

# Medical Education

## Medical biochemistry: Is it time to change the teaching style?

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### ABSTRACT

**Background.** The Medical Council of India (MCI) recommendations on medical education suggest a shift from didactic lectures to more interactive lectures. This study assessed the effectiveness of different pedagogical methods in biochemistry and the perceptions of students and teachers about the shift from didactic to interactive lectures.

**Methods.** An interventional crossover study was done with the topic divided into three biochemical modules and one clinical module. The students were divided into two batches, one of which was given didactic and the other, interactive lectures. They were assessed immediately after the lecture and four months later. Anonymous feedback was obtained to gauge the students' perceptions regarding the mode of teaching. The teachers' feedback on the use of both pedagogical styles was also obtained.

**Results.** There was no significant difference between the performance of the two groups in either examination in three of the modules. However, there was a statistically significant difference between the two groups' performance in the module that had clinical applications, with students from the interactive lecture group performing better. All students preferred interactive classes, irrespective of the topic taught. The teachers indicated that, although at the outset the interactive lectures were difficult to manage, both in terms of content and time, these drawbacks could be overcome with time and practice.

**Conclusion.** Interactive lectures are an effective teaching method in biochemistry, especially in topics involving clinical application.

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### INTRODUCTION

Looking back at their medical careers, most practising doctors vent their frustration at having spent their preclinical year trying to learn incomprehensible reactions and pathways that they never understood. Biochemistry is one of the foundation-stones of medicine and is taught in medical colleges across India, primarily through didactic lectures, in the first year of the medical course.<sup>1</sup> Several studies have shown that didactic teaching has many drawbacks, including: (i) it is teacher-centric;<sup>2,3</sup> (ii) it is a passive learning method;<sup>2,3</sup> (iii) the students' interest and attention diminishes significantly after 20–30 minutes;<sup>4–6</sup> (iv) the rate of

retention of factual information is low;<sup>7–9</sup> (v) the students' level of satisfaction is low;<sup>7–9</sup> and (vi) it is monotonous for the students.<sup>10</sup>

Didactic lectures are a time-tested method of teaching<sup>11,12</sup> and are here to stay. They are irreplaceable when it comes to teaching the basics in a subject such as biochemistry. To overcome their drawbacks and increase their effectiveness, didactic lectures are punctuated with short interactive sessions in the form of buzz groups, group discussions and quizzes, in which the students are allowed to apply the information they have been taught, leading to what are termed interactive lectures.<sup>8,13,14</sup>

Reactions and pathways of the human system form a part of the biochemistry syllabus. Teaching these pathways and cycles to first-year MBBS students through interactive lectures could be a challenge for medical teachers. Moreover, delivering interactive lectures to a group of students in an organized manner and within the specified time, while not missing out on important points, are the main drawbacks of interactive lectures in biochemistry.<sup>15,16</sup>

While many studies have shown the advantages of using interactive lectures in medical education,<sup>15,17–19</sup> the literature on the use of such lectures to help students grasp biochemical equations and their clinical significance is inconclusive. This study is unique in that it makes a direct comparison between the learning outcomes associated with interactive lectures and didactic lectures on clinical and non-clinical topics in biochemistry. The study also compared students' preferences regarding pure biochemistry topics and topics which have clinical applications, taught both in didactic and interactive classes. The subjects consisted of two cohorts (first-year MBBS students) with the same academic background and statistically similar academic grades. The study was conducted at a time when medical colleges in India were gearing up for the new revised curriculum of the Medical Council of India (MCI), which stipulates that didactic lectures should not exceed one-third of the teaching schedule and that two-thirds of the schedule should include interactive, practical, clinical or/and group discussions.<sup>20</sup>

We compared the effectiveness of interactive lectures in biochemistry with that of didactic lectures. This was measured by (i) a test conducted with multiple-choice questions, conducted immediately after the lecture, to evaluate understanding and simple recall; (ii) assessing the students' level of satisfaction, and learning about their preferences and suggestions regarding improvements in teaching–learning methods through anonymous feedback forms, which the students filled in after all the topics in the study were covered; (iii) the students' performance in the topic in the comprehensive final examination at the end of the year, i.e. 4 months after the study, to evaluate the retention, synthesis and elaboration of knowledge of the topic.

We also asked the teachers about their opinion on taking interactive lectures.

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**METHODS**

A prospective crossover interventional study in biochemistry was done at Malankara Orthodox Syrian Christian (MOSC) Medical College, Kolenchery, Kerala. One hundred first-year MBBS students were enrolled for the study after their written consent was obtained. The students were randomly divided into two groups. The average marks obtained by the members of the two groups in all the previous class tests were calculated and there was no significant statistical difference between the groups.

The topic of the study was haemoglobin. The study was divided into four modules: synthesis, porphyrias, degradation and jaundice, and the biochemical basis of haemoglobinopathies. One group was given a didactic lecture in the first class, and this group formed the control group for this module. The second group was given an interactive lecture on the same topic. For the next module, the teaching methodology for the groups was reversed—the first group was given an interactive lecture and the second, a didactic lecture. The four modules were taught such that each group was given two didactic lectures and two interactive lectures, so that all students were exposed to both types of lectures (Fig. 1).

Tests containing multiple-choice questions were conducted immediately after the lectures—both didactic and interactive, and the students' performance was assessed.

At the end of all the lectures, anonymous feedback was obtained from all 100 students with the help of a questionnaire. There were three parts to the questionnaire. In the first part, the students were asked to state whether they preferred didactic or interactive lectures and the reason for their preference. The second part had seven divisions. The students were asked to rate the effectiveness of the two types of lectures on a Likert scale in terms of how far they helped in enhancing knowledge, creating interest in the topic, recollecting the content of the lecture, clearing doubts, covering wider aspects of the topic, maintaining a time schedule, and motivating them to study further. The scale ranged from 0=very poor to 5=excellent. The third part of the questionnaire sought their suggestions on how to improve teaching-learning methods.

After 4 months, in the first-year comprehensive final examination, the answers to a structured essay question from one

of the modules on haemoglobin were evaluated and the marks obtained by the two groups were compared.

All lectures in the entire study were delivered by the same teacher, who used the same teaching aids: chalkboard and PowerPoint presentation. The professor who lectured the students was also the principal investigator of the study. The duration of all classes was one hour. Of this, 45 minutes were devoted to the lecture and 15 to summarizing and clearing the students' doubts in the case of the didactic classes. In the case of the interactive classes, 30 minutes were devoted to the lecture, 15 minutes to group discussions, and 15 minutes to summarizing and clearing doubts.

*Exclusion criteria*

Students who were repeating the classes and had prior knowledge of the topics were excluded. Also, we did not evaluate 14 forms because the students had either not submitted them or had not filled them properly.

*Statistical analysis*

Both in the immediate test and the comprehensive final examination conducted after 4 months, the Mann-Whitney test was used to compare scores of the control group (didactic lecture) and the intervention group (interactive lecture) in all four modules. A p value of <0.05 in the difference between the median scores of the two groups was considered significant. The data were analysed using Microsoft Excel.

**RESULTS**

The results of the immediate test conducted after each module as a measure of initial comprehension and immediate recall (Table I) showed no statistically significant difference between the scores of the two groups in modules 1, 2 and 4. However, in module 3, the scores of the intervention group were found to be significantly higher than those of the control group. Module 3 dealt with a clinically oriented topic, jaundice.

All 86 students whose feedback was evaluated preferred interactive lectures (Table II). Interactive lectures were associated with a higher median score for helping to enhance understanding, create interest in the lecture, motivate the students to study further, enhance immediate recollection, and clear doubts. Interestingly, the median scores for didactic and interactive lectures were similar for the wider aspects of the topics covered and the time schedule (Table III).

The students gave the following suggestions for improvement of teaching-learning methods:

1. Classes should be interactive.
2. A short test should be conducted at the end of each class, as this helps in the process of recall and learning.
3. Group discussions help one retain and recall knowledge.

TABLE I. Comparison between scores of control group (didactic lecture) and intervention group (interactive lecture) in the immediate test after each module

Module	Control group		Intervention group		p value
	Median	Number of students	Median	Number of students	
1	49.6	48	47.5	48	0.52
2	51.4	49	47.5	49	0.44
3	42.8	48	55.1	49	0.02
4	48.8	46	47.2	49	0.77

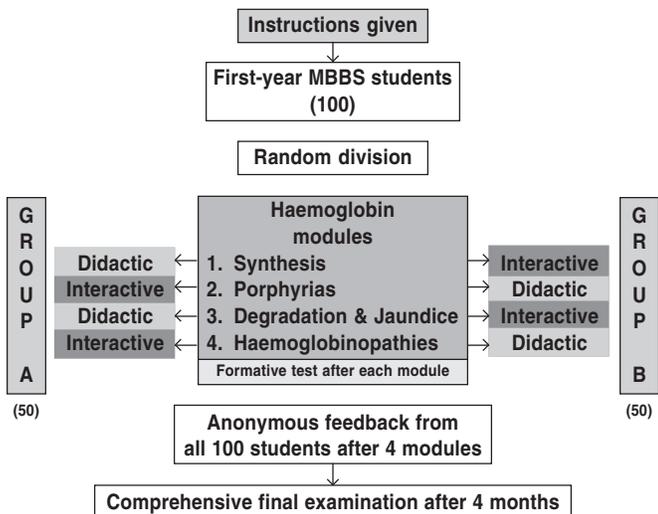


FIG 1. Overview of study design: Lecture types, modules and crossover protocol

TABLE II. Reasons given by students for preferring interactive lectures

Reason	n (%)
Students are actively involved in the lecture.	72 (84)
The lectures enhance the understanding and recollection of the topics discussed.	65 (76)
They managed to stay awake during the course of the lecture.	21 (24)
The prospect of a group discussion and test paper at the end of each session makes students more attentive.	19 (22)
The change in pace from pure lecture to interaction breaks the monotony of the lecture.	11 (13)
The students have a better opportunity to clear their doubts.	8 (9)

TABLE III. Comparison of students' perceptions of the effectiveness of the lectures

Assessment criterion	Lecture (median score)*	
	Didactic	Interactive
Enhanced understanding of the concepts taught	3	4
Created interest in lecture	3	4
Motivated students to study further	2	4
Helped in immediate recall of the material taught	2	4
Helped in clearing doubts	2	3
Wider aspects of topic covered	3	3
Able to finish class on time	3	3

\* The maximum score was 5.

The results of the final comprehensive examination to evaluate later recall and critical thinking showed no statistically significant difference between the marks obtained by the two groups for the structured essay question on haemoglobin synthesis ( $p=0.82$ ).

#### Teachers' perception

1. The time and effort spent on preparing for an interactive class are greater than those for a didactic class. This difference in time and effort becomes less marked over a period of time.
2. The feedback during interactions may be immediate, and sometimes instantaneous, making it easy to modify future classes.
3. Interaction helps to build a better rapport between students and teachers.
4. It was more difficult to cover all aspects of the lecture during interactive lectures due to time constraints.
5. The lecturer may lose control over the group during multiple, independent group discussions.
6. On the other hand, didactic lectures allow the integration of points from several sources within the allotted time.

#### DISCUSSION

The change in the curriculum and attempts to incorporate suitable modifications aim to make Indian medical education globally relevant. The proposal to limit the number of didactic classes to less than one-third of the total represents a shift from conventional teacher-oriented, passive learning to more active, student-centric learning. The data available on how these changes could be applied to the teaching of medical biochemistry in Indian medical colleges and its results are inadequate and inconclusive.

In this study, every student was exposed both to didactic and interactive lectures. The classes consisted of topics in pure biochemistry and also, topics with clinical applications. This helped to compare the outcomes related to didactic lectures and interactive lectures, and also, to determine and compare those related to pure biochemistry classes and clinically oriented classes. Moreover, it gave us an idea of the perceptions regarding these.

Many studies have shown that the performance of students is better after interactive lectures and other active learning methods than after didactic lectures.<sup>8,17,21,22</sup> However, we found no differences between the measurable outcomes of the two types of lectures in the immediate post-lecture period, as also in the long term, except when the topic was clinically oriented. However, the fact that all students prefer interactive to didactic lectures, irrespective of whether the topic is biochemistry or clinically oriented, favours the transformation of biochemistry lectures to the interactive style, as far as possible. This is in line with the teachers' perception that although the classes may initially be difficult to manage, both in terms of time and content, these limitations are overcome as the classes progress.

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