Research Article

Understanding the Effects of E-Learning on Subject Physiology through using Blackboard among Medical Students During the COVID-19 Era

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ARTICLE INFO

ABSTRACT

BACKGROUND:
The COVID-19 pandemic has significantly impacted global education, including medical education, with traditional lectures and internships being disrupted and replaced by online learning platforms. This study aims to investigate the impact of e-learning through Blackboard on medical student's physiology education, as it directly relates to their curriculum and future medical practice.

METHODS:
A structured questionnaire was developed to gather data on the impact of e-learning on physiology. The questionnaire's design ensured content validity and inter-reliability by incorporating existing literature, theoretical frameworks, and expert input. A total of 149 second and third-year medical students participated in the study. The online questionnaire, distributed via Google Forms, utilized a Likert scale for students to rate their attitudes towards online teaching. It covered demographic information, student satisfaction, and satisfaction with assignment methods.

RESULTS:
Most participants were female (64%), and most students accessed online classes through their phones (93%). Results indicated that students agreed that online learning protected them from COVID-19 and facilitated better time management. However, a significant proportion for preferred face-to-face lectures and reported being distracted by the comforts of home. Overall, satisfaction rates were high, particularly for the assignment method, highlighting its benefits.

CONCLUSION:
This study shows that e-learning through Blackboard positively impacted medical students physiology education during COVID-19. Despite challenges and a preference for in-person learning, most students were satisfied with online teaching and found the assignment method beneficial. These findings highlight the potential of online platforms like Blackboard in medical education during crises, offering insights for improvement.

1. INTRODUCTION

A coronavirus disease 2019 (COVID-19) outbreak, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has swept across China and the world, leading to a pandemic (Alsoufi et al., 2020; Hammerstein et al., 2021). The global education system has faced significant challenges due to COVID-19, with countries implementing lockdowns (Dhawan, 2020; Woolliscroft, 2020). The rapid spread of COVID-19 has disrupted traditional medical lectures, impacting medical education, including health treatment, bedside teaching, lab activities, and lectures (Sklar, 2020; Zalat et al., 2021). Additionally, medical student internships have been affected by the burden of COVID-19 in healthcare institutions (Tempski et al., 2021). To curb the spread of COVID-19, the World Health Organization (WHO) has issued guidelines that discourage social gatherings at sports, entertainment, educational, and religious events in several countries, including Saudi Arabia (Yezli & Khan, 2020).

In response to the COVID-19 pandemic, educational activities have shifted to online classes. E-learning has gained prominence worldwide due to the shortage of health educators and the need for technology-enabled active learning (TEAL) (Health Assembly, 2017; Global Strategy on Human Resources for Health: Workforce 2030, 2020). Recent technological advancements have facilitated the evolution of e-learning (Norheim, 2016; Ravitz & Blazevski, 2014). Various online teaching tools, such as Microsoft, Zoom, Blackboard, and Teams, are used by medical schools. Blackboard Learn, in particular, is a reliable online tool that enables effective communication between students and teachers, offering a transparent and fair open grading system. Many Saudi universities utilize Blackboard as a virtual learning tool for online education (Subramanian et al., 2014; Khan et al., 2022; Elzainy et al., 2020).

The present study aimed to assess the nature of online learning and the students' self-directed responsibility for their learning using Blackboard (Liang et al., 2004). One advantage of transitioning from conventional classes to e-learning is the opportunity for learners to demonstrate problem-solving and critical-thinking skills through online evaluation (Alsadoon, 2017). Several studies have evaluated the impact of online teaching using Blackboard Learn on medical and dental students in Saudi Arabia (Khan et al., 2022; Alturise, 2020; Dost et al., 2020). The COVID-19 pandemic necessitated a significant shift to remote learning to ensure the safety of students and staff. Assessing the impact of this sudden shift to e-learning, particularly in the context of physiology, is crucial for evaluating the effectiveness and challenges of online medical education during the pandemic. Physiology requires a deep understanding of intricate physiological processes as a complex subject. Therefore, the authors aimed to investigate the impact of e-learning on physiology through Blackboard and assess how effectively students can grasp and retain physiological concepts using online teaching methods.

However, no studies have examined the impact of e-learning on physiology through Blackboard in the COVID-19 era among medical students. Consequently, this research seeks to investigate the impact of e-learning on physiology through Blackboard among medical students during the COVID-19 era.

2. MATERIALS AND METHODS

2.1. Participant

During the 2020-2021 academic year, our students were enrolled in a five-year medical program similar to the UCL programme. They focused on various basic sciences, including physiology, in the second and third years. The study was conducted at Al-Qunfudhah Faculty of Medicine, University of Umm Al-Qura. The participants attended the second term of the COVID era, which included the second semester courses (cardiorespiratory and gastrointestinal) for the second year and musculoskeletal and endocrine courses for the third year.

Before the COVID era, physiology courses were incorporated into the integrated system schedule, featuring five to six face-to-face lectures lasting approximately one hour each week and two laboratory sessions lasting around two hours. However, due to the national measures implemented by the Saudi Ministry of Health to combat the COVID-19 situation, the University of Umm Al-Qura transitioned from in-person attendance to online education. The university utilised the online teaching system, Blackboard, for student's remote learning. Physiology staff members adapted by delivering online lectures through Blackboard, while student attendance was monitored on the platform. At the end of the academic year, students underwent online assessments consisting of multiple-choice questions. The study employed a convenience sampling technique to select participants, targeting individuals who were easily accessible and available for participation.

2.2. Development of questionnaire

After obtaining informed consent from the students, an online questionnaire was administered to them using Google Forms. The questionnaire link was distributed to them via WhatsApp. A total of 149 students, including 79 second-year and 70 third-year students, participated in the study. Participants had experience with both face-to-face and online teaching methods. The questionnaire was carefully designed to gather relevant data and included Likert scale questions ranging from one (strongly disagree) to five (strongly agree) in the Google Forms format.

The structured questionnaire was developed to evaluate various aspects, including the impact of e-learning on physiology as a subject. It was meticulously crafted, incorporating insights from subject matter experts and existing literature. The questionnaire also assessed students' attitudes towards online teaching during the COVID era. To ensure the validity and reliability of the questionnaire, content validity and inter-reliability were maintained. This involved incorporating insights from subject matter experts, drawing upon existing literature, and adhering to established theoretical frameworks in the field of medical education and e-learning. Furthermore, clear instructions and explanations for each item in the questionnaire were provided to minimize ambiguity and enhance the validity of respondents' answers.

2.3. Stages of the procedure

The questionnaire was structured into three sections. The first section gathered demographic information, gender, age, academic year, and the mode of online attendance. The second section, comprising seven questions, focused on student satisfaction. The third section, consisting of three questions, assessed student satisfaction with assignment methods during online learning during the COVID-19 pandemic. Satisfaction rates were calculated following the method outlined by Guilbert (1998).

- Total satisfied = (Strongly agreed participant + agreed participant) * 100
- Total unsatisfied = (Strongly disagree participant + disagree participant) * 100

2.4. Data analysis

The study data were collected into an Excel spreadsheet and analyzed using the IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). Descriptive statistical analysis was conducted to summarize the demographic characteristics such as gender, age, academic year and participants' attendance method. Qualitative data from the questionnaire was analyzed using appropriate statistical methods, such as percentages, means, and standard deviations. *P* values less than 0.5 were considered as significant. The Cronbach's alpha coefficient was utilized to evaluate the internal consistency of the questionnaire items. Cronbach's alpha is a metric that gauges the degree of interrelation among a group of items. It exists on a scale between 0 and 1, where higher values signify stronger internal consistency.

3. RESULTS

3.1. Participant demographic distribution

According to the study findings, most participants in our study were female (64%). There were 79 students in the second year, accounting for 53% of the participants, with an average age of 18-19 years. Additionally, there were 70 students in the third year, making up 47% of the participants, with an average age of 20-21 years. Most students (140/93%) attended online classes through Blackboard, primarily using their phones (Table 1).

Table 1: Demographic distribution of participants

Characteristics	Demographic distribution	No (%)
Gender	Male	55 (36%)
	Female	94 (64%)
Age group	18-19years	79 (53%)
	20-21 years	70 (47%)
Academic year	2nd year	79 (53%)
	3rd year	70 (47%)
Method of attendance on Blackboard	Phone	140 (93%)
	Laptop	9 (6%)

3.2. Online Questionnaire response

The majority of students were distracted by home comforts, with 60 (40.2%) agreeing and 35 (23.4%) strongly agreeing, while 28 (18.7%) disagreed and 22 (14.7%) strongly disagreed, and 4 (2.5%) remained neutral. Regarding time management, 80 (53.6%) students agreed, and 30 (20.1%) strongly agreed that it was difficult. Many students agreed with the handling of online learning, with 75 (50.3%) agreeing and 34 (22.8%) strongly agreeing. Regarding protection from COVID-19 spread, most students agreed, with 72 (48.3%) agreeing and 52 (34.8%) strongly agreeing.

In the study, participants reported that online learning was easier to manage, with 65 (43.6%) students agreeing and 41 (27.5%) strongly agreeing. They also expressed that the university's online teaching methods were helpful in their studies, with 52 (34.8%) agreeing and 29 (19.4%) strongly agreeing. However, 27 (18.1%) participants strongly disagreed and 33 (22.1%) simply disagreed with this notion.

At the same time, a significant number of students, specifically 62 (41.6%), agreed that they missed face-to-face contact, while 28 (18.7%) strongly agreed with this sentiment. Most students found the assignments simple to complete, with 129 (86.5%) students agreeing or strongly agreeing. Additionally, the assignments were deemed beneficial by 149 students, with 112 (75.1%) of them agreeing and 27 (18.1%) strongly agreeing. Most students also reported that the assignments served as an effective method of assessment, with 95 (63.7%) agreeing and 44 (29.5%) strongly agreeing (Table 2A-E).

Table 2A: Questionnaire questions (Q1-Q2) and answers of medical students on them

Questions	Strongly disagree (SD)	Disagree (D)	Neutral (N)	Agree (A)	Strongly agree (SA)	Total (T)	Mean* ±(SD)
Q1. Are you distracted by home comforts?	22 (14.7%)	28 (18.7) %	4 (2.5%)	60 (40.2%)	35 (23.4%)	149	3.39±3.17
Q2. Are your time management facing difficulties?	11 (7.3%)	12 (8%)	16 (10.7%)	80 (53.6%)	30 (20.1%)	149	3.70±3.36

*Mean- The mean is the average value calculated by summing up all the individual response scores and dividing the sum by the total number of responses. Key abbreviation: SD- Strongly disagree, D- Disagree, N- Neutral, A- Agree, SA- Strongly agree, T- Total

Table 2B: Questionnaire questions (Q3-Q4) and answers of medical students on them

Questions	Strongly disagree (SD)	Disagree (D)	Neutral (N)	Agree (A)	Strongly agree (SA)	Total (T)	Mean* ±(SD)
Q3. Can you handle online learning?	10 (6.7%)	20 (13.4%)	10 (6.7%)	75 (50.3%)	34 (22.8%)	149	3.69±3.36
Q4. Using these methods limited the spread of COVID-19.	4 (2.5%)	18 (12%)	3 (2%)	72 (48.3%)	52 (34.8%)	149	4.01±3.63

*Mean- The mean is the average value calculated by summing up all the individual response scores and dividing the sum by the total number of responses. Key abbreviation: SD- Strongly disagree, D- Disagree, N- Neutral, A- Agree, SA- Strongly agree, T- Total

Table 2C: Questionnaire questions (Q5-Q6) and answers of medical students on them

Questions	Strongly disagree (SD)	Disagree (D)	Neutral (N)	Agree (A)	Strongly agree (SA)	Total (T)	Mean* ±(SD)
Q5. Were online lectures easy to follow?	8 (5%)	22 (14.7%)	13 (8.7%)	65 (43.6%)	41 (27.5%)	149	3.73±3.40
Q6. Online teaching of lectures is effective in teaching students.	27 (18.1%)	33 (22.1%)	8 (5%)	52 (34.8%)	29 (19.4%)	149	3.15±2.97

*Mean- The mean is the average value calculated by summing up all the individual response scores and dividing the sum by the total number of responses. Key abbreviation: SD- Strongly disagree, D- Disagree, N- Neutral, A- Agree, SA- Strongly agree, T- Total

Table 2D: Questionnaire questions (Q7-Q8) and answers of medical students on them

Questions	Strongly disagree (SD)	Disagree (D)	Neutral (N)	Agree (A)	Strongly agree (SA)	Total (T)	Mean*± (SD)
Q7. Do you miss face-to-face lectures?	19 (12.7%)	22 (14.7%)	18 (12%)	62 (41.6%)	28 (18.7)	149	3.39±3.13
Q8. The assignment in physiology was easy to complete.	5 (3%)	10 (6.7%)	5 (3.3%)	100 (67.1%)	29 (19.4%)	149	3.93±3.50

*Mean- The mean is the average value calculated by summing up all the individual response scores and dividing the sum by the total number of responses. Key abbreviation: SD- Strongly disagree, D- Disagree, N- Neutral, A- Agree, SA- Strongly agree, T- Total

*Table 2E: Questionnaire questions (Q9-Q10) and answers of medical students on them*

Questions	Strongly disagree (SD)	Disagree (D)	Neutral (N)	Agree (A)	Strongly agree (SA)	Total (T)	Mean*± (SD)
Q9. The assignment was beneficial.	0 (0%)	2 (1.3%)	8 (5%)	112 (75.1%)	27 (18.1%)	149	4.10±3.60
10. The assignment is a good method for assessment.	1 (0.6%)	3 (2%)	6 (4%)	95 (63.7%)	44 (29.5%)	149	4.19±3.72

*Mean- The mean is the average value calculated by summing up all the individual response scores and dividing the sum by the total number of responses. Key abbreviation: SD- Strongly disagree, D- Disagree, N- Neutral, A- Agree, SA- Strongly agree, T- Total

3.3. Satisfaction rate of the answers of the medical students

The satisfaction rates revealed that the proportion of satisfied individuals exceeded that of dissatisfied individuals. Question number nine had the highest satisfaction rate of 93%, indicating that the assignment benefitted the students. Conversely, question number six had the highest dissatisfaction rate of 41.1%, suggesting that many students expressed dissatisfaction with online teaching and preferred face-to-face instruction (Figure 1).
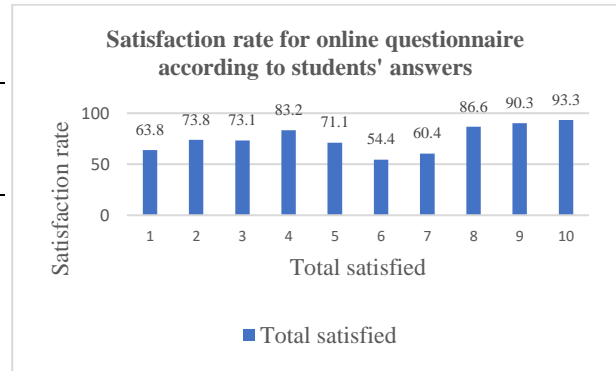
Figure 1. Satisfaction rate for online questionnaire according to students' answers

The questionnaire encompassed a total of 10 items and was completed by 149 respondents. The calculated Cronbach's alpha coefficient for the structured questionnaire in this study was 0.61, signifying the level of internal consistency within the survey results.

4. DISCUSSION

The entire world went into lockdown as COVID-19 rapidly spread. To mitigate the negative effects of the COVID-19 pandemic on global education, educational institutes switched from traditional face-to-face learning to e-learning. Before the COVID-19 pandemic, various virtual course management systems were used in LMS-based educational institutions. The study aimed to provide valuable insights into the effects of e-learning on subject physiology among medical students during the COVID-19 era, which could inform educational strategies and interventions in the future.

Among the various online teaching tools, Blackboard Learn was identified as the most appropriate online tool for effective communication between students and teachers due to its transparent and fair open grading system. Previous reports have determined the impact of online teaching using the Blackboard Learn tool among medical and dental students in Saudi Arabia. However, no studies determining the impact of e-learning through the Blackboard Learn tool were available during COVID-19.

As a result, an analysis was carried out using questionnaire responses from medical students for novel e-learning courses and the Blackboard Learn tool to determine the impact of e-learning on physiology through Blackboard in the era of COVID-19 among medical students. Several studies have reported that female students prefer e-learning more than male students (Alsoufi *et al*., 2020; Tempski *et al*., 2021; Ibrahim *et al*., 2021). Many studies investigating the impact of e-learning on students have shown that most participants (51%) fall between the ages of 18 and 19 (Al Zahrani *et al*., 2021; Alhazmi *et al*., 2022).

In the current study, most students (63.75%) believed that e-learning had distracted them from home comforts, while 33.56% disagreed and 2.68% were neutral. When asked about the difficulty of time management, most medical students (73.82%) agreed it was challenging.

Most students (73.15%) were satisfied with the handling of online learning. Most students (85.23%) believed that online learning protected them from COVID-19 infection.

Most students agreed that online learning was easier to handle, and several students (54.36%) believed that the university's virtual teaching methods assisted them in online learning, while 60% disagreed. Meanwhile, 60.40% of medical students reported missing face-to-face instruction. Most students (86.78%) agreed that the assignment was easy to complete, while 93.29% believed it benefited them. These findings are supported by various studies conducted on e-learning (Al Zahrani *et al.*, 2021; Moya-Salazar *et al.*, 2022; Abdelbagi, 2023). In our study, Blackboard was found to be effective for delivering educational materials via e-learning, with 93% of students attending class via phone.

The critical feature was the ability to track student attendance and the amount of time they spent in e-learning classes. A study conducted at Taif University found that using Blackboard to deliver lectures in e-learning classes was a very effective method (AlKarani *et al.*, 2020). Blackboard Learn is another online tool beneficial for delivering educational material in Saudi Arabia among nursing students (AlKarani *et al.*, 2020). This study found that most medical students (>75%) were satisfied with online learning, while more than 18% were dissatisfied, suggesting a preference for e-learning over face-to-face instruction. The highest level of satisfaction was found in question number 10, with a percentage of 93.3%, indicating that the assignment was very beneficial for the students. In contrast, the lowest level of satisfaction was found in question number six, with a percentage of 40.2%. A study showed that 86% of students were satisfied with e-learning, while 13.80% were dissatisfied (AlKarani *et al.*, 2020). Our study also found that most medical students reported that Blackboard had improved their performance at the institute.

A growing body of evidence on Blackboard suggests that using it improves student performance (Ibrahim *et al.*, 2021; AlKarani *et al.*, 2020; Alkarani, 2022). According to our findings, the majority of students strongly agreed that online learning was an effective method for assessing assignments, which is consistent with the findings of several studies (AlKarani *et al.*, 2020; Alkarani, 2022; Elsamanoudy *et al.*, 2020).

However, our study has some limitations: (i) it was limited to second-year medical students; (ii) it was limited to people in their second decade of age group; (iii) it did not compare outcomes of online learning with face-to-face learning modes; and (iv) it did not compare the impact of Blackboard with other online learning tools. In addition to that, the study is also subject to limitations such as potential sampling bias, self-reporting bias, and limited generalizability to other populations due to the small sample size. Furthermore, the cross-sectional design also limits the ability to establish causal relationships

5. CONCLUSION AND RECOMMENDATION
Based on the satisfaction and perceptions of medical students in our study, most rated Blackboard as an effective eLearning tool, particularly for theoretical learning. The online platform Blackboard has been shown to improve the performance of medical students. Combining online learning with face-to-face instruction, specifically through the Blackboard platform, may further enhance medical students' learning achievements. Institutions should regularly evaluate the effectiveness of e-learning platforms and adapt them based on feedback from students and faculty. Continuous improvement efforts should address challenges and enhance the online learning experience. Further research is needed to assess the long-term impact of e-learning on subject physiology among medical students. Longitudinal studies and mixed-methods approaches can provide a more comprehensive understanding of the effects over time and allow for a deeper exploration of students' experiences and perceptions.

CONFLICT OF INTEREST
The author declares that there is no conflict of interests.

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