

Comparative study between “case-based learning” and “flipped Classroom” for teaching clinical and applied aspects of physiology in “competency-based UG curriculum”

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ABSTRACT

Background: The new curriculum is competency-based and revised. The student must be imparted and should have learned these competencies. New teaching-learning methods such as “Case-based learning (CBL)” and “Flipped classroom (FCR)” can help medical students to be competent Indian medical graduates. **Aims and Objectives:** This study was aimed to evaluate the effectiveness of “CBL” over “FCR” for teaching clinical and applied aspects of physiology. **Materials and Methods:** Faculty and residents of the department of physiology and first-year MBBS students were introduced and oriented to the study and concept of CBL and FCR. Students were divided into two groups; one was taught clinical and applied aspects of cardiovascular physiology by CBL and another group by FCR. Pre- and post-test with a validated questionnaire were conducted for both groups. Feedback from the students was collected on 5-point Likert's scale and the marks obtained by them were analyzed statistically by paired *t*-test. **Results:** Both CBL and FCR improved the post-test marks significantly when compared to pre-test marks ($P < 0.0001$). CBL and FCR methods showed no significant difference, but the mean post-test marks were higher in FCR. As per the students' feedback, 62% of students strongly agreed that CBL is useful for clinical and applied aspects of physiology. **Conclusion:** CBL and FCR both are equally important and complementary to each other. CBL was found to be slightly more effective for later days of clinical practices, whereas FCR slightly more effective for better performance in university examinations.

Keywords: Case-based learning, competency-based UG curriculum, flipped classroom, students' perception

Introduction

The new curriculum is competency-based and revised. It has emphasized the competencies; the student must be imparted and should have learned. New teaching-learning methods like “case-based learning (CBL)” and “flipped classroom (FCR)” can

help medical students acquire more knowledge and skills to be competent Indian medical graduates.

According to a study done by George *et al.*,^[1] the trainee doctors and staff found CBL to be more interesting, stimulating, and useful compared to didactic seminars. They recommended CBL be incorporated into medical teaching at all levels and across the spectrum of healthcare education. Another study showed that flipped classroom model resulted in better scores than the traditional teaching method for training undergraduates. This teaching-learning method also could be adopted in the training of primary care physicians.^[2]

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Hereby, we compared CBL and FCR for teaching clinical and applied aspects of physiology in training undergraduates.

In **CBL**, a small group of students focus on “creative problem solving,” with some advanced preparation.^[3] Discovery is encouraged in a format in which both students and facilitators share responsibilities for coming close on cardinal learning points. CBL proponents argue that it provides an exploration of issues and ambiguity as well as encourages debate and discussion. It also provides more structure for the learner in an efficient, goal-directed manner. In CBL, learning objectives are identified early and students prepare according to their objectives. The tutors guide the group through the focussed questions to drive them along the learning objectives to arrive at a diagnosis.^[4] According to a “physiology education paper,” in CBL, students discuss a clinical case-related to the topic taught and evaluate their understanding of the concept using a high order of cognition. This process encourages active learning and produces a more productive outcome.^[5]

“**Flipping the classroom**” has become something of a buzzword in the last several years, driven in part by high-profile publications in “The New York Times,” Fitzpatrick, 2012, “The Chronicle of Higher Education,” Berret, 2012 and Science, Mazur, 2009. “Flipped classroom” is the result of assigning didactic materials to the learners, before class time while using face-to-face time for more active learning strategies such as reflection, group projects, or discussion. The core element of “FCR” includes assigning pre-class content, formative assessment, working on learning gaps, developing competencies, and teachers’ role as a guide on the side.^[6] In essence, “flipping the classroom” means that students gain first exposure to new material outside of class, usually via reading or lecture videos, and then use class time to do the harder work of assimilating that knowledge, perhaps through problem-solving, discussion, or debates. In terms of Bloom’s revised taxonomy (2001), this means that students are doing the lower levels of cognitive work (gaining knowledge and comprehension) outside of the class and focussing on the higher forms of cognitive work (application, analysis, and synthesis and/or evaluation) in class where they have the support of their peers and instructors. Learners can test their models by identifying their learning gaps, seeking resources, and assistance, and interpreting information based on their experience for further development.^[7]

The purpose of the organic learning environment in the health care community is to meet the challenges of the 21st-century practice.^[8-11] In response, accrediting bodies in undergraduate medical education and other health care professions required competency-based medical curricula and medical school faculty must ensure “self-directed learning experiences” for their students to foster the development of life-long learning skills.^[12] For this teaching and learning methods such as CBL and FCR should be evaluated for their effectiveness. The aim of this study was to evaluate and compare CBL and FCR and gather the students’ perceptions regarding these methods.

Methods and Materials

This study was conducted in the department of physiology. The design of the study was an “Educational interventional (experimental) study.” Ninety-four students out of 120 students of phase 1 MBBS batch 2020-2021 who gave written informed consent for this study were included. The study protocol was approved by the institutional ethical committee.

Exclusion criteria

Students with a history of long-term drug therapy, acute or chronic diseases, and those who were not interested were excluded from the study.

Collection of data

After orientation and introduction to the topic, a pre-test with a validated questionnaire (30 multiple-choice questions) was conducted to assess the basic knowledge of 94 first-year MBBS students, who gave their informed consent for the study. Then they were divided into two groups; students having odd roll numbers such as 1, 3, 5... were kept in “group-A” and students with even roll numbers such as 2, 4, 6... were kept in “group-B.” They were given code numbers to maintain their identities confidential as per the guidelines of the “institutional ethics committee.” Teaching-learning method (CBL or FCR) was allotted to them by a lottery system. Study materials (ppts, PDFs, and videos) were provided to the students 3 to 4 days before the scheduled sessions. One group was exposed to CBL and another group to FCR.

For CBL, a paper-based clinical case, a “70-year-old lady suffering from heart failure with a history of hypertension” was provided to the groups of students. They were also provided the predetermined learning objectives and questions for critical thinking. They were allowed to discuss in groups of 10 students with a trained facilitator. They were made to sit in a circle as per the COVID protocol to maintain eye-to-eye contact and ensure that they followed the rules of group dynamics. The group through consensus elected a chairperson, scribe, timekeeper, and presenter for the group discussion. The chairperson ensured the active participation of each member of the group according to the principles of group dynamics. The scribe noted down the group activity and the timekeeper gathered and compiled the time data of the participants during the group activity. The role of the facilitator was not to lead the group but to keep the discussion on the right track by observing the whole process.

In the end, the presenter from each subgroup presented the conclusion of the group discussion followed by a final compilation of the session by the faculty.

For FCR, students were made to sit in the classroom as per the COVID protocol. The discussion was started with simple questions based on the application of the knowledge acquired by the students to identify the learning gaps. A few students

attempted to answer but they were not clear about their concept. Then the teacher, who was in the role of mentor and guide, explained the applied aspects and discussed the higher level of cognitive aspects by giving examples of a few clinical cases related to the topic. The students were curious about the applied aspects such as effects of a sudden change in the posture, massage over the carotid sinus, or denervation of 9th and 10th cranial nerves. Many students were found to be very interested during the discussion on hypertension and heart failure (clinical aspect). The pathophysiology of hypertension and heart failure along with the approach for management of such cases were discussed.

After teaching by “CBL” and “FCR,” feedback forms were distributed among the students of both groups to get their feedback on the ‘5-point Likert scale.’ Duly filled up feedback forms were collected from them. After 1 week, a post-test was conducted with the same set of MCQs for both groups, and marks obtained by the students were noted.

Statistical analysis

Likert’s scale was used to get feedback from the students about their perception of the two teaching-learning methods. Marks obtained by the students were analyzed statistically by paired *t*-test using SPSS 15.

Results

Marks obtained before and after teaching by “CBL” and “FCR” were compared and analyzed by Student’s paired *t*-test. As shown in Table 1, there was a statistically significant improvement in posttest marks compared to pretest marks in both teaching and learning methods of CBL and FCR.

The effectiveness of CBL and FCR was compared by applying an independent *t*-test to post-test marks [Table 2]. It was found that the mean post-test marks were more in the FCR method although these were not statistically significant.

Most of the responses to all items in the questionnaire were either strongly agreed or agreed. On average, only 4% and 5.2%

of students exposed to CBL and FCR, respectively, had neutral opinions. No student disagreed with any items in the questionnaire.

As is evident from Table 3, 100% of students responded to the questions of the feedback questionnaire. Also, 58% of students strongly agreed for continuation of CBL as a teaching learning method in other batches, whereas 50% strongly agreed with FCR. On taking faculty feedback, all agreed that both CBL and FCR were useful methods for the students.

Discussion

CBL provides preexposure to clinical cases in a healthcare-related field with a lot of specialized knowledge in that area to improve clinical performance, whereas FCR facilitates pre-class preparation and problem-solving quality, which is essential for healthcare workers in all disciplines.

Our study compared CBL and FCR for teaching clinical and applied aspects in the new “competency-based curriculum.” The feedback data of Likert’s scale showed that 62% of students strongly agreed that CBL is useful for clinical and applied aspects in contrast to 42% of students for FCR. Also, 60% of students strongly agreed that CBL improved their understanding in contrast to 52% for FCR. Next, 90% of students were in a positive view that FCR will help their performance in the university examinations in comparison to 86% for CBL. The mean post-test marks were slightly higher in FCR (12.34) than for CBL (11.21), which indicates that the performance after FCR was slightly better in comparison to post-CBL.

Singh (2011) conducted a study on CBL for teaching anatomy. He observed that CBL improved problem-solving as evident from the response of 62% of students who agreed to improved problem solving and 69% strongly agreed to a better understanding of theory taught to them. In our study, the percentage of students who strongly agreed with improved problem solving was 50% and understanding of theory was 60% with CBL, which was slightly less. In his study, the significance of CBL in strengthening the clinical concepts was made evident from the response of 51% toward better performance in university examinations in contrast to 87% of students agreeing to the perception of helping them perform better in later days of clinical course. These data were approximately close to our results; 48% and 82% respectively. Therefore, the findings in our study support the results of this study. It might have occurred due to restricted exposure to CBL during the COVID pandemic.^[13]

Another study conducted by Zhao *et al.*^[14] (2020) on the effects of PBL and CBL by comparing the total pre- and post-class quiz scores showed that the PBL (Problem Based Learning)–CBL group’s performance was significantly higher than the traditional group’s (from 52.76 to 67.51 vs. from 67.03 to 71.97), thus indicating the effectiveness of the combined PBL–CBL teaching model. This study also endorses the responses obtained in our study and strongly agreed with a better understanding of CBL.

Table 1: Comparison of pre-test and post-test marks of case-based learning (CBL) and flipped classroom (FCR)

Teaching method	Pre-test marks	Post-test marks	<i>t</i> Stat	Pearson correlation
CBL	8.74 (3.1)	11.21 (3.5)	-5.81*	0.62
FCR	8.49 (3.5)	12.34 (3.9)	-8.40*	0.64

**P*<0.0001. SD=Standard deviation, FCR=Flipped classroom, CBL=Case-based learning, Values are mean (SD)

Table 2: Comparison of post-test marks of case-based learning (CBL) and flipped classroom (FCR)

Teaching method	Post-test marks	Test Result
CBL	11.21 (3.5)	<i>t</i> Stat=-1.48
FCR	12.34 (3.9)	<i>P</i> >0.0001

SD=Standard deviation, FCR=Flipped classroom, CBL=Case-based learning, Values are mean (SD)

Table 3: Students' perception on Likert's scale toward CBL and FCR

Questions	Strongly agreed (%)		Agreed (%)		Neutral (%)		Disagreed (%)		Strongly disagreed (%)	
	CBL	FCR	CBL	FCR	CBL	FCR	CBL	FCR	CBL	FCR
Method used for teaching clinical and applied physiology was useful	62	42	38	54	0	4	0	0	0	0
Helped to improve understanding	60	52	34	48	6	0	0	0	0	0
Encouraged students to achieve learning objectives	60	44	38	52	2	4	0	0	0	0
Brought in more interaction	66	60	34	34	0	6	0	0	0	0
Conducted in a systematic manner	34	54	56	44	10	2	0	0	0	0
Facilitators were helpful	54	58	40	42	6	0	0	0	0	0
Improve problem solving ability	50	46	50	46	0	8	0	0	0	0
Can be continued for future batches	58	50	42	40	0	10	0	0	0	0
Will help to perform better in university exam	48	48	38	42	14	10	0	0	0	0
Will help to perform better in later days of clinical course	82	58	16	34	2	8	0	0	0	0
Average	57	51	39	44	4	5.2	0	0	0	0

FCR=Flipped classroom, CBL=Case-based learning, Values are in percentage.

Bergmann and Sams found in their study (2020) that FCR can complement the CBL. FCR has the advantage of providing a variety of learning experiences appropriate for each student with organized interactive encounters in classrooms, providing challenging creative thinking in students, and promoting novel exposures to learning through collaboration, expert insight, and feedback.^[15]

Kolahdouzan *et al.*^[16] studied in 2020 the effect of CBL and flipped classroom methods in comparison with lecture method on learning and satisfaction of internship students in surgery. They found that students' learning was improved and they were more satisfied in comparison with the lecture method.

This study brings out the importance of new teaching aids such as CBL and FCR for teaching clinical aspects in physiology under competency-based undergraduate curriculum to supplement the revised curriculum of UG medical students. It is the need of the hour to deviate from the standard teaching practices and embrace concepts such as CBL and FCR. The results are well supplemented by earlier conducted studies.

Conclusion

This study showed that both CBL and FCR are very important and complementary to each for "competency-based UG curriculum." CBL was found to be slightly more effective for later days of clinical practices, whereas FCR slightly more effective for better performance in university examinations. Therefore, both CBL and FCR should be included and implemented as per the requirement depending on the topic in the competency-based UG curriculum so that a competent "Indian medical graduate" can be prepared at the end of the MBBS course to meet the national goals of our country.

Declaration of patient consent

The authors certify that they have obtained all appropriate students' consent forms. In the form, the students' have given

their consent for their test results and feedback to be reported in the journal. The students' understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Limitation

The number of sessions for CBL and FCR were less and delayed due to lockdown during the second wave of the COVID pandemic.

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Nil.

Conflicts of interest

There are no conflicts of interest.

References

- George T, Carey RA, Abraham OC, Sebastian T, Faith MF. Trainee doctors in medicine prefer case-based learning compared to didactic teaching. *J Family Med Prim Care* 2020;9:580.
- Arya V, Gehlawat VK, Rana R, Kaushik J. Flipped classroom versus traditional lecture in training undergraduates in pediatric epilepsy. *J Family Med Prim Care* 2020;9:4805-8.
- Slavin SJ, Wiks MS, Usatine R. Innovation in education in the clinical years. *Acad Med* 1995;70:1091-5.
- Thistlethwaite JE, Davies D, Ekeocha S, Kidd JM, MacDougall C, Matthews P, *et al.* The effectiveness of case-based learning in health professional education. A BEME systematic review: BEME guide no. 23. *Med Teach* 2012;34:421-44.
- Gade S, Chari S. Case-based learning in endocrine

- physiology: An approach toward self-directed learning and development of soft skills in medical students. *Adv Physiol Edu* 2013;37:356-60.
6. Lage MJ, Platt GJ, Treglia M. Inverting the classroom: A gateway to create an inclusive learning environment. *J Eon Edu* 2000;31:30-43.
7. Michael J, Modell HI. *Active Learning in Secondary and College Science Classrooms: A Working Model for Helping the Learner to Learn*. New Jersey: LEA; 2003.
8. Graffam B. Active learning in medical education. Strategies for beginning implementation. *Med Teach* 2007;29:38-42.
9. Cooke M, Irby DM, O'Brien BC. *Educating Physicians: A Call for Reform of Medical School and Residency*. San Francisco, CA: John Wiley & Sons; 2010.
10. Morrison G, Goldfarb S, Lankan PN. Team training of the medical students in 21st century: Would Flexner approve? *Acad Med* 2010;85:254-9.
11. Erlander R, Cameron T, Ballard AJ, Dodge J, Bull J, Aschenbrener CA. Toward a common taxonomy of competency domains for the health professions and competencies for physicians. *Acad Med* 2013;88:1088-94.
12. LCME. Functions and structure of a medical school: Standards for accreditation of medical education programs leading to the M.D. Degree 2017.
13. Praveen R, Singh J. Introduction of case-based learning for teaching Anatomy in a conventional medical school. *Anat Soc India* 2011;60:232-5.
14. Zhao W, He L, Deng W, Zhu J, Su A, Zhang Y. The effectiveness of the combined problem-based learning (PBL) and case-based learning (CBL) teaching method in the clinical practical teaching of thyroid disease. *BMC Med Educ* 2020;20:381.
15. Busebaia TJ, John B. Can flipped classroom enhance class engagement and academic performance among undergraduate pediatric nursing students? A mixed-methods study. *Res Pract Technol Enhanc Learn* 2020;15:1-6.
16. Kolahdouzan M, Mahmoudieh M, Rasti M, Omid A, Rostami A, Yamani N. The effect of case-based learning and Flipped classroom methods in comparison with lecture method on learning and satisfaction of internship students in surgery. *J Educ Health Promot* 2020;9:256.