

Online Vs On-campus Teaching Methodology: Analyzing Medical Students' Performance in the Subject of Biochemistry

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Abstract: Introduction: Biochemistry is studied in the first two years of the Bachelor of Medicine-Bachelor of Surgery (MBBS) program in Pakistan and is a comparatively difficult subject to study. Complex language, retention of a large volume of facts, and intellectual concepts lead the students to end up with poor notions about the subject. In our local setup, students do not study foundation modules of basic sciences before entering Medical school. Consequently, within the tough and crammed curriculum of MBBS, it becomes rather more challenging to teach the subject to the students. Furthermore, COVID-19 infection has impacted education over the globe and resulted in the closure of schools and universities. Opting for online teaching was the best option of the time and helped to continue with education in the country, however, it seems that it leads to the deterioration of the student's performance.

Aim and objectives: It was assumed that online teaching decreases the performance of the students in terms of their exam scores specifically in a subject with complex concepts. Thus, it is decided to evaluate medical students' performance in the subject of Biochemistry at Rashid Latif Medical College, Lahore, Pakistan with an online and on-campus teaching methodology.

Methodology: It was a retrospective and longitudinal study. We analyzed end-of-course exam scores in the subject of Biochemistry for the academic sessions 2019-20 & 2020-21. A structured proforma was developed to record study findings after validation from an expert faculty member. We made a comparison of the performance of students of 1st year MBBS who were taught the course on campus and online. The same was done with 2nd year MBBS students. The variance of performance was calculated, and correlations were analyzed statistically by applying independent sample t-tests.

Results: 90.1% of the 1st year and 60.5% of 2nd year students passed the end-of-course exam when taught on campus while 56.6% of the 1st year and 34.2% of 2nd year students passed the end-year course exam when taught the same courses online by the same teaching faculty. It is observed that the performance of 1st and 2nd year MBBS students decreased with a variance of 20% when taught online. Moreover, the students who were taught on campus in 2019-20 and were taught online in 2020-21 after their promotion to 2nd year MBBS showed a decline in their performance with a variance of 35%. An independent sample t-test was used to compare the mean of end course results, between 1st-year class, session 2019-20 with on-campus teaching, and 1st-year class, session 2020-21 with online teaching. The results showed a statistically significant difference between the mean of end course results for the 1st-year class, session 2019-20 with on-campus teaching, and 1st-year class, session 2020-21 with online teaching ($t = 7.565$, $p = < 0.001$). 1st-year class with on-campus teaching has a statistically significantly higher mean score on end course results (60.61 vs 48.51). Results for the 2nd-year class, session 2019-20 with on-campus teaching, and 2nd-year class, session 2020-21 with online teaching also showed a statistically significant difference between the mean of end course results ($t = 4.788$, $p = < 0.001$). The 2nd-year class, session 2019-20 with on-campus teaching has a statistically significantly higher mean score on end course result (49.1 vs 39.2).

Conclusion: It was identified that the MBBS student performance in the subject of Biochemistry declined when taught online in comparison to the same courses taught on campus by the same teaching faculty.

Keywords: Teaching methods, Medical student, Biochemistry, COVID-19

1. Introduction

The learning ability of a student varies not only in terms of individual behaviors but also in the method one opts to learn. The key role of a teacher in the process of learning is to facilitate the student for maximum gain of skills and knowledge [1]. Biochemistry is studied in the first two years of the Bachelor of Medicine-Bachelor of Surgery (MBBS) program in Pakistan. It contains a distinct "language" of names, processes, and rules which imposes a great challenge on the students. Moreover, the retention of a large volume of facts as well as the understanding of abstract concepts leads the students to end up with poor ideas about the subject.

In our local setup where students enter a medical school after a higher secondary education degree or A-level and not after the Bachelor of Science, a two-year graduate degree, do not study foundation modules of basic sciences before entering the Medical school. Within the tough and packed curriculum of MBBS, it becomes rather more challenging to teach the subject to the students [2]. Attending school increases an individual's learning. Carlsson et al. established in a study that only ten days of extra schooling considerably increases test scores for the use of knowledge [3]. Previous studies show that teaching may not support conceptual learning without interaction with the teacher. The individualized questioning from the students to evaluate their understanding and correction of the misconception were what led to greater learning when taught in the instructor-supported environment. They further noted that when trained by the online method, the students may not be able to compare their work with their peers' work [4]. In a study conducted at the University of Central Florida, it was established that dependent learners seek motivational approval and are not comfortable with online teaching [5].

COVID-19 influenced education over the globe. It resulted in the closure of schools and universities and shifted teaching and learning from on-campus to online aiming to reduce contact and save lives. Online teaching was a substantial trauma to children's social life and learning [6]. Although it helped to continue the teaching, however, it seems that it deteriorated the learning and performance of the students.

2. Aims and Objectives

It was assumed that online teaching decreases the performance of the students in terms of their exam scores specifically in a subject with complex concepts. So, it is decided to evaluate medical students' performance in the subject of Biochemistry at Rashid Latif Medical College (RLMC), Lahore, Pakistan with an online vs on-campus teaching methodology.

3. Methodology

It was a retrospective and longitudinal study. The study period was two years. We analyzed end-of-course exam scores in the subject of Biochemistry for the academic sessions 2019-20 & 2020-21. 1st year and 2nd year MBBS students of academic session 2019-20 were taught on campus and 1st year and 2nd year MBBS students of academic session 2020-2021 were taught online. A structured proforma was developed to record study findings after validation from three expert faculty members. Students were taught the same course content by the same faculty members in both academic sessions. The performance of students was compared through the end-of-course exam scores. To standardize the students' performance evaluation process, the same assessment tools and methods were used. RLMC is affiliated with the University of Health Sciences (UHS), Lahore, Pakistan, a degree-granting University, and a blueprint developed by UHS for the assessment of the Biochemistry course in the first and second professional exams was used to construct the short essay and multiple-choice question paper. Whether taught online or on campus, all had to appear for the exam on campus. The variance of both classes' students' end-of-course exam scores was calculated in terms of performance, and correlations were analyzed statistically by applying independent sample t-tests to assess for a difference in end-of-course exam scores between 1st-year and 2nd-year class, session 2019-20 with on-campus teaching and 1st-year and 2nd-year class,

session 2020-21 with online teaching. The level of statistical significance was set at $P < 0.05$. All statistical analysis was carried out using Statistical Package for the Social Sciences version 28.0 software (SPSS Inc, Chicago, IL, USA).

4. Results

90.1% of the 1st year (mean scores= 60.6±9.85) and 60.5% (mean scores=49.13± 16.97) of 2nd year students passed the end-of-course exam when taught on campus while 56.6% (mean scores= 48.5±17.06) of the 1st year and 34.2% (mean scores= 39.2±18.95) of 2nd year students passed the end-of-course exam when taught the same courses online by the same teaching faculty (see table 1). It is observed that the performance of 1st and 2nd year MBBS students decreased with a variance of 20% when taught online. Moreover, the students who were taught on campus in 2019-20 and were taught online in 2020-21 after their promotion to 2nd year MBBS showed a decline in their performance with a variance of 35.2% ($t=14.343$, $p= <0.001$).

TABLE I: End course score of 1st year and 2nd MBBS students with on-campus and online teaching

Academic Session	Class	Result		
		Passed Students	Mean of Score	Std dev
		n (%)	n	± (n)
OC - 2019-2020	1st Year	137 (90.1)	60.6	± 9.85
	2nd Year	92 (60.5)	49.13	± 16.97
OL - 2020-2021	1st Year	86 (56.6)	48.5	± 17.06
	2nd Year	52 (34.2)	39.2	± 18.95

OC = On-campus teaching, OL = Online teaching

TABLE II: Comparative analysis of end-course-exam scores of 1st year and 2nd MBBS students with on-campus and online teaching

Mode of Teaching	OC - 2020*			
	1st Year		2nd Year	
	Var (%)	p-value /t-score	Var (%)	p-value/t-score
OL - 2021*	1st Year	-20.0	< 0.001/7.565	-
	2nd Year	-35.2	< 0.001/14.343	-20.1 < 0.001/4.788

OC = On-campus teaching, OL = Online teaching

* End-course-exam conducted on-campus

** Significant if p-value < 0.05 (two-tailed)

An independent sample t-test was used to compare the means of end course result, a normally distributed interval dependent variable for two independent groups (1st year class, session 2019-20 with on-campus teaching

vs 1st year class, session 2020-21 with online teaching). The results showed a statistically significant difference between the mean of end course results for the 1st year class, session 2019-20 with on-campus teaching, and 1st year class, session 2020-21 with online teaching ($t = 7.565$, $p = < 0.001$) (see table 2). 1st year class with on-campus teaching has a statistically significantly higher mean score on end-of-course results (60.61 vs 48.51) (see table 1). Results for the 2nd year class, session 2019-20 with on-campus teaching, and 2nd year class, session 2020-21 with online teaching also showed a statistically significant difference between the mean of end-of-course results ($t = 4.788$, $p = < 0.001$) (see table 2). The 2nd year class, session 2019-20 with on-campus teaching has a statistically significantly higher mean score on end course result (49.1 vs 39.2) (see table 1).

5. Discussion

During the pandemic of COVID-19, online teaching was the only option to continue with teaching activities. However, the results strongly demonstrated that the on-campus teaching method is better than online teaching and helps to increase students' performance. Biochemistry is a conceptual subject and deals with an understanding of biological processes. Its inherent complexity makes it a difficult subject for students and teachers both. Unlike the subjects where it is likely for students to relate with specimens or real-life examples, conceptualization in biochemistry is challenging for the students. They cannot elaborate on the definitions without having a clear understanding [7]. Thus, if they are not taught face to face it becomes difficult for them to understand the complex concepts and our study proved it. The analysis of variance showed a decline in the performance of the students to 20% when taught online. Moreover, the students who were taught on campus in 2019-20 and were taught online in 2020-21 after their promotion to 2nd year MBBS showed a decline in their performance with a variance of 35.2%. Contrary to our results, Khaled et al in a study proved that the online method of teaching is more effective and better than on-campus teaching and suggested that it can be a good method for students in many ways, including the increasing ability to learn independently without the assistance of teacher provided the students are skilled and have access to the appropriate e-learning tools [8]. With online teaching students face many difficulties, for example, staying motivated during the teaching without the perception of someone else in the class, and feeling completely isolated. In addition, teachers are unable to control students' cheating and maintain classroom discipline. The non-affording students fight to get the necessary electronic equipment to cope with this new method of learning. Those who don't raise necessary queries to clear doubts and any ambiguous statements are unable to get appropriate feedback from their teacher. Researchers have shown that specific media and its composites are prerequisites of online learning and thus many of them support one-on-one learning [9-10 & 11]. Every student in a developing country like Pakistan has no adequate access to internet facilities which is the key to online teaching. This may be one factor for the poor outcome of online teaching. Moreover, studies have proved that with online teaching, the presence of students cannot be ensured and there is a significant correlation between students' perceptions of the presence of their fellow students in the class and their performance. The feeling of the instructor's presence is also significantly correlated with both affective learning and performance and on-campus teaching not only ensures the teacher's immediacy but also students' perception of being in the class [12]. Nevertheless, many factors directly correlate to the performance of the students which include the perception of the fellow students being around, handling of queries and clear misconceptions in the presence of the teacher and getting instant feedback, staying motivated and engaged, real face-to-face contact, accountability, are vitals components of on-campus teaching.

6. Conclusion

It was identified that the MBBS student performance in the subject of Biochemistry declined when taught online in comparison to the same courses taught on campus by the same teaching faculty. Consequently, an on-campus teaching methodology is a better option specially to teach a difficult and conceptual subject like Biochemistry. Further research to evaluate and explore different teaching methods can be of great help to develop appropriate teaching strategies for the maximum outcome in terms of the performance of students.

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8. References

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