

Flipped Classroom versus Traditional Lecture as a Teaching Learning Method for Undergraduate Medical Students: An Educational Interventional Study from Southern India

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ABSTRACT

Introduction: The current competency-based undergraduate medical curriculum necessitates the cultivation of skills in self-directed learning, critical thinking and deep learning among learners. The flipped classroom is a teaching-learning method that can foster these skills.

Aim: To compare the effectiveness of the flipped classroom versus traditional lectures as teaching-learning methods in final-year undergraduate students.

Materials and Methods: An educational interventional crossover study was conducted in the Department of Paediatrics at Vinayaka Mission's Kirupananda Variyar Medical College and Hospital, Salem, Tamil Nadu, India, from August 2023 to December 2023, involving 100 final-year MBBS students. They were randomly divided into two groups of 50 each. One group was taught using a flipped classroom approach, while the other received a traditional lecture for the first topic. The teaching-learning methods were interchanged for the second topic. Pretest and post-test scores

were recorded and feedback was obtained from the students after the flipped classroom session. The Mann-Whitney U and Wilcoxon signed-rank tests were used for independent and paired samples, respectively. A p-value of <0.05 was considered significant.

Results: There was no statistical significance in the post-test scores between the two teaching-learning methods for both topics 1 and 2 (p-value=0.194, p-value=0.493, respectively). Additionally, there was no statistical significance in the pretest to post-test score differences between the two teaching-learning methods for both topics (p-value=0.884, p-value=0.806). However, 97% of the students agreed that the flipped classroom was interactive and interesting and about 94% felt that their self-learning skills improved with the flipped classroom activity.

Conclusion: The flipped classroom is not superior to traditional lectures as a teaching-learning method for undergraduate students. Nevertheless, most of the students preferred the flipped classroom due to its interesting and interactive nature.

Keywords: Active learning, Interactive teaching, Inverted classroom, Lifelong learner, Self-directed learning

INTRODUCTION

Flipped classroom is a teaching-learning method that centers on the delivery of print, audio, or video-based material before a lecture or class session. The class session is then dedicated to more active learning processes involving the application of knowledge through problem-solving or case-based scenarios [1]. The flipped classroom is a learner-centered teaching-learning method that helps students become active learners [2]. The classroom time in a flipped classroom is spent on higher levels of revised Bloom's taxonomy of learning (apply, analyse and evaluate) [3]. It also facilitates learning from peers [2].

Medical education in India has undergone a major change in the curriculum, moving towards competency-based medical education. According to the recent Graduate Medical Education regulations, the Indian Medical Graduate must fulfill the role of a lifelong learner, which requires the student to master the skill of self-directed learning [4]. Moreover, the upcoming changes in the assessment of undergraduates, from predominantly subjective to objective, may necessitate deep learning of the subject. Several studies have shown that the flipped classroom is an effective teaching-learning method [5,6]. Thus, the flipped classroom may help students become self-directed and lifelong learners.

The objective of this study was to compare the effectiveness of the flipped classroom versus traditional lecture as teaching-

learning methods in improving the learning outcomes of final-year undergraduate students in Paediatrics.

MATERIALS AND METHODS

An educational interventional study with a crossover design was initiated after obtaining approval from the Institutional Ethics Committee (No. VMKVMC&H/IEC/23/075). Written informed consent was obtained from the students before commencing the study. The study was conducted in the Department of Paediatrics at Vinayaka Mission's Kirupananda Variyar Medical College and Hospital, Salem, Tamil Nadu, India, from August 2023 to December 2023. The students and faculty members of the department were informed about the study.

Inclusion criteria: One hundred students from Part II MBBS of Phase III were included in the study.

Exclusion criteria: Students who did not attend the pretest or the post-test were excluded from the study.

Two pretests, each containing 15 multiple-choice questions, were administered to the students on two different topics: acute rheumatic fever and ventricular septal defect. Then, all 100 students enrolled in the study were randomly divided into two groups using computer-generated random numbers. Resource materials in the form of PowerPoint slides with voice-over, journal articles and standard

books were provided for the flipped classroom topics. For the first topic on acute rheumatic fever, Group A was taught using the flipped classroom method, while Group B was taught using the traditional lecture method.

For the second topic on ventricular septal defect, Group A was taught using the traditional lecture method, while Group B was taught using the flipped classroom method, thereby allowing for a crossover. Thus, both groups had the opportunity to be exposed to a new teaching-learning method: the flipped classroom. Post-test responses were recorded at the end of every session and feedback was obtained at the end of the flipped classroom session. During the in-class activities of the flipped classroom sessions, the students were asked to solve case vignettes in small groups. The answers were then discussed with the facilitator.

STATISTICAL ANALYSIS

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) software version 29.0. Continuous data were represented as median with Inter-Quartile Range (IQR). The Mann-Whitney U test was used for comparing independent samples and the Wilcoxon signed-rank test was used for paired samples. A p-value of <0.05 was considered significant.

RESULTS

A total of 100 students participated in this study. The pretest and post-test scores were available for 89 students for both topics. For the first topic on acute rheumatic fever, the post-test score was higher than the pretest score in Group A, which was taught using the flipped classroom method, but there was no significant difference between them (p-value=0.557). There was no significant difference between the pretest and post-test scores in Group B, which was taught using the traditional lecture (p-value=0.519). For the second topic on ventricular septal defect, there was a significant difference between the pretest and post-test scores for both groups, where Group A was taught using the traditional lecture (p-value=0.002), whereas Group B was taught using the flipped classroom method (p-value=0.002) [Table/Fig-1]. There was no significant difference in the post-test scores between the flipped classroom method and traditional lecture for both topics (p-value=0.194; p-value=0.493) [Table/Fig-2]. The difference between the pretest and post-test scores among the two teaching-learning methods—flipped classroom and traditional lecture—was not statistically significant for both topics [Table/Fig-3].

Topic 1* (N=89)				Topic 2* (N=89)			
Group A (n=42) Flipped classroom		Group B (n=47) Traditional lecture		Group A (n=41) Traditional lecture		Group B (n=48) Flipped classroom	
Pretest	Post-test	Pretest	Post-test	Pretest	Post-test	Pretest	Post-test
8 (7, 9)	9 (7, 9.25)	9 (8, 9)	9 (8, 10)	7 (6.5, 8)	8 (7, 10)	7 (7, 8)	8 (7, 9)
†p-value=0.557	†p-value=0.519	†p-value=0.002	†p-value=0.002				

[Table/Fig-1]: Comparison of pretest scores and post-test scores in different groups.

*Median (IQR), Topic 1-Acute rheumatic Fever, Topic 2-Ventricular septal defect, †Wilcoxon signed rank test

Topic 1* (N=89)			Topic 2* (N=89)		
Flipped class (n=42)	Lecture (n=47)	p-value†	Flipped class (n=48)	Lecture (n=41)	p-value†
9 (7, 9.25)	9 (8, 10)	0.194	8 (7, 9)	8 (7, 10)	0.493

[Table/Fig-2]: Comparison of post-test scores of flipped classroom and traditional lecture.

*Median (IQR), Topic 1-Acute rheumatic Fever, Topic 2-Ventricular septal defect, †Mann-Whitney U method

The students' feedback on the flipped classroom session is shown in [Table/Fig-4]. A total of 93 students responded to the feedback questionnaire, with 46 belonging to Group A and 47 belonging to Group B.

	Topic 1 (N=89)		Topic 2 (N=89)	
	Flipped class (n=42)	Lecture (n=47)	Flipped class (n=48)	Lecture (n=41)
Mean rank	45.42	44.63	44.39	45.72
p-value†	0.884		0.806	

[Table/Fig-3]: Comparison of pretest-post-test difference between the teaching learning methods.

†Mann-Whitney U test, between two teaching-learning methods in each topic

No.	Questions	Response on Likert scale (N=93)					Mean±SD
		5	4	3	2	1	
1.	The resource materials provided before the class was adequate	49 (52.7)	39 (41.9)	2 (2.2)	3 (3.2)	0	4.408±0.82
2.	The time given for preparation before the class was adequate	44 (47.3)	45 (48.4)	3 (3.2)	1 (1.1)	0	4.408±0.66
3.	I learnt all the resource material that was provided to me before the class	31 (33.3)	52 (55.9)	10 (10.8)	0	0	4.225±0.63
4.	It was NOT time consuming to learn the topic before the class	21 (22.6)	48 (51.6)	19 (20.4)	4 (4.3)	1 (1.1)	3.903±0.84
5.	The class room activity was aligned well with the pre-classroom activity	38 (40.8)	49 (52.7)	6 (6.5)	0	0	4.344±0.60
6.	The classroom session was interactive and interesting	48 (51.6)	42 (45.2)	3 (3.2)	0	0	4.483±0.56
7.	My understanding of the topic has improved after the classroom activity	46 (49.5)	39 (41.9)	7 (7.5)	0	1 (1.1)	4.387±0.72
8.	My skill of learning by myself has improved after the classroom activity	43 (46.2)	44 (47.3)	6 (6.5)	0	0	4.397±0.61
9.	My communication skills with my peers has improved after the classroom activity	39 (41.9)	49 (52.7)	5 (5.4)	0	0	4.365±0.59
10.	I prefer similar teaching learning method in the future for other topics also	38 (40.9)	42 (45.2)	12 (12.9)	0	1 (1.1)	4.247±0.76

[Table/Fig-4]: Students' feedback on the flipped classroom as a teaching-learning method.

5=Strongly agree; 4=Agree; 3=Neutral; 2=Disagree; 1=Strongly disagree. The values presented are the number of responses to each statement (%)

DISCUSSION

Present study showed a significantly higher post-test score than the pretest score in one of the flipped classroom sessions, implying that this teaching-learning method may improve the learning of the subject. However, when flipped classroom sessions were compared with traditional lecture sessions, there was no significant difference in the post-test scores for both topics (p-value=0.194, p=0.493). This study indicates that the flipped classroom is not a superior teaching-learning method compared to the traditional lecture.

The feedback from the students showed that 97% of the study population felt that the flipped classroom session was interactive and interesting and 94% of them agreed that their self-learning skills improved with the flipped classroom activity. Additionally, 86% of the study population recommended flipped classrooms for further teaching. Studies conducted by Hew KF and Lo CK, as well as Rui Z et al., demonstrated that the flipped classroom is a more effective teaching-learning method than the traditional didactic lecture in

improving learning outcomes in medical students [5,6]. However, a study conducted by Hernández-Guerra M et al., yielded mixed results when there was a change in the comparison groups [7]. Similarly, a study performed by Arya V et al., also reported mixed results with different topics [8].

Present study did not find a significant difference between the two teaching-learning methods in improving the learning outcomes of medical students, which was consistent with several studies [9-12]. The in-class activity of the flipped classroom is based on Bloom's higher domains of learning, namely: apply, analyse and create [3]. This approach requires prior learning by the students before the class. Authors did not set a minimum pretest score as eligibility to participate in the study; had we done so, it might have ensured that students engaged in prereading. Although there was no significant difference in the knowledge gained by the students, most students expressed satisfaction with the flipped classroom method, similar to findings in many other studies, as it promoted active learning among them [10,12].

The strength of present study was its crossover design, which helped eliminate bias from the faculty involved and the choice of topics.

Limitation(s)

The limitations of present study included the fact that flipped classroom sessions were conducted for only two topics due to the limited availability of the study period. Moreover, the students may need more time to adapt to the new teaching-learning method. Additionally, study did not assess knowledge retention after a certain period, which could have strengthened the validity of the study.

CONCLUSION(S)

The flipped classroom is not a superior teaching-learning method for medical undergraduates. However, most students favoured flipped classroom sessions for further learning, as they promoted

active learning and enhanced their self-directed learning skills. Future multicentric studies in various disciplines of medicine over a longer period at different learner levels would be beneficial to further evaluate the effectiveness of the flipped classroom method in educating medical students.

REFERENCES

- [1] Sharma N, Lau CS, Doherty I, Harbutt D. How we flipped the medical classroom. *Med Teach.* 2015;37(4):327-30.
- [2] Singh K, Mahajan R, Gupta P, Singh T. Flipped classroom: A concept for engaging medical students in learning. *Indian Pediatr.* 2018;55(6):507-12.
- [3] French H, Arias-Shah A, Gisondo C, Gray MM. Perspectives: The flipped classroom in graduate medical education. *Neoreviews.* 2020;21(3):e150-56.
- [4] National Medical Commission (Undergraduate Medical Education Board). Guidelines under Graduate Medical Education Regulation 2023 [Internet]. [cited 2024 Sep 30]. Available from: <https://www.nmc.org.in/MCIRest/open/getDocument?path=/Documents/Public/Portal/CBME%201.pdf>.
- [5] Hew KF, Lo CK. Flipped classroom improves student learning in health professions education: A meta-analysis. *BMC Med Educ.* 2018;18(1):38.
- [6] Rui Z, Lian-Rui X, Rong-Zheng Y, Jing Z, Xue-Hong W, Chuan Z. Friend or foe? flipped classroom for undergraduate electrocardiogram learning: A randomized controlled study. *BMC Med Educ.* 2017;17(1):53.
- [7] Hernández-Guerra M, Quintero E, Morales-Arráez DE, Carrillo-Pallarés A, Nicolás-Pérez D, Carrillo-Palau M, et al. Comparison of flipped learning and traditional lecture method for teaching digestive system diseases in undergraduate medicine: A prospective non-randomized controlled trial. *Med Teach.* 2021;43(4):463-71.
- [8] 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(9):4805-08.
- [9] Riddell J, Jhun P, Fung CC, Comes J, Sawtelle S, Tabatabai R, et al. Does the flipped classroom improve learning in graduate medical education? *J Grad Med Educ.* 2017;9(4):491-96.
- [10] Lin Y, Zhu Y, Chen C, Wang W, Chen T, Li T, et al. Facing the challenges in ophthalmology clerkship teaching: Is flipped classroom the answer? *PLoS One.* 2017;12(4):e0174829.
- [11] Bossaeer JB, Panus P, Stewart DW, Hagemeier NE, George J. Student performance in a pharmacotherapy oncology module before and after flipping the classroom. *Am J Pharm Educ.* 2016;80(2):31.
- [12] McLaughlin JE, Griffin LM, Esserman DA, Davidson CA, Glatt DM, Roth MT, et al. Pharmacy student engagement, performance, and perception in a flipped satellite classroom. *Am J Pharm Educ.* 2013;77(9):196.

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