Medical, Dental, and Nursing Students’ Experience with Virtual Practical Sessions: A Cross-Sectional Study in a Developing Country

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Background: The COVID-19 pandemic has disrupted the scope of healthcare education and shifted the teaching methods from on-campus to virtual. The impact of such a shift has rarely been investigated, and limited evidence exists about students’ experience in terms of effort made and time spent, especially for laboratory sessions. Assessing students’ experiences will provide paramount evidence to fine-tune laboratory virtual learning sessions.

Objective: To assess students’ experience of virtual (online) laboratory sessions versus on-campus laboratory sessions, including preference, time spent, the effort made, ability to remember instructions, and preference for future teaching.

Methods: A cross-sectional study was utilized. A Google Forms questionnaire was prepared and sent to medicine, dentistry, and nursing school students registered at Jordan University of Science and Technology (JUST) during the 2019/2020 academic year. Self-reported preference, time spent, efforts made, ability to remember instructions and preference for future teaching were assessed for virtual versus on-campus anatomy, pathology, microbiology, histology, and physiology laboratory sessions.

Results: A total of 455 students participated in this questionnaire. More students in histology (55.2%), pathology (57.4%), and microbiology (55.3%) laboratories, but not anatomy (39.6%) physiology (443.95), reported preferring virtual sessions over on-campus sessions. More students from histology (35.6%) and microbiology (37.0%) reported spending less effort than on-campus sessions. More than half of the participants agreed that virtual laboratory sessions consumed less time than on-campus sessions. Participants reported that they cannot remember the instruction given during virtual teaching compared to on-campus teaching. Differences in students’ experiences were detected by gender, major, and year of study.

Conclusion: The COVID-19 pandemic has the potential to change the future of healthcare education, and preparation for future crises is paramount. Effort made, time spent, ability to remember, and preference for virtual education should be considered in terms of gender, major of study, and year. These differences should also be reflected in the planning of virtual sessions for effective implementation.

Keywords: medical students, COVID-19, laboratory sessions, virtual environment, on-campus sessions, Jordan

Introduction

Significant disease outbreaks related to severe acute respiratory syndrome coronaviruses (SARS) have been reported in the Middle East and East Asia over the last two decades. Coronavirus disease 2019 (COVID-19) later witnessed a global spread, resulting in a worldwide pandemic,1 with evidence of life-threatening manifestations.2
To flatten the COVID-19 epidemiologic curve and achieve disease containment, countries, including Jordan, adopted non-pharmaceutical public health intervention measures, including nationwide curfews and restricting non-essential activities.\(^3\) As a response, universities have turned to pure online education and have partially or completely closed their campuses to limit the spread of the SARS-CoV-2 virus. This rapid transition has severely disrupted the teaching process.\(^5\) Educational institutions have encountered numerous obstacles during this drastic transition in teaching medical students.\(^6\) In addition, major concerns, such as possible technical problems, limited internet access, the inability of laboratories to instruct clinical skills, and concerns about academic performance, have limited the credibility of remote electronic exams during the transition from on-campus laboratory sessions to remote online (virtual) laboratory sessions.\(^7\)–\(^9\)

Several factors were found to influence students’ preference for virtual learning. A recent study at the University of Nevada explored several factors. First, learning pace, technology skills, work status, and previous online courses significantly influenced students’ preferences and experiences.\(^10\) Instructor training, student training, and structured schedules were also found to influence the success of virtual learning.\(^11\) Among medical students in the United Kingdom, employing online teaching platforms to allow students to digest knowledge on their own time and then constructively discuss it with their peers effectively achieved learning outcomes.\(^12\) Another recent case-control study among physiotherapy students in Italy reported a preferable outcome of online teaching compared to face-to-face delivery of the same course.\(^13\) While these studies investigated students’ preferences and experience with virtual learning in developed countries, little evidence has been generated from developing countries. This is a critical gap in evidence as healthcare educational institutions in developing and developed countries vary significantly in terms of available resources, infrastructure, and healthcare priorities. Limited resources and infrastructure (including internet access and utilization and virtual environment), more focus on basic skills, and reliance on classical instructional methods have been reported from developing countries.\(^14\) To bridge this research gap and to explore students’ experience with virtual laboratory sessions, the present study aimed to assess medical, dental, and nursing students’ preferences and experiences related to virtual education compared to on-campus education.

**Methods**

**Study Settings**

Healthcare education at Jordan University of Science and Technology (JUST) encompasses a significant portion of laboratory services provided to medical, nursing, and dental students. These are provided between years one and four as part of stand-alone sessions or systems and modules. The medical school at JUST houses all these laboratories and is responsible for students’ learning within practical sessions. The first semester of the academic year of 2019/2021 included on-campus practical sessions. This has shifted to online teaching/sessions as of the second semester, given the COVID-19 pandemic.

**Study Design and Tools**

A cross-sectional study design was utilized. A preliminary questionnaire was created and reviewed by three faculty members at the School of Medicine at JUST. The questionnaire was further edited after initial review by a sample of medical, dentistry, and nursing students (N=10).

The questionnaire was distributed online via the Google Forms link and shared with students through the e-learning platform. After three and six days, a follow-up reminder was sent. The questionnaire was distributed after the second semester of the 2019/2020 academic year. The survey included 16 questions that collected students’ demographics (academic major and gender), and the major part aimed to assess the students’ experience of virtual (online) laboratory sessions versus on-campus laboratory sessions, including preference, time and effort spent, ability to remember instruction and preference for future teaching.

**Participants**

Eligible students were those enrolled in JUST’s medical, dental, and nursing specialties. An email was sent to students registered in virtual laboratory classes during the second semester of the academic year 2019/2020.
IRB Approval
Approval for the study was obtained from the institutional review board (IRB) of JUST (IRB number 13/134/2020). On the first page of the online questionnaire, participants were informed about the study’s aim, objective, and right to withdraw at any point. Also, they were assured that all information would be confidential and used for research purposes only. Participation was voluntary.

Statistical methods
Data was extracted into an Excel sheet and then into SPSS version 26. Data were reported in numbers and percentages as appropriate. The chi-square test was used for statistical comparisons. The alpha level was set at 0.05 for statistical significance.

Results
Characteristics of Study Participants
A total of 455 students from the faculty of medicine, dentistry, and nursing at Jordan University of Science and Technology agreed to participate in the survey. About half (50.1%, n=228) of the participants were females, 48.6% (n=221) were from the first-year level, while the other second, third-, and fourth-year levels were 30.8% (n=140), 19.3% (n=88), and 1.3%, respectively. Five laboratories were taken during the Spring semester of the 2019/2020 academic year, including anatomy, histology, pathology, microbiology, and physiology. The majority of students were from the faculty of medicine (83.7%, n=381), while the faculty of dentistry and nursing were 16.3% (n=74). Physiology was the major laboratory taken, with 455 students, while participants enrolled in anatomy, histology, pathology, and microbiology were 448, 436, 362, and 362 students.

Participants’ Experience with Virtual Sessions
Participants’ experience in virtual sessions is presented in Table 1. Virtual laboratory sessions for histology (55.2%, n=237), pathology (57.4%, n=198), and microbiology (55.3%, n=194) were preferred over on-campus sessions (P-value <0.05 for all comparisons). In contrast, anatomy (60.4%, n=265) and physiology (56.2%, n=172) on-campus sessions were preferred over virtual sessions (P-value<0.05 for both comparisons). In all laboratories investigated, students reported that virtual laboratory session consumes less time than on-campus sessions, with 56.7% (n=244) for anatomy, 58.9% (n=246) for histology, 54.1% (n=192) for pathology, 56.2% (n=200) for microbiology, and 56.5% (n=174) for physiology (Table 1).

Students reported spending less effort on virtual teaching than on-campus teaching in histology (35.6%, n=155) and microbiology (37%, n=134) laboratories. Similar measures for virtual and on-campus teaching methods were reported for pathology (38.7%, n=140). However, students reported spending more effort on virtual teaching compared to on-campus teaching in anatomy (44.2%, n=198) and physiology (25.7%, n=117) laboratories (Table 1).

The ability to remember instructions during virtual laboratory sessions was inferior to on-campus laboratory sessions in all laboratories as 40.2% (n=159) in the anatomy laboratory, 46.4% (n=181) in the histology laboratory, 48.9% (n=153) in the pathology laboratory, 47.8% (n=150) in the microbiology, and 44.7% (n=122) in the physiology reported remembering instructions better during virtual laboratory sessions (Table 1).

The majority of students in histology, pathology, and microbiology laboratories reported preferring future virtual sessions, with 222 students (59.8%), 195 students (52.56%), and 184 students (49.6%), respectively. However, students in anatomy and physiology laboratories reported not preferring virtual future sessions, with 225 students (60.65%) and 149 students (40.16%), respectively (Table 1).

Differences by Gender, Major, and Year
As shown in Table 2, significant differences in effort made and ability to remember instructions were detected by gender in various laboratories taken. In comparison to on-campus sessions, 41.1%, 41.8%, 44.6%, and 38.4% of males put in “less effort” in virtual histology, pathology, microbiology, and physiology laboratory sessions, respectively, while 42.2%,
48.0%, 39.7%, and 38.5% of females put in “similar effort” in virtual histology, pathology, microbiology, and physiology laboratory sessions, respectively (p-value <0.05 for all comparisons). Also, 45.2% and 52.6% of males were able to remember instructions better in anatomy and histology virtual sessions, respectively, whereas 35.5% and 40.5% of females were able to remember instructions better in anatomy, and histology virtual sessions, respectively (p-value <0.05).

Students were divided into two groups; the first was those in medicine college, and the second was those in dentistry and nursing college. A statistical significance (p-value <0.05) was seen in preference for virtual laboratory, time spent, and ability to remember in different laboratories. Medicine college students preferred virtual sessions in pathology and microbiology laboratories (59.6% and 57.7%, respectively) compared to dentistry, and nursing college students (38.5% and 38.1%, respectively). Meanwhile, 59.8%, 60.3%, 56.2%, and 59.2% of medicine college students spend less time with anatomy, histology, pathology, and physiology virtual laboratory sessions, respectively, in contrast to 40.0%, 48.2%, 39.5%, and 40.8% of dentistry, and nursing college students spend less time with anatomy, histology, pathology, and physiology virtual laboratory sessions, respectively.

As illustrated in Table 2, significant differences by the increase of the year of study were detected for preference of virtual laboratory over on-campus laboratory in histology, pathology, microbiology, and physiology, as well as for effort made in anatomy, pathology, microbiology, and physiology. Students were able to remember the instructions better for the virtual laboratory in all laboratories taken (anatomy, histology, pathology, microbiology, and physiology).
Table 2: Distribution of Study Participants by Preference, Time Spent, Efforts Made, and Ability to Remember and by Gender, Study Major, and Year

<table>
<thead>
<tr>
<th>Gender</th>
<th>Major</th>
<th>Year of Study</th>
<th>Preference for anatomy virtual laboratory over on-campus laboratory</th>
<th>Preference for histology virtual laboratory over on-campus laboratory</th>
<th>Preference for pathology virtual laboratory over on-campus laboratory</th>
<th>Preference for microbiology virtual laboratory over on-campus laboratory</th>
<th>Preference for physiology virtual laboratory over on-campus laboratory</th>
<th>Time spent on anatomy virtual laboratory compared to on-campus laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Less</td>
</tr>
<tr>
<td>Female</td>
<td>Dentistry, Nursing</td>
<td>1</td>
<td>141</td>
<td>61.8%</td>
<td>135</td>
<td>57.1%</td>
<td>0.149</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Medicine</td>
<td>2</td>
<td>121</td>
<td>56.3%</td>
<td>131</td>
<td>57.7%</td>
<td>0.222</td>
<td>30</td>
</tr>
<tr>
<td>Male</td>
<td>Dentistry, Nursing</td>
<td>3</td>
<td>142</td>
<td>65.7%</td>
<td>136</td>
<td>57.1%</td>
<td>0.031</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td>Medicine</td>
<td>4</td>
<td>78</td>
<td>45.3%</td>
<td>94</td>
<td>54.7%</td>
<td>0.028</td>
<td>26</td>
</tr>
</tbody>
</table>

(Continued)
Table 2 (Continued).

<table>
<thead>
<tr>
<th>Gender</th>
<th>Major</th>
<th>Year of Study</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Gender</td>
<td>Dentistry, Nursing</td>
</tr>
<tr>
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</tr>
<tr>
<td></td>
<td>Male</td>
<td>No.</td>
</tr>
<tr>
<td>Time spent on histology virtual laboratory compared to on-campus laboratory</td>
<td>Less</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>Similar</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>More</td>
<td>36</td>
</tr>
<tr>
<td>Time spent on pathology virtual laboratory compared to on-campus laboratory</td>
<td>Less</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>Similar</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>More</td>
<td>32</td>
</tr>
<tr>
<td>Time spent on microbiology virtual laboratory compared to on-campus laboratory</td>
<td>Less</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Similar</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>More</td>
<td>36</td>
</tr>
<tr>
<td>Time spent on physiology virtual laboratory compared to on-campus laboratory</td>
<td>Less</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>Similar</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>More</td>
<td>31</td>
</tr>
<tr>
<td>Effort made on anatomy virtual laboratory compared to on-campus laboratory</td>
<td>Less</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>Similar</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>More</td>
<td>103</td>
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<tr>
<td>Effort made on histology virtual laboratory compared to on-campus laboratory</td>
<td>Less</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Similar</td>
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<td></td>
<td>More</td>
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<tr>
<td>Effort made on pathology virtual laboratory compared to on-campus laboratory</td>
<td>Less</td>
<td>Similar</td>
</tr>
<tr>
<td>Effort made on microbiology virtual laboratory compared to on-campus laboratory</td>
<td>Less</td>
<td>Similar</td>
</tr>
<tr>
<td>Effort made on physiology virtual laboratory compared to on-campus laboratory</td>
<td>Less</td>
<td>Similar</td>
</tr>
<tr>
<td>Students' ability to remember instruction better in anatomy virtual laboratory</td>
<td>No</td>
<td>129</td>
</tr>
<tr>
<td>Students' ability to remember instruction better in histology virtual laboratory</td>
<td>No</td>
<td>116</td>
</tr>
<tr>
<td>Students' ability to remember instruction better in pathology virtual laboratory</td>
<td>No</td>
<td>83</td>
</tr>
<tr>
<td>Students' ability to remember instruction better in microbiology virtual laboratory</td>
<td>No</td>
<td>84</td>
</tr>
<tr>
<td>Students' ability to remember instruction better in physiology virtual laboratory</td>
<td>No</td>
<td>77</td>
</tr>
</tbody>
</table>
Discussion

The COVID-19 pandemic and associated non-pharmaceutical interventions changed education delivery methodologies. With the presence of modern technology, the opportunity for the swift switch to virtual teaching techniques was provided, and virtual courses were offered in the majority of health-related specialties. Still, little is known about students’ experiences from within developing countries. This study explored students’ experience related to virtual learning methods within laboratory settings compared to the usual on-campus teaching modality, inferring key recommendations to build inclusive virtual curricula. The results indicate that while there is a preference for using virtual sessions, differences in experiences must be addressed by gender, year, and major of study. This area needs further investigation to fine-tune students’ experiences with virtual sessions better.

About half of the study participants preferred virtual delivery methods over on-campus ones. Similarly, about half preferred to have virtual sessions in the future. Based on these findings, comparable satisfaction with the virtual learning experience can be suggested. This finding agrees with previous reports from China documenting high satisfaction rates of virtual education. Studies from our region showed lower satisfaction rates, with only 30% of students satisfied with the online learning experience. Multiple factors could be accounted for in determining the overall satisfaction with virtual learning. Among the positives, commuting time, learning at one’s own pace, learning from the convenience of the household, and availability of all relevant material were reported. In the meantime, low-quality internet connectivity, tutors’ internet literacy, the platform, its design, and the ability to enhance interaction could be among the main restraints to online learning.

In a scoping review, several factors were determined as facilitators and barriers to intervention effectiveness, including pedagogical background, course design, students’ profiles, and methodology of delivery. The platform’s role was emphasized earlier, and students’ satisfaction was related to page appearance, navigation potentials, online applications, and interactive environment. Given the newer generations’ awareness of digital platforms, investigating digital health competencies and attitudes could help shape the future of virtual learning, moving the reliance from computer-dependent learning to the use of multiple modalities, including tablets and smartphones. Finally, the findings highlight the need to holistically address virtual learning, making the most of advanced technology, and proper planning since the recent experience was mandatory and forced by the pandemic.

Among the five subjects of concern, three, pathology, microbiology, and histology, were preferred when given virtually. This could be due to the nature of the provided material, but the determinant of this association is not well understood and warrants further investigations. Another previously studied variant that impacts the preference of virtual and on-campus teaching methods is the interactions, whether it is student-instructor or student-student. Traditional face-to-face teaching has always been preferred to increase engagement and provoke interactions. Nonetheless, other factors may impact this satisfaction, including the psychological impacts of COVID-19 and the technology used to improve interactions.

It is worth mentioning that the understanding of the teaching material was less with virtual sessions in all five laboratories. Despite that, the virtual sessions yielded a comparable knowledge of some topics, which could indicate that some topics can be shifted into virtual or hybrid teaching in the future, granting holistic and careful, attentive planning. Moreover, enhancing virtual teaching platforms could help in pandemic preparedness, which will equip our educational system with the need to improve remote teaching in similar circumstances.

This study has limitations. At first, the sample is not generalizable to all healthcare students, even in Jordan, as the data was collected from students at one university. As well, the online survey does not provide a representative sample. Accordingly, more research should be utilized using cross-country samples and a more random sampling approach. The number of medical students and participants from the first years of study was predominant. As such, this is a threat to internal and external validity. More qualitative studies should focus on understanding gender differences regarding efforts made and time spent.

Conclusion

The COVID-19 pandemic can potentially change the future of medical education, and preparing for future crises is paramount. Virtual teaching has many benefits and can be promoted and implemented if adequately planned and executed in line with student feedback during the COVID-19 experience. Gender difference, as well as study major and year of
study, seems to play a role in efforts made, time spent, and ability to remember when considering. More research is recommended to fine-tune and improve students’ experience with virtual teaching.

Data Sharing Statement
Further data is available from the corresponding author on reasonable request.

Ethics Approval
The study was approved by the Institutional Review Board (IRB) of Jordan University of Science and Technology with IRB approval reference number 13/134/2020.

Consent to Participate
On the first page of the online questionnaire, participants were informed about the study’s aim, objective, and right to withdraw at any point. Also, they were assured that all information would be confidential and used for research purposes only.

Author Contributions
All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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The authors declare no conflicts of interest in this work.

References


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