N1 influenza, the severe acute respiratory syndrome (SARS) (Patil et al., 2003), and most recently, Ebola (Woodward & McLernon-Billows, 2018), there is paucity of literature that could inform adaptations of medical education methods during or post disasters, conflicts, or outbreaks. Recent articles have reflected on these changes and challenges and have suggested means of responding to the new reality, and offered advice on adopting new tools to ensure the best possible delivery of the curriculum (Daniel, 2020; Fawn et al., 2020; Liang et al., 2020; Ross, 2020; Sandars et al., 2020).

A recent meta-analysis that compared offline and online undergraduate medical education (under normal circumstances) revealed either no difference in outcomes on knowledge tests or a slightly higher performance for those who received online learning (Pei & Wu, 2019). In addition, a review of the literature showed that the adoption of E-Learning, in comparison with mostly traditional and other means of learning, expands access to education and increases the pool of faculty, in low resource settings (Frehywot et al., 2013). These data suggest that for preclinical education, there might not be a major negative impact of moving to online learning. It should be noted, however, that the situation brought about by the COVID-19 pandemic, which necessitated an abrupt transition to online education, may not be identical to that in which online delivery was a, planned and well-designed method to deliver at least part of the curriculum of the medical school; thus, the outcomes in knowledge acquisition during the recent COVID-19-forced transition to online teaching cannot be confidently predicted (Lim et al., 2009).

The American University of Beirut Faculty of Medicine (AUBFM), which follows the American model of medical education, suspended all in-person physical classes and assessments for years 1 and 2 on March 12, 2020. Thus, faculty, students and staff had to shift to online learning practically immediately. In this paper, we report our experience with this forced transition to online learning, specifically addressing Year 1 and 2 students' perceptions of and response to it, and examining whether this transition affected their knowledge acquisition as reflected by their performance on written examinations.

II. METHODS

This is not a research study, as confirmed by our Institutional Review Board (IRB), since our purpose was to describe our experience with the delivery of the medical school curriculum after the sudden shift to online education, and whether that affected the students' performance on their examinations and their evaluation of the courses. This was neither a planned intervention nor a systematic approach to test a specific hypothesis.

A. Setting

We analysed data from Year 1 and 2 classes of medical students who took the same courses either online (2019-2020) or face-to-face (2018-2019). We examined student performance in two courses, one for first year medical students (115 Class of 2022 students as face-to-face in 2018-2019 *versus* 118 Class of 2023 students as online in 2019-2020) entitled The Blood, and the other for second year medical students (114 Class of 2021 students as face-to-face in 2018-2019 *versus* 115 Class of 2022 students as online in 2019-2020) entitled Human Development and Psychopathology. Both courses are integrated modules that cover the histology, pathology, physiology, biochemistry, pathophysiology, pharmacology of the blood and lymphatic system and of neuropsychiatry, as well as the clinical, social, ethical, and behavioural aspects of related disorders.

Both courses extend over four weeks and end with a final summative examination. The main teaching activities consist of lectures and team-based learning (TBL) sessions, along with other small or large group discussions sessions dealing with epidemiology, evidence-based medicine, medical ethics, and social determinants of health relevant to the medical topics being covered.

The transition to online learning with the current medical students (2019-2020) was as follows: The didactic lectures were delivered either as asynchronous Voice-Over-PowerPoint (VOP) recordings or synchronous live lectures using Webex, which were recorded live. These recordings were made available to students on Moodle, the learning management system used at AUBFM. Faculty chose which of the two modes best suited them. As for the TBLs and group discussion sessions, they were run live using either Webex or Zoom applications. The latter was particularly appropriate for TBL sessions as it allowed virtual breakout rooms for team discussions.

The Respondus lockdown browser, with camera recordings serving as a virtual proctor, was adopted for written assessments, which included the individual Readiness Assurance Tests (i-RAT) of the TBLs as well as the final examinations. All these assessments utilise single-best answer multiple choice questions. Previous to the transition to online learning in 2018-2019, all i-RATs and group-RATs (g-RATs) were paper-based with physical proctoring, while the final course examinations,

which used single best answer multiple choice questions, were computer-based, and were run on American University of Beirut (AUB) secure computers, also with physical proctoring.

Prior to COVID-19, final examinations were a hybrid of locally generated questions and National Board of Medical Examiners (NBME) customised examinations. During the COVID-19 pandemic, NBME examinations were not available and final examinations were totally locally generated. With regard to TBL's, during the online transition, no g-RATs were performed due to our inability to ensure their security; thus, automatic feedback, which was an integral part of the TBL process, was not possible, and was replaced by a brief review of the questions by the TBL preceptor.

In addition, and in order to reduce the potential for cheating and communication among students, we reduced the time allotted for final examinations from 1.2 minutes per question to 1 minute per question. Reducing the on-line time during examinations was also done in order to minimise connectivity problems that arise due to the poor internet infrastructure in Lebanon and due to the frequent cuts in electricity.

B. Students' Attitudes

At AUBFM, at the end of every course, students are expected to anonymously fill an online course evaluation form. This form includes twelve statements on various aspects of the course with which the students express a level of agreement (Sup. Table 1). Scores are assigned to their responses as follows: 1: Strongly disagree, 2: Disagree, 3: Neither agree nor disagree, 4: Agree, 5: Strongly agree. One of the items on that form (# 4) addresses the effectiveness of the teaching methods. An overall course rating is calculated as the average score for all 12 items. We compared the scores on both item #4 and the overall rating for the course given online (2019-2020) for both Year 1 and 2 medical students with the scores for the same course when delivered face-to-face (2018-2019).

Due to the lack of survey items that are specifically tailored to online teaching in the regular course evaluation forms, we asked the students to respond to 3 additional open-ended questions. This part was administered only to the current (2019-2010) first year medical students who had completed the Blood course and were the following:

1) In your opinion, what are the advantages of online teaching and learning over face-to-face teaching and learning?

2) In your opinion, what are the disadvantages of online teaching and learning over face-to-face teaching and learning?

3) Please provide suggestions for improvement of the online teaching and learning process.

C. Performance on the Final Examinations

Overall performance in the same courses was compared between the current classes (online) and the previous year's classes (face-to-face). Thus, for the current Year 1 class (Class of 2023) the comparator class was the current Year 2 class (Class of 2022), and for the latter the comparator class was the current Year 3 class (Class of 2021). We restricted the comparisons of final examination grades to performance of the various classes on the locally generated questions.

In order to ensure that any two classes being compared did not differ in terms of academic or cognitive abilities, we also compared the performance of the current and the previous year's classes according to: 1) their scores on the Medical College Admissions Test (MCAT) taken prior to admission to medical school; and 2) their overall grades in other courses that were given face-to-face during the current year (i.e. in the earlier part of the 2019-2020 academic year); these courses included one entitled Cellular and Molecular Basis of Medicine (CMM) given during year 1, and another entitled The Kidney and Urinary System given during year 2; these were the first courses to be delivered during the current year.

In comparing grades and scores on courses and examinations, we took into account the passing standards set for each. At AUBFM, we use criterion based absolute passing grades for every assessment. For written assessments such as final examinations using multiple choice questions, the Angoff method is utilised to set the passing grade. Similarly, the passing grade for a course is calculated based on the weighting of the individual assessment tools in that course. Thus, for any two courses or examinations that we compared, we first did the analysis using the raw grades, and then, when needed, we also compared the adjusted grades after equalising the passing grades.

D. Data Analysis

For the three survey questions, answers were downloaded on excel for systematic and iterative thematic analysis. Answers were manually coded by one of the authors. The compiled codes were then discussed, compared and consolidated into themes by two of the authors over 3 meetings. The focus was on main themes, commonalities and conflicting views of participants, and relationships between themes. Findings were tabulated

with relevant quotes. For the evaluation scores and performance on exam, data were available on excel and statistical comparisons were conducted using the Student's unpaired *t*-test.

III. RESULTS

A. Students' Attitudes

Twenty-six of the 118 current medicine one student filled the survey, and four more sent an email to the course coordinator, the response rate is hence 24.5%. Several themes emanated for each of the three questions especially concerning disadvantages of online learning; these are tabulated in Table 1 with representative quotes. The main advantages of online learning were the time flexibility with asynchronous learning coupled with better overall well-being as a result of staying at home. VOPs were valued because they allowed students to control their learning pace.

As for disadvantages, there were several. These included: the loss of motivation, the potential for procrastination, the problems arising from a bad internet connection leading to greater internet costs, inadequacy of the home environment for learning, less interaction with teachers and students, paucity of immediate feedback, loss of hands on experiences, and struggles because of the faculty's deficiencies in the area of information technology in general, and in online teaching, in particular.

The students made several suggestions to improve the process, and these included proposals for faculty development, and provision of better technical support and knowhow. In addition, they proposed to decrease or cancel synchronous lectures and provide all didactic lectures as VOPs, to be followed by synchronous online sessions for questions and feedback. They also proposed to imbed questions within the VOPs to stimulate students to think (akin to audience response polls used in live lectures), as well as forum discussions to increase interactions with peers and faculty. Students also insisted that they receive more detailed feedback on their performance on examinations and i-RAT questions.

Despite the many disadvantages cited and the clear room for improvement for online teaching and learning, the overall course ratings as well as the evaluation of teaching for the online courses were not different from their face-to-face counterparts (Tables 2 and 3).

Survey question	Theme	Quote
Advantages of online teaching and learning in comparison to face to face teaching and learning	Time flexibility with asynchronous learning	"Better scheduling that allows us to sleep and rest at night in order to wake up better prepared to ace those PowerPoints" (S9) "Easier to manage our time" (S18)
	Control of learning pace with VOP	"Being able to speed through slides/concepts we already understood and pausing and replaying concepts that we have trouble with makes the whole learning process a lot more efficient and focused" (S27)
	More wellbeing	"Less time to commute which allows more time to rest and take care of oneself" (S9) "Having a very healthy diet with my family in the village" (S12) "The [exam] performance is better and stress in minimal" (S23)
Disadvantages of online teaching and learning in comparison to face to face teaching and learning	Potential for procrastination and loss of motivation	"Less motivation, harder to follow the schedule, requires strong time management skills" (S5) "Face to face teaching helps me organize my day better" (S4) "Being at university with other students around studying during the day motivated me" (S26)
	Bad internet connection	"Internet connection in our country is not stable to hold a class or an exam, so we are resorting to 3g/4g. This leads to a lot of extra expense" (S3) "Time consuming" (S2) and "Sessions would run for more than their original allocated time" (S3) "Longer exams might coincide with the times of the electricity shut offs. This would automatically freeze Respondus and the student will have to restart their computer and so on. Although we are given extra time this adds a lot of stress to an already stressful situation" (S19) "Asking questions are much more difficult and needs much more time" (S7) "WebEx needed a stronger Wi-Fi in some sessions which leads to a harder way to grasp the information" (S18) "The internet connection everywhere in Lebanon is not the best, sometimes we have trouble listening. Sometimes it also gets really crowded when everyone wants to talk at the at the same" (S21)
	Home environment less conducive to learning	"Not everybody has the privilege of adjusting their environments to their liking, whether that be because of their dog barking or their family members not respecting their study time" (S28) "This experience helped my appreciate how much I concentrate better in the library" (S9)

	Loss of interaction with teachers	"No direct interaction, harder to communicate directly with professors" (S2)
		"Face to face interaction was lost: no clues to non-verbal clues, no gestures seen" (S17)
		"It is true that we can always email the doctors for any additional questions but that does not compare to in person interactions" (S19)
	Loss of interaction with students	"not being able to interact with my friends" (S12)
		"Students lose their social skills as they interact less with each other-more into introversion" (S17)
		"You feel there is a barrier between you and the students" (S17)
	Lack of immediate feedback	"One problem is during exams not being able to see my mistakes" (S15)
		"Not correcting our exam and not seeing our mistakes was a huge disadvantage for the online learning" (S18)
		"Restricting questions to only emails" (S11) and "some professors don't respond to emails" (S16) and "the response may be delayed" (S29)
	Loss of hands on experiences	"No hands-on experience for courses like clinical skills" (S3)
		"Mainly missing out on clinical skills" (S22)
	Faculty's lack of IT knowhow or experience	"Professors have different abilities and effectiveness in knowing how to do a VOP/online lecture" (S11)
		"Most Drs. don't know how to use zoom or WebEx" (S6)
		"Many instructors are not technically inclined or are outright aversive to it" (S13)
		"So much time is wasted on technical issues" (S19)
		"Professors sometimes don't see the raised hands and sometimes it doesn't even work. In some lectures we had to wait for the professor to give us access, so we spent time waiting while they didn't see that some people are trying to access the lecture" (S21)
		"One of the disadvantages is using the live WebEx sessions. Some professors are losing their recordings, others have a poor connection" (S23)
	Effect on faculty's teaching skills	"Some professors …just read instead of teaching" (S7)
		"Many professors are not exactly cooperative in terms of explaining mainly because they read their PowerPoints" (S23)
		"Can't explain a topic and be passionate about it if talking to a screen or microphone" (S23)
Suggestions to improve the current online teaching	Technical support and knowhow	"Train the staff on the proper way of utilising the platforms" (S2)
		"Make IT staff more readily available to help instructors" (S16)
		"Agree on one way to give the lecture via WebEx as some professors used WebEx team, where we had to ask permission for access, and it was kind of chaotic. It would also be better if the professor agreed on one way to have the questions asked to avoid interruptions and multiple people talking at the same time" (S21)
	More VOPs and less WebEx for lectures	"I think VOP is a much safer option and a less tiring one" (S23)
		"Revert from live WebEx sessions to VOP" (S3)
	More interaction and immediate feedback	"Open forums for discussion" (S3)
		"Adding analytical questions in PowerPoints" (S9)
		"See exams and mistakes" (S15)
		"If the professors want to use WebEx ... then they should allow questions at all times and not only at the end of the session" (S11)
		"Include small assessment questions (clicker like questions) at the end of each major concept so that the students can assess their understanding" (S19)
		"Recording voice over PowerPoint for lectures, with every group of lectures followed by a WebEx session where the professor answers questions" (S24)
		"Review/Q&A session once a week" (S25)

Table 1. Themes Generated from the Three Survey Questions with Selected Representative Quotes
VOP: Voice Over PowerPoint

Medicine class of	2022	2023	*P*-value
Academic Year 1	2018-2019	2019-2020	
Number of students	115	118	
	Baseline performance		
MCAT scores	509±6	510±6	0.119

Class average on the final exam of the CMM course	82.6±6.1	84.3±7.4	0.011
Passing grade for the final exam of the CMM course	64.1	64.7	
Adjusted grade for the final exam of the CMM course[a]	83.2±6.1	84.3±7.4	0.065
	Performance in The Blood course		
Course delivery	Face to Face	Online	
Number of questions on the final exam	50	77	
Class average on the final exam	83±9	81±9	0.043
Passing grade for the final exam	65	61	
Adjusted grade for the final exam[a]	83±9	85±9	0.091
	Student Evaluation of The Blood Course		
Rating of teaching methods	4.0±0.8	4.0±1.0	0.920
Overall course rating	4.0±0.7	4.1±0.8	0.754

Table 2. Comparison of Performance of Year 1 Students in Various Courses and Examinations and Their Evaluation of the Blood Course

Data are presented as Mean ± Standard Deviation

P-values were generated by Student's unpaired t-test

MCAT: Medical College Admissions Test; CMM: Cellular and Molecular Basis of Medicine

[a]adjusted after equalizing the passing grades on the examinations in the 2 different years

Medicine class of	2021	2022	*P*-value
Academic Year 2	2018-2019	2019-2020	
Number of students	114	115	
	Baseline performance		
MCAT scores	509±5	509±6	0.842
Class average on the final exam of the CMM course	83.8±6.4	82.6±6.1	0.156
Passing grade for the final exam of the CMM course	65.3	64.1	
Adjusted grade for the final exam of the CMM course[a]	82.6±6.4	82.6±6.1	0.455
Performance on the final exam of The Kidney course	78.1±7.9	78.7±7.2	0.558
Passing grade for the final exam of The Kidney course	62.2	62.3	
	Performance in the Human Development and Psychopathology course		
Course delivery	Face to Face	Online	
Number of questions on the final exam	45	75	
Class average on the final exam	83.7±7.4	83.5±6.8	0.892
Passing grade for the final exam	68.0	64.8	
Adjusted grade for the final exam[a]	83.7±7.4	86.7±6.8	0.002
	Student evaluation of the Human Development and Psychopathology course		
Rating of teaching methods	4.2±0.9	4.1±0.9	0.426
Overall course rating	4.3±0.7	4.1±0.8	0.251

Table 3. Comparison of Performance of Year 2 Students in Various Courses and Examinations and Their Evaluation of the Human Development and Psychopathology Course

Data are presented as Mean ± Standard Deviation

P-values were generated by Student's unpaired t-test

MCAT: Medical College Admissions Test; CMM: Cellular and Molecular Basis of Medicine

[a]adjusted after equalizing the passing grades on the examinations in the 2 different years

B. Performance of Students in the Courses and Examinations

As shown in Tables 2 and 3, there were no statistically significant differences in the MCAT scores between any two classes that were compared. The performance of the Year 1 students on the CMM course during the current academic year (online) was higher than that of students during the previous year (face-to-face); however, the passing grade for the two courses was slightly different. When the passing grades were equalised, there was no longer a difference between the two classes. Similarly, there was no difference in the performance of the Year 2

students on either the CMM course they took in Year 1, or on The Kidney and Urinary System course between the current class and the previous year's class (all face-to-face).

With regard to The Blood course, the grade on the final examination was significantly lower for current students (online) relative to their predecessors (face-to-face); however, the passing grades on these examinations were different, with the current year's examination having a lower passing grade than last year's. When the passing grades were equalised, there was no longer a difference in the performance on the final examination.

The performance of the students in the Human Development and Psychopathology course's final examination was almost identical in the online group compared with their predecessors (all face-to-face). Interestingly, the passing grade on this year's examination was lower than that on last year's examination, such that when the passing scores were equalized, the current class had better performance on the final examination than last year's class.

IV. DISCUSSION

Medical education scholars have been increasingly disseminating opinions about sudden transitioning to online education to COVID-19 and the adaptations that are being implemented. Few studies have documented the actual institutional experiences, the perspectives of students, and the lessons learned in different medical courses or curricula such as TBL (Gaber et al., 2020), anatomy (Srinivasan, 2020) and continuing medical education in obstetrics and gynaecology (Kanneganti et al., 2020). Only one report from Wuhan, China, evaluated nursing interns' outcomes on emergency medicine theoretical and practical examination scores (Zhou et al., 2020). The current paper is the first to examine the impact of this abrupt transition to online learning, which occurred in numerous countries worldwide, on the performance of our medical students in knowledge-based examinations. It reveals that the sudden shift to full online learning that our medical school had to adopt did not have a negative influence on the students' knowledge acquisition as judged by their performance on final examinations. It also did not affect their overall reception and evaluation of the courses. These results are particularly interesting and important considering the many disadvantages that the students cited in relation to the online delivery of the courses.

Many of the limitations and disadvantages of online education cited by students had to do with technical and infrastructural matters and with faculty know-how and

IT support. These are problems that can, theoretically, be easily remedied. The more challenging, however, limitations had to do with the process of learning, what facilitates or hampers it, the students' ability to self-regulate and to motivate themselves, the negative impact of isolation, loss of socialisation and interaction with peers and faculty, and the almost total lack of hands-on experiences.

These limitations did not affect the students' ability to achieve learning, at least in the domain of knowledge acquisition and application. It is clear that students in the three classes that were examined had, at baseline, a similar level of achievement meaning that any differences in student performance in the courses that were given online this year cannot be ascribed to differences in the academic performance or ability of the students. Therefore, the lack of difference in performance between classes taking the course online versus those taking it face-to-face suggests a consistency in performance that was not affected adversely by the sudden transition to online learning.

One reason for this lack of difference in performance between online and face-to-face delivery of the courses may be that the outcomes that were being sought and assessed were essentially knowledge acquisition and knowledge application. This agrees with the overall results of multiple studies that compared online vs offline learning in medical school, and which, in fact, tended to favour online learning (Pei & Wu, 2019). Indeed, even before our sudden shift to total online education, many of our students had adopted their own approaches to achieve the knowledge learning outcomes. Even though lectures were not available online, attendance at face-to-face lectures (which was not mandatory) was never complete, and for the majority of students, the rate of attendance ranged between 25% and 75% (unpublished data). In fact, the students indicated that they depended instead on notes and voice recordings made during the lecture that were shared by their classmates or predecessors, and that they used several Web-based resources. In contrast, attendance at TBL exercises and other interactive and small group sessions is mandatory at our school, and students uniformly participated in them, as they did in the online Zoom-based sessions. Thus, our students were probably well prepared for this sudden shift. In line with this view, Ferrel and Ryan (2020), in a recent editorial on the impact of COVID-19 on medical education, predicted that many medical students in their didactic years may perceive little change in their study schedule, since many of them already use outside resources and watch school lectures after they have been presented.

The lack of significant differences in scores and attitudes may also attest to our - and indeed all - medical students' resilience and adaptability to difficult situations, for they are high-achieving and resourceful students who have been selected from among an exceedingly competitive group of applicants, and likely have the cognitive powers and non-cognitive qualities to meet such challenges. Ferrel and Ryan (2020) also emphasised the need for medical students to adapt and be innovative during the pandemic, and to devise ways by which they can exhibit their skills, work ethics and teamwork. In fact, one of the advantages of the online shift that our students cited was the flexibility this approach afforded them in managing their time, setting their schedules, controlling their pace of learning and achieving better self-care. Nevertheless, some of them found it challenging to do so, and to regulate their environment and motivate themselves; rather, they seemed to require external cues or assistance to get into a learning mode, and found difficulty in establishing boundaries between work and home, as suggested recently by Rose (2020). In this context, it is noteworthy that our students preferred asynchronous to synchronous learning, and this is consistent with Daniel's recommendation to use this approach because it gives teachers "flexibility in preparing learning materials and enables students to juggle the demands of home and study" (Daniel, 2020).

Our findings also raise questions about certain assumptions regarding student learning and the optimal teaching approaches for knowledge-based objectives, such as the value and benefits of face-to-face interactions among students and with faculty in a didactic context. Our results suggest that students can achieve these knowledge objectives without the personal interaction and contact with faculty. This, of course, does not address the non-cognitive learning outcomes that might be negatively affected by pure online learning. As summarised by Fawn et al. (2020), while content may be covered well in such abrupt transitions to online learning, we cannot be sure that the valuable non-cognitive learning that happens as a result of the "social activity, the relationship-building, the problem-solving, the dialogue and generation of ideas and the students' own discovery of other content that has not been pre-defined by the teacher" has been achieved.

We cannot make definite, long-term conclusions from this single account that is restricted to 2 courses in the preclinical years, a brief period of time, and one institution, and a low response rate for the survey questions, but the results are encouraging, and may have implications for educational practice. The lack of decline in cognitive performance may suggest that the sudden shift to online education might not be a totally negative

development. If our findings are reproduced or generalised, one can use them to validate what progressive medical educators have been advocating for years, that: online educational technology must change the way we educate our students; didactic lecturing should give way to flipped classrooms; and valuable teacher time must be expended to help students apply knowledge rather than to simply transfer information in scheduled lectures. Quoting Ezekiel Emanuel (2020), who in a recent article stated that the reconfiguration of medical education, fuelled by online educational technology, seemed inevitable, Wolanskyj-Spinner (2020) suggested that the coronavirus epidemic appears to be an inflection point that is forcing a disruption in how we teach medicine. At AUBFM, we have long pressed the faculty who teach medical students to record their lectures and use the scheduled class time thus saved to implement flipped classrooms, employing small-group-based, problem-solving and interactive sessions. While many responded, many also hesitated, objected, and even resisted. The following two additional comments provided by two students illustrate their frustration with the resistance of faculty and their hopes to move in that direction:

"I really hope we can make online learning standard coming out of this phase ... There was an attempt a few years ago but many instructors refused to be recorded or to fiddle with computers; we must seize the opportunity now."

"Please never stop recording lectures, regardless of the status of live classes!"

Ahmed et al. (2020) recently reported that during the 2003 SARS epidemic in China, novel online problem-based learning techniques had to be implemented in one medical school that proved to be so popular that they were applied as part of the regular curriculum in later years. We believe that medical educators can harness the current disruption in how we teach medical students, and make use of to implement novel and sound educational practices and adopt a wide variety of valid approaches and tools that, otherwise, might have been resisted by unwilling individuals with entrenched ideas.

V. CONCLUSION

In conclusion, rapid transition to online learning did not affect student knowledge acquisition negatively. As such, the sudden shift to online education might not be a totally negative development and can be harnessed to drive a more progressive medical education agenda. These results are particularly important considering the several disadvantages that the students cited in relation to the online delivery of the courses.

Notes on Contributors

Nathalie Zgheib developed the concept, collected and analysed data, and wrote the first draft of the manuscript. Ahmed Ali also developed the concept, performed the literature review, and revised the manuscript write-up. Ramzi Sabra also developed the concept, collected and analysed data, and revised the manuscript write-up. The three authors read and approved the final version of the manuscript.

Data Availability

The data that support the findings of this manuscript are available from the corresponding author upon reasonable request.

Ethical Approval

This is a report of experience with educational practices. It was confirmed by our Institutional Review Board (IRB) that the activities described in this article do not constitute human subject research.

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Declaration of interest

The authors do not have any conflict of interest to declare.

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Appendix

Sup. Table 1. Items on the Course Evaluation Form Used at AUBFM

	ITEM
1	The objectives of this course were clearly outlined.
2	Emphasis was on learning and using basic concepts and principles.
3	The content and materials were appropriately organized to achieve the objectives.
4	The teaching methods (case-based, problem-based, didactic lectures, etc.) used were effective in helping understand the information and concepts.
5	There was adequate presentation of scholarly research work which is at the basis of the concepts and facts.
6	The required course activities (assignments, etc.) were consistent with meeting course objectives.
7	The required resource materials contributed to the learning experience: textbooks
8	The required resource materials contributed to the learning experience: Handouts /Web based material.
9	The required resource materials contributed to the learning experience: laboratory.
10	The methods of assessment (examination, etc.) reflected the course objectives.
11	The content of the course had clinical relevance.
12	Repetition between this course and other courses was re-enforcing and needed.