Education Section

Comparison of Student Performance in Online versus Offline Teaching: A Case-Control Study in Obstetrics and Gynaecology Lectures in the Qassim Region, Saudi Arabia

ZAHEERA SAADIA[1], HOSSAM OMAR HAMID[2]

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ABSTRACT

Introduction: During the Coronavirus Disease 2019 (COVID-19) pandemic, there was a global need for online learning. Numerous publications were observed both in favour of and against online platforms, but most of them were qualitative. Now that the pandemic is over, we aimed to explore the effectiveness of online teaching compared to offline teaching.

Aim: This study aimed to descriptively compare the performance of medical students in online versus offline class teaching of the Obstetrics and Gynaecology course.

Materials and Methods: This quantitative retrospective case-control study was conducted in the Department of Obstetrics and Gynaecology at College of Medicine, Qassim University, from July 2022 to January 2023. The academic year 2018/2019 was considered the control group (August 2018 to June 2019, offline teaching), and the year 2020/2021 was considered the case group (online teaching, August 2020 to June 2021). A total of 123 students had the Obstetrics and Gynaecology course delivered online, compared to a control group of 115 students who had the same course offline. Chi-square test was applied to analyse categorical variables, considering a p-value <0.05 as significant.

Results: The measured outcomes included overall students' performance in terms of marks and grades, as well as performance in relation to gender and attendance rates. Overall, students' grades and attendance were higher in the online group (p=0.004 and p=0.03, respectively), which was more evident among male students (p=0.009).

Conclusion: The findings suggest that medical students' performance in online learning is comparable to or better than face-to-face teaching. Further research is needed to explore the performance of male students compared to female students.

Keywords: COVID-19, Medical learning, Pandemic

INTRODUCTION

A student's knowledge is constructed through social interaction [1]. According to the theory of constructivism, self-directed learners acquire knowledge through active interaction [2]. Online platforms played a crucial role in facilitating this active interaction during the COVID-19 pandemic [3]. In Saudi Arabia, including Qassim University, there was a rapid adoption of online platforms, which enabled the shift of all courses, including Obstetrics and Gynaecology, to online blackboard platforms. These platforms provided a constructive environment for students, tutors, and peers, facilitating interactive lectures, seminars, blogs, and quizzes.

The utility and necessity of online platforms were particularly evident during the pandemic [4-6]. These platforms ensured the continuity of medical education in the face of the sudden onset of the pandemic [7]. Despite the benefits, online learning also presents challenges such as cheating and anxiety [8-10]. Furthermore, reported limitations include family distractions, lack of commitment, and lack of motivation [7].

Numerous studies were published during the pandemic, but many of them were from disciplines other than medicine, had small sample sizes, or relied on questionnaires [11]. The results were conflicting regarding the advantages and disadvantages of online teaching methods. Some studies reported that online methodology is generally feasible and flexible [5,6]. However, these studies often focused on a single component of a course, limiting the credibility of the overall results [5]. Questionnaire-based studies reported students' perceptions of improved performance with online teaching, but lacked actual numerical data to measure this performance. Conversely, other studies found no significant difference between methodologies [12]. However, these studies enrolled students from different years, which could potentially bias the results [12]. Prior experience with face-to-face teaching may have influenced the results [12,13].

There is a need, once the pandemic situation has settled, to retrospectively examine and compare students' performance. This will help policymakers provide appropriate recommendations, as there is an ongoing demand to continue with online teaching.

In the current study, the authors aimed to compare the effectiveness of online delivery of the Obstetrics and Gynaecology course versus onsite class teaching. They addressed previous limitations by enrolling a group of students from one academic year (final year) who had the course delivered online during the COVID-19 pandemic, and comparing them to a control group that had the same course components delivered online. The primary outcome measured was students' performance in terms of final course marks and grades. Secondary outcomes included course attendance and the performance of male and female students in both modalities. Authors hypothesised that students' online performance is comparable to face-to-face teaching.

MATERIALS AND METHODS

This quantitative retrospective case-control study was conducted in the Department of Obstetrics and Gynaecology at College of Medicine, Qassim University from July 2022 to January 2023. The data of students were retrospectively obtained from the department's records. There were three batches taught annually, consisting of one girls group and two boys groups, with approximately 40-45 students per batch. Ethical clearance was obtained from the University Ethical Board (approval no. 21-22-09, dated 28th June 2022).

Sample size calculation: Using the Epi tool online sample size calculator, a sample size of 98 per group had a power of 80% with a confidence level of 95%. (https://epitools.ausvet.com.au/casecontrolss). All data were kept anonymous to maintain confidentiality.

Inclusion criteria: All students attending the course sessions between August 2018 and June 2019 (offline) and August 2020 to June 2021 (online) were included in the study. A total of 123 students were used as the control group (N=123) as they had traditional in-class teaching. Students from the academic year 2020/2021 (N=115) who had all their sessions online during the COVID-19 pandemic were included as subjects.

Exclusion criteria: Students with missing data were excluded.

Study Parameters

The course in both the subjects and controls consisted of 8 credit hours and was delivered over a nine-week period. It included a clinical component with bedside teaching on real patients, as well as, a theoretical component in the form of interactive lectures, seminars, and case discussions. The assessment tasks, tools, and duration was similar for both groups. The exam tools included Multiple Choice Questions (MCQs), Modified Essay Questions (MEQs), Objective Structured Clinical Exams (OSCEs), oral case discussions, and Mini-cex exams.

All clinical components were conducted online through blackboard. Structured OSCE using pictures was conducted, and clinical case scenarios were used for conducting the case discussions. To ensure similarity in the examinations for both groups, the exams were prepared by the same individuals. The examiners for both groups used the same sort of cases, as those seen in the ward by the offline group and case scenarios for the online group.

According to university rules, the minimum passing mark for the course is 60% of the total course marks. Student grades are defined as follows: (D) for marks between 60 and less than 65%, (D+) for marks between 65 and less than 70%, (C) for marks between 70 and less than 75%, (C+) for marks between 75 and less than 80%, (B) for marks between 80 and less than 85%, (B+) for marks between 85 and less than 90%, (A) for marks between 90 and less than 95%, and (A+) for marks between 95 and 100% of the total course marks. Passing students' grades can also be represented as excellent grades (A and A+), above-average grades (B and B+), average grades (C and C+), and below-average grades (D and D+).

STATISTICAL ANALYSIS

The data coding, tabulation, and statistical analysis were performed using Statistical Package for the Social Sciences (SPSS) version 23.0. The selected variables were students' grades, gender, repeaters or not, and summative grades. Descriptive statistics were used to summarise values such as mean±SD, variance, and central tendency. Inferential statistics were used to compare both groups and draw conclusions. Chi-square was applied to observe the effect in categorical variables. Other statistical tests applied were the Fisher's-exact test and Independent t-test. A p-value < 0.05 was considered significant.

RESULTS

A total of 238 participants were enrolled in both groups of the study, with a total of 123 in the online group and 115 in the face-to-face group [Table/Fig-1]. The percentages of male and female students, as well as fresh and repeater students, were comparable (p=0.520). The overall number of students absent from course activities was higher in the onsite group compared to the online group (p=0.034). However, when the absence is divided into categories, the absolute low absence rates (below 5% and 5-10%) from course activities were higher in the online group. Online and face-to-face students with the overall grades is mentioned in [Table/Fig-2].

Variable	Level	Online (N=123)	Traditional offline (N=115)	p-value
Gender	Male	84 (68.2%)	74 (64.3%)	0.5206
	Female	39 (31.7%)	41 (35.6%)	
State of student	Fresh	118 (95.9%)	114 (99.1%)	0.1169
	Repeater	5 (4.06%)	1 (0.9%)	
Attendance	Below 5%	46 (37.3%)	26 (22.6%)	0.03498
	5-10%	55 (44.71%)	38 (33.0%)	
	Above 10%	22 (17.8%)	31 (27%)	
Grades	A	4 (3%)	3 (2.6%)	0.00241
	B+	28 (23%)	7 (6.1%)	
	B	21 (17%)	22 (19.1%)	
	C+	27 (22%)	17 (14.8%)	
	C	22 (18%)	27 (23.5%)	
	D+	14 (11%)	23 (20%)	
	D	5 (4%)	12 (10.4%)	
	F	2 (2%)	4 (3.5%)	

[Table/Fig-1]: Demographic and academic variables in online and face-to-face classes.
*Absence of >25% of total course activities prevents student to sit final exam based on University roles. Two students had above 25% absent but they had official excuse accepted; p-value<0.05 considered significant

Overall grade	Groups		Total N=238 n (%)	Chi-square value (p-value)	Overall Chi-square value, p-value
	Online N=123 n (%)	Traditional offline N=115 n (%)			
Excellent grades					
# A	4 (3.3%)	3 (2.6%)	7 (2.9%)	-	0.004
Above-average grades					
B+	28 (22.8%)	7 (6.1%)	35 (14.7%)	8.0705 (0.018)	
B	21 (17.1%)	22 (19.1%)	43 (18.1%)		
Average grades					
C+	27 (22%)	17 (14.8%)	44 (18.5%)	2.5214 (0.112)	
C	22 (17.9%)	27 (23.5%)	49 (20.6%)		
Below-average grades					
D+	14 (11.4%)	23 (20%)	37 (15.5%)	0.3626 (0.547)	
D	5 (4.1%)	12 (10.4%)	17 (7.1%)		
Failed students					
# F	2 (1.6%)	4 (3.5%)	6 (2.5114%)	0.43 (NS)	

[Table/Fig-2]: Cross-tabulation of online and face-to-face students with the overall grades.
Chi-square test except in #F where Fisher's-exact test was used as values in each cell were below 5; p-value<0.05 considered significant

In [Table/Fig-2,3], the different exam tools and tasks are listed. The marks for the continuous assessment task, which constitutes 40% of the total course marks, were significantly higher in the online group. In the final exam task, which constitutes 60% of the course, the MCQ exam marks were significantly higher in the online group, while the marks for other final exam tools were comparable between both groups.

Assessment task and tools		Online N=123	Traditional offline N=115	Confidence interval	p-value
		Mean±SD	Mean±SD		
Continuous assessment mark (40%)		31.48±3.25	29.8±3.09	0.85-2.48	0.001
Final exam mark (60%)	MCQ (30%)	21.64±3.13	19.53±3.56	1.24-2.95	0.001
	OSCE (10%)	7.74±1.23	7.51±1.09	-0.54-0.52	0.129
	MEQ (5%)	3.75±0.74	3.6±0.65	-0.02-0.32	0.099
	Clinical (15%)	12.59±1.23	12.61±1.01	-0.32-0.28	0.87

[Table/Fig-3]: Cross-tabulation of student's marks in continues assessment and tools of final exam.
Independent sample t-test was used to calculate the p-value; p-value<0.05 considered significant

The subgroup analysis for the comparison of students' grades among male students in both groups is shown in [Table/Fig-4], and for female students in [Table/Fig-5].

| Overall grade | Groups | | | p-value |
	Online N=84 N (%)	Traditional offline N=74 N (%)	Total N=158 N (%)	
A	2 (2%)	3 (4%)	5 (3%)	
B+	21 (25%)	3 (4%)	24 (15%)	
B	12 (14%)	13 (18%)	25 (16%)	
C+	18 (21%)	13 (18%)	31 (20%)	0.009
C	17 (20%)	15 (20%)	32 (20%)	
D+	9 (11%)	15 (20%)	24 (15%)	
D	3 (4%)	9 (12%)	12 (8%)	
F	2 (2%)	3 (4%)	5 (3%)	

[Table/Fig-4]: Cross-tabulation of male students and overall grade.
Chi-square test was used, p-value<0.05 considered significant

| Overall grade | Groups | | | p-value |
	Online N=39 No (%)	Traditional offline N=41 No (%)	Total N=80 No (%)	
A	2 (5%)	0 (0%)	2 (2%)	
B+	7 (18%)	4 (10%)	11 (14%)	
B	9 (23%)	9 (22%)	18 (22%)	
C+	9 (23%)	4 (10%)	13 (16%)	0.221
C	5 (13%)	12 (29%)	17 (21%)	
D+	5 (13%)	8 (20%)	13 (16%)	
D	2 (5%)	3 (7%)	5 (6%)	
F	0 (0%)	1 (2%)	1 (1%)	

[Table/Fig-5]: Cross-tabulation of female students and overall grade.
Chi-square test was used, p-value<0.05 considered significant

[Table/Fig-4] shows significantly higher grades above the average for male students in online teaching compared to onsite teaching, with an overall p-value of 0.009. Conversely, in female students [Table/Fig-5], there was no significant difference in grades between the two study groups. The number and percentage of male and female students were also tabulated across different grade levels and compared between the teaching modalities. There were no significant differences in performance between male and female students in both the study groups (p>0.05) [Table/Fig-6].

| Overall grade | | | Groups | | p-value |
			Online	Traditional offline	
A	Gender	Male	2 (40%)	3 (60%)	
		Female	2 (100%)	0	0.147
	Total		4 (57.1%)	3 (42.9%)	
B+	Gender	Male	21 (87.5%)	3 (12.5%)	
		Female	7 (63.3%)	4 (36.4%)	0.101
	Total		28 (80%)	7 (20%)	
B	Gender	Male	12 (48%)	13 (41.9%)	
		Female	9 (50%)	9 (50%)	0.897
	Total		21 (48.8%)	22 (51.2%)	
C+	Gender	Male	18 (58.1%)	13 (41.9%)	
		Female	9 (69.2%)	4 (30.8%)	0.735
	Total		27 (61.4%)	17 (38.6%)	
C	Gender	Male	17 (53.1%)	15 (46.9%)	
		Female	5 (29.4%)	12 (70.6%)	0.140
	Total		22 (44.9%)	27 (55.1%)	
D+	Gender	Male	9 (37.5%)	15 (62.5%)	
		Female	5 (38.5%)	8 (61.5%)	1
	Total		14 (37.8%)	23 (62.2%)	
D	Gender	Male	3 (25%)	9 (75%)	
		Female	2 (40%)	3 (60%)	0.600
	Total		5 (29.4%)	12 (70.6%)	
F	Gender	Male	2 (40%)	3 (60%)	
		Female	0	1 (100%)	1
	Total		2 (33.3%)	4 (66.75)	
Total	Gender	Male	84 (53.2%)	74 (46.8%)	
		Female	39 (48.8%)	41 (51.2%)	0.583
	Total		123 (51.7%)	115 (48.3%)	

[Table/Fig-6]: Cross-tabulation of gender and overall grade.
Chi-square test was used

DISCUSSION

The results of this study indicate that students who participated in online courses achieved better grades compared to those who attended in-person classes. This is evident from a higher percentage of students achieving above-average grades and a lower percentage of students with below-average grades. Specifically, the marks for the continuous assessment task (which accounts for 40% of the total course marks) and the MCQ section of the end-course exam task (which accounts for 30% of the total course marks) were higher for the online group compared to the offline teaching group. These findings can be partially explained by the higher overall attendance in the online group and the potential for students to have more dedicated study time after completing online activities.

These findings are consistent with some previous studies in the literature. For example, Zheng M et al., compared students who were forced to study online during the COVID-19 pandemic in 2020 in summers with those who studied in the classroom in 2019 in summers, and found that online students were more likely to achieve an A grade compared to classroom students [14]. However, the current study findings are inconsistent with a recent study by Darkwa BF and Antwi S, which compared online and face-to-face modes of study among undergraduates and found that classroom learning was a more effective method of learning for students [15].

In contrast to the findings of the current study, Paul J and Jefferson F, conducted a study comparing online and classroom-based (face-to-face) modes of study in higher education institutions. Their study, which involved 548 students (401 traditional students and 147 online students), was conducted before the era of COVID-19. The authors found no significant differences in academic performance between online and face-to-face students [13]. While their study did not find differences in performance, their assumptions may help to explain the disparities found in the current study. They argued that traditional classroom-based teaching may be seen as restrictive, inflexible, and impractical by students. They further suggested that technological advancements provide students with more effective teaching methods through online platforms. These benefits may have contributed to the better performance of online students in the current study [13].

Similarly, in the study conducted by Zheng M et al., the authors found that their student participants expressed a preference for online courses and expressed a desire for continued online delivery even after the pandemic. This suggests that there may be positive aspects of online courses or online delivery methods that contribute to greater success compared to traditional classroom-based delivery [15].

One finding in the current study that may not explain the better performance of online students is the higher percentage of students with less than 10% absence in the online group (82%) compared to the onsite teaching group (55%). However, this difference in attendance seems to be compensated by the presence of more

students with a high absence rate (more than 10% of course activities) in the onsite group, resulting in an overall significantly higher attendance rate in the online group.

The current study revealed better grades among male students in online teaching compared to males in onsite teaching, while grades were comparable among female students in both modalities. These differences between male groups may be attributed to variations in Intelligence Quotient (IQ) or attention levels among different male students. These findings align partially with other studies. For example, Paul J and Jefferson F, investigated gender differences in a study involving 548 undergraduate participants but did not compare grade performance between different teaching modes [12]. Similarly, Hsiao YC examined the effect of gender in 18,085 male and female undergraduate students and found that self-learning satisfaction rates were higher in face-to-face teaching for male students, contradicting the current study findings. However, in female students, both teaching modes had equal satisfaction rates, consistent with the current study's findings [16]. To the best of our knowledge, studies comparing different male or female groups, as conducted in the current study, are lacking. This unique finding suggests the need for future studies to replicate these results. It is important to note that the study was conducted at a single university and focused on a single course. However, Qassim University is a prominent higher education institution in the region, and the findings are expected to be representative of similar situations in other universities in the area.

Limitation(s)

- The study was conducted at a single university and focused on a single course.
- Long-term follow-up was not possible.

CONCLUSION(S)

This study demonstrates the effectiveness of online teaching compared to face-to-face teaching in terms of students' performance and overall attendance. The findings suggest that the online teaching method adopted for the course resulted in better grades and higher attendance. The results of this study may support the recommendation for the continuation of hybrid teaching even after the COVID-19 pandemic, especially for clinical courses like Obstetrics and Gynaecology. The information provided in this study can be valuable for policymakers in making decisions for future studies.

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PARTICULARS OF CONTRIBUTORS:
1. Professor, Department of Obstetrics and Gynecology, Qassim University, Buraidah, Qassim, Saudi Arabia.
2. Associate Professor, Department of Obstetrics and Gynecology, Qassim University, Buraidah, Qassim, Saudi Arabia; Professor, Department of Obstetrics and Gynecology, Assiut University, Egypt.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Zaheera Saadia,
8260, Alrajhi Buildings, King Khalid Road Apt 108, Buraidah, Al Qassim, Saudi Arabia.
E-mail: zaheerasaadia@hotmail.com

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