



Original Article

Evaluation of the effect of COVID-19 mandated shift to virtual teaching on medical students' performance at King Khalid University, Abha

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المخلص

أهداف البحث: تطلب الانتشار السريع لوباء كوفيد-19 من السكان في معظم أنحاء العالم اتخاذ احتياطات صارمة. تم تعليق التعليم وجها لوجه، وتحولت عملية التدريس والتعلم إلى الوضع الافتراضي. كان هذا تحدياً هائلاً للطلاب والمعلمين وأولياء الأمور والأوصياء والمسؤولين الأكاديميين. كان الهدف الرئيسي من هذه الدراسة هو تقييم تأثير التحول إلى الوضع الافتراضي على الأداء الأكاديمي لطلاب بكالوريوس الطب وبكالوريوس الجراحة في دروس علم الأمراض العامة والجهازية.

طرق البحث: تمت مقارنة الدرجات التي تم الحصول عليها في اختبار قصير واختبار عملي تم إجراؤه قبل التحول الكلي إلى الفصول الافتراضية مع اختبار قصير وامتحان عملي آخر أجري على نفس مجموعات الطلاب بعد بضعة أسابيع من التدريس الافتراضي. تم إجراء اختبارات المزدوج لاختبار الفرضيات. تم تصميم استبانة إلكترونية قصيرة وإرسالها إلى الطلاب المستهدفين. تم أيضاً إجراء مسح على الطلاب المستهدفين لفهم تجربتهم مع التعلم الإلكتروني خلال هذا الوقت (إجمالي عدد الطلاب هو 103).

النتائج: أفاد ستون في المائة من الطلاب أن تجربة التعلم الإلكتروني لديهم قيمة، ويفضل 84% أن يكون التعلم الإلكتروني جزءاً من التعليم والتعلم حتى بعد استعادة الحياة الطبيعية. كان أداء الطلاب في اختبارات فصول التدريس ما بعد الافتراضية أفضل بكثير مما كان عليه في اختبارات التدريس في الصف قبل الافتراضي.

الاستنتاجات: لاقى شكل التعلم الافتراضي استحسان الطلاب وأثر في نتائجهم الأكاديمية. يجب أن توفر المعاهد دورات تدريبية للموظفين والطلاب لمعالجة

السلبيات التعليمية المحتملة وتوفير تقنيات تعليمية حديثة ومختبرات محاكاة لتعزيز النظم التعليمية.

الكلمات المفتاحية: التعليم الطبي؛ التعلم الإلكتروني؛ أداء أكاديمي؛ تعليق الدراسة؛ كوفيد-19

Abstract

Objectives: The rapid spread of the COVID-19 pandemic required populations in most parts of the world to take drastic precautions. Face-to-face teachings were suspended, and the teaching and learning process was shifted to the virtual mode. This was a formidable challenge for students, teachers, parents, guardians, and academic administrators. The main objective of this study was to assess the impact of the shift to virtual mode on medical students' academic performance in general and systemic pathology courses.

Methods: The grades achieved in a quiz and practical test taken before the shift to virtual classes were compared to another quiz and practical exam taken by the same groups of students after several weeks of virtual teaching. The paired *t*-test was conducted to test the hypotheses, and SPSS software was used for data analyses. A short electronic survey was designed and sent to the targeted students (N = 103). The targeted students were also surveyed to understand their experience with e-learning during this time.

Results: In total, 60% of the students reported their e-learning experience as valuable, and 84% prefer to have e-learning as part of the teaching and learning process even after normalcy is restored. The students' performance in the post-virtual tests was significantly better than that in the pre-virtual tests.

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Conclusion: The virtual learning format was well received by the students and influenced their academic outcomes. Institutes should provide training sessions for staff and students to address potential education drawbacks and provide modern educational technologies and simulation labs to enhance the educational systems.

Keywords: Academic performance; COVID-19; E-learning; Medical education; Study suspension

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Introduction

In December 2019, an outbreak of pneumonia from an unknown cause was detected in Wuhan, China. This disease, later termed coronavirus disease 2019 (COVID-19), is caused by a coronavirus named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).¹ The infection spread fast across borders causing severe illness and death, prompting the World Health Organization (WHO) to declare it a public health emergency of international concern on 30 January 2020.² Due to its unrelenting spread and global effect on health, the WHO declared the outbreak a pandemic on 11 March 2020.³ To stop the spread of this infection, drastic measures were undertaken by countries and populations, including strict lockdowns and cessation of all social, educational, and economic activities.

The first confirmed case of COVID-19 in KSA was registered by the Saudi Ministry of Health on 2 March 2020.⁴ The government of KSA undertook appropriate early precautions toward COVID-19. On 9 March 2020, all face-to-face classes were suspended, and institutions were directed to shift to virtual learning to ensure social distancing and curb the spread of the pandemic. Lectures, small group teachings, and practical classes were engaged virtually. Short and final exams were also switched to the online platform.⁵

Several medical colleges and universities in the KSA have been utilizing some components of the virtual learning element in their curriculum. The Blackboard™ learning management system (LMS) has been provided by the Ministry of Education to all universities and is the official LMS in most institutions. Departments at the College of Medicine, King Khalid University have used blended learning and flipped classrooms to varying degrees. The COVID-19 crisis has forced the entire teaching and learning process to happen in the virtual mode, which all stakeholders have well received. The College of Medicine at King Khalid University follows the traditional curriculum based mainly on large group lectures alongside practical teaching sessions, tutorials, and clinical teachings in small groups. During the shift to virtual learning, lectures and practicals were conducted using Blackboard and Zoom™. Virtual learning is here to stay even after the pandemic, and colleges are contemplating how to better incorporate blended learning into their curricula. Hence, it is essential to study this aspect of

technology-assisted learning from different perspectives to implement and utilize it better in the long term.

The main objective of this study was to assess the impact of the shift to the virtual mode of teaching on medical students.

Materials and Methods

Study design

The research was conducted immediately after the semester ended in May 2020. After data collection from medical education, the study was designed and conducted. The study was suspended in the middle of the term on 9 March 2020, as stated in the Introduction. The length of each teaching mode, either traditional or virtual, was almost 8 weeks.

Study population and sampling methods

This study included all Bachelor of Medicine and Bachelor of Surgery (MBBS) of 5th and 6th levels students (N = 103) enrolled in the General and Systemic Pathology course during the January to May 2020 semester. This study was cross-sectional, and simple random sampling was utilized as the sampling method.

Mode of instruction

The College of Medicine at King Khalid University follows a traditional curriculum based mainly on large group lectures alongside practical teaching sessions, tutorials, and clinical teachings in small groups. During the shift to virtual learning, the lectures and practicals were conducted using Blackboard and Zoom. Similar to face-to-face classes, PowerPoint™ presentations were used with the instructor addressing the students through a virtual platform. The method of teaching for pre-tests was face-to-face sessions. Microscopic slides were examined by students with the help of tutors, and pathological features were outlined. Materials were given to the students for self-study for post-tests, in addition to online sessions that included digital slides as an objective structured practical examination (OSPE).

For assessments, the multiple-choice question method was used for both pre-and post-exams. The questions included cognitive and problem-based questions. Additionally, for post-exams, specific procedures were taken while preparing for exams (e.g., the order of the questions was varied), and the option of going back to the earlier questions was inactivated to minimize the chances of cheating among students. For practicals, pre-tests included microscopic slides as OSPE and post-tests included digital slides as OSPE. For both types of assessments, students were asked to identify the tissue/organ and write an accurate diagnosis for each slide.

Data analysis

This research study compared the grades obtained by students in a low-stake summative assessment quiz and practical examination just before the shift to virtual learning

with those achieved in similar tests after several weeks of online instruction. A survey of the students was also conducted to assess their experiences and perception concerning virtual learning. Authors have dealt with experts in the medical education department who used content validation to observe all specific items on the questionnaire to determine whether the questionnaire addressed the topic overall. The experts created a list of all that the questionnaire was meant to measure and checked the items on the questionnaire against this list. This allowed us to ensure that every item corresponded to the desired measurement and that everything that should be measured was actually measured. Since the before and after data pertained to the same group of students, the paired *t*-test was used to test the significant differences in pre- and post-test marks. The paired *t*-test was conducted to test the hypotheses for the quizzes and practical exams. The null hypotheses for the present study are:

- H1.** There is no difference in the marks of Quiz 1 and Quiz 2.
H2. There is no difference in the marks of Practical 1 and Practical 2.

IBM SPSS Statistics V22.0 was used for the data analyses. The student feedback responses were analyzed using Excel to evaluate their online education and exam experience.

Assumption of paired sample *t*-test

Before performing the paired sample *t*-test, the assumptions of the *t*-test were established. The two critical assumptions were the normality of the dependent variables and the outlier. To assess the normality, a variable named P difference was created, which was the difference between marks P1 and P2. Similarly, another variable labeled as Q difference was created, denoting the difference between Q1 and Q2. The values of each variable were transformed to a standardized value and tested at a critical value of ± 4 , the threshold value of standard scores. No univariate outliers were reported in this study. Correlation analysis measured the linear association between students' marks on pre- and post-exams. The Pearson correlation coefficient was used, which ranged from -1.0 to $+1.0$. It was presumed that students' age group, gender, and year of study were not significant factors in this study, so they were disregarded. For the item-based analysis, the difficulty index was calculated according to the students' responses to the question. The difficulty of questions was evaluated according to the blueprint standards used for teaching in the college.

Results

Regarding the sample's demographic distribution, the percentage by gender was 56.3% ($n = 58$) for males and 43.7% for females ($n = 45$). The percentage by academic year was disregarded in the study since the study's objective was to compare the outcomes of students pre- and post-shifting to virtual teaching mode, which was not based on a specific academic year or level. Table 1 displays the paired sample statistics of two pre- and post-test marks. The lowest mean, with a mean value of 8.64, was found in the Practical 1 exam, indicating that students had difficulties with microscopic skills during the face-to-face study during the hands-on

Table 1: Paired samples statistics for quizzes and practical exams.

Type of assessment	N	Mean	SD	Standard error of the mean
Pair 1 Q1	103	10.61	2.819	0.278
Q2	103	12.72	1.115	0.110
Pair 2 Practical 1	103	8.64	1.305	0.129
Practical 2	103	9.94	0.274	0.027

N: number of students.

microscopic study compared to the projected slides (video demonstration) after shifting to e-learning. The further lowest variability was observed in Quiz 2 (standard deviation = 1.115). Generally, students' marks on Q2 and Practical 2 were higher than those on Q1 and Practical 1.

Furthermore, no significant correlation between Q1, Q2, Practical 1, and Practical 2, as evident from Table 2. However, the absence of the correlation does not influence the paired comparison between the exams, as apparent from the findings in Table 3.

At the 5% significance level, the two null hypotheses were rejected; thus, it can be concluded that there was a statistically significant difference between the mean marks of the pre- and post-tests for both the quiz and practical exams. Hence, one can conclude that the online teaching method was better in imparting the course content. Table 4 shows that both quizzes were of comparable difficulty. Hence, the variation in results was unlikely due to the variation in the quiz quality.

Table 5 shows that the proportion of students who had a good experience with e-learning was 60%, whereas those who did not have a good experience were lower than the fifth of the percentages of the total responses (73%). In response to which extent participants attended online lectures, more than 70% of students reported that they attended virtual classes regularly. A small 5% of respondents reported not attending the classes regularly. The majority of respondents (50%) reported that the internet's poor connection was the main obstacle to e-learning. In comparison, the remaining responses were split among technical problems and having insufficient experience in technology (28% and 24%, respectively). A high percentage of students (84%) responded that virtual learning is the best choice for delivering lectures and conducting exams, whereas only a small percentage (16%) think face-to-face learning in actual classrooms is the only way. About three-fourths of the students reported that online learning had no negative impact on their academic progress. By contrast, the remaining students stated that their academic progress was negatively influenced by e-learning.

Table 2: Paired samples correlation for quizzes and practical exams.

Type of assessment	N	Correlation	Sig.
Pair 1 Q1 & Q2	103	0.143	0.151
Pair 2 Practical 1 & Practical 2	103	-0.032	0.751

Table 3: Paired samples test for quizzes and practical exams.

Type of assessment	Paired differences				<i>t</i>	df	Sig. (two-tailed)	
	Mean	SD	Std. error mean	95% Confidence interval of the difference				
				Lower				Upper
Pair 1 Q1–Q2	–2.107	2.880	0.284	–2.670	–1.544	–7.425	102	0.000
Pair 2 Practical 1 Practical 2	–1.301	1.342	0.132	–1.563	–1.039	–9.839	102	0.000

Table 4: Item-analysis-based comparison of the difficulty level of the two quizzes (n: no. of questions).

		Offline exams (N = 30)	Online exams (N = 30)	P-values	Interpretation
Difficulty index	Difficult questions	1%	15%	0.04	Significant
	Moderate questions	83%	70%	0.21	Not significant
	Easy questions	16%	15%	0.9	Not significant
Discrimination index	Good questions	84%	48%	0.002	Significant
	Fair questions	8%	30%	0.025	Significant
	Poor questions	2%	15%	0.04	Significant
	Cannot calculate	6%	7%	0.86	Not significant

Table 5: Perceptions of students regarding E-learning (N = 75).

Question	Response	Count	%
How would you evaluate this e-learning experience?	Good	45	60
	Moderate	12	16
	Bad	18	24
How regular were you in attending virtual classes?	Excellent	54	72
	Moderate	18	24
	Poor	3	4
What was the main challenge you faced in e-learning?	Net problem	36	48
	Technology problem	21	28
	Lack of experience	18	24
Do you wish to continue with the virtual mode even after the return of normalcy?	Yes	63	84
	No	12	16
Did virtual learning affect students' academic progress negatively?	Yes	21	28
	No	54	72

^aSome students (27%) did not respond to the survey.

Discussion

This study compared the results of low-stake assessment tests before and after the shift to virtual learning. The multiple-choice question method was adopted and estimated for questions. Additionally, specific instructions were given to the college staff to activate sorting questions while preparing for online exams. Although online tests are subject to suspected fraud, the college has taken precautions such as shuffling questions. The study analyzed the data using the paired samples test of two pre- and post-test marks. It was observed that the scores achieved during the study suspension period and after attending the virtual classes were higher than those achieved before the study was suspended and taking the examinations face-to-face.

The possible reason for students' high performance during the study suspension could be due to focused learning via the LMS and lack of distractions due to the lockdown. The students saved time commuting to college and moving from one department to another in virtual education. In addition, most students are technology savvy and can utilize technology to aid their learning.^{6,7}

After performing statistical analyses and taking the average grades of the targeted students in this study, a short electronic survey about the impact of the COVID-19 pandemic on medical students' academic levels was designed, and students were requested to complete it. COVID-19 has allowed us to consider which components of medical education can continue in virtual or hybrid formats.⁸ After the initial difficulties, especially regarding the lack of online teaching experience for teachers and students' difficulty making sense of a total shift to virtual learning, virtual learning has become the norm for most educational institutions. Technical challenges such as internet issues also affect the online educational process, resulting in students leaving virtual classes or interrupting broadcasting due to the heavy load on the e-learning platforms. The survey results reflected this, with 48% of the respondents reporting that the internet problem caused significant difficulty in their virtual learning experience.

Similarly, 28% of the respondents stated that technology issues were a significant challenge. As the shift to virtual learning was abrupt, many students were not using computers and gadgets for resources, lacked interest, or otherwise did not get the time to upgrade themselves technologically.

Although most students achieved high scores on the online exams, the percentage of students who expressed satisfaction with the transition to e-learning did not exceed half, as a few students believed that their experience with e-learning was not beneficial. By contrast, a smaller percentage thought there was no difference between standard and virtual learning. Similar findings were found in a study conducted among medical college students in Pakistan after the

shift to virtual learning, which showed that 77.4% of the respondents had negative perceptions toward e-learning.⁹

The designed survey was used to assess whether e-learning negatively affected the students' academic level. The vast majority of responses (72%) affirmed that online education did not negatively influence their educational level. On the other hand, others, who were a small percentage (28%) relative to the previous percentage, assumed that their academic level had been affected by e-learning. In terms of measures toward the education sector, efforts to minimize the incidence of the COVID-19 virus among populations have contributed to the widespread shutdown of schools, colleges, universities, and other educational institutions. It has been stated that closing schools and educational institutions affected more than 80% of students at different academic levels.¹⁰ The shift to online mode posed concerns for the faculty regarding their ability to cope with current technology. In addition, parents and students who operated from home placed high demands on computers and information technology equipment.¹¹

Opinions differ from one student to another depending on many factors such as familiarity with the skills of dealing with technology, the reception of information, the possibility of communicating with the lecturers, and many others that the students were unfamiliar with in their first experience.¹² In this study, more than 70% of respondents indicated that they attended the virtual classes regularly, whereas less than 5% stated that their attendance was below expected. These percentages are not surprising, as there are much fewer obstacles to attending virtual classrooms and following up with the lecturer compared to attending in-person classes. In the online education system, the student can attend anywhere, and attendance is not tied to a specific location. By following up on the attendance electronically on the Blackboard or Zoom platform, staff was assured of the extent of students' commitment to attend virtual classes. Likewise, the percentage of students signing up for absent colleagues disappeared completely.

Transitioning to online teaching has a range of disadvantages, including limited access to the internet and lack of experience of certain students with new technology and solving technical issues when they encounter difficulties while attending virtual classes, doing assignments, or taking exams.¹³ The students' responses to one of the survey questions were about the significant challenges in e-learning during the COVID-19 pandemic. Hence, the problems of connecting to the internet and the network's availability were the first problems they faced, with rates up to 50%, followed by technological difficulties and lack of experience in dealing with the issues (28% and 24%, respectively).

Despite some obstacles in e-learning, as explained above, a large group of respondents in the survey (84%) chose to continue online education even after the pandemic. By contrast, a small proportion (16%) prefer to return to the conventional education system. This is similar to another study of medical students and teachers, which showed that 76% of the respondents prefer to use the virtual learning experience for their future teaching and learning activities.¹⁴

Even though there were some difficulties as per students' perceptions, the students' performances were higher on

online than offline exams. This might be due to some techniques the students created to answer the questions accurately or to be away from stress in traditional exam halls. On the other hand, the students faced some aforementioned problems during their attendance in the online classes, but during the exams, they were familiar with these errors and were able to address these issues. The pandemic provided a platform for the community to improve its education delivery and turn its vision to new technologies. In doing so, higher education institutions should take the opportunity to enhance their evidence-based practices, offer affordable prevention and intervention strategies, and adapt to the needs of changing circumstances.¹⁵

Study limitations

The most prominent limitation of the study is that it was limited to two courses and two levels because of the difficulty in collecting data for more courses and levels during the pandemic. The other limitation is that the student response rate to the questionnaire, which was designed to assess their opinions and experiences during the shift to the virtual classroom, was relatively low for an unknown reason. In addition, some variables and factors affecting virtual education may need further investigation to obtain specific recommendations adopted by medical schools in their future plans. Perhaps the study recommendations cannot be implemented in all medical colleges, universities, and other institutes because of the different strategies from one institute to another.

Conclusion

In conclusion, the virtual learning format was well received by the students, and it influenced their academic outcomes. Hence, institutions can start preparing to retain virtual learning components and implement a blended learning approach, given its myriad advantages. In the future, medical colleges should provide information technology training sessions for staff and students to address such issues and provide modern educational technologies and simulation labs to enhance educational systems, either traditional or virtual.

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Conflict of interest

The authors have no conflict of interest to declare.

Ethical approval

This study was approved by the Research Ethics Committee at King Khalid University (HAPO-06-B-001) (Approval No. ECM#2020-3216).

Authors contributions

HMO conceived and designed the study, conducted the research, provided the research materials, wrote the original draft, and supervised the study. HMM collected and organized data and edited the final draft of the manuscript. MOA analyzed and interpreted the data and provided logistic support. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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