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Effectiveness and Perception of Flipped Classroom over Didactic Lectures in Teaching Embryology among First Year Medical Students: A Comparative Study

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ABSTRACT
Traditional way of teaching involves commonly used instructional methods through didactic lectures for curriculum delivery which has a limited scope of interactions. Flipped classroom constitutes a novel instructional approach designed to encourage student involvement and enhance self-directed learning. Hence, a study was conducted to compare the effectiveness of the flipped classroom approach over traditional didactic lectures and to assess the perception of students regarding flipped classrooms. 120 students were randomly divided into two batches A and B of 60 students each. Topic one was taught by the flipped classroom method for batch A and by a didactic lecture for batch B. Topic two was taught by the flipped classroom method for batch B and by a didactic lecture for batch A. Multiple choice-based pre-test and post-test were done for all the batches at the end of each session to assess academic scores. Perception of students regarding the conduct of flipped classroom approach was taken by a validated structured questionnaire on a Like rt scale. Mean values of academic scores of tests conducted were statistically significant with flipped classroom compared to didactic lectures with p value<0.001. Analysis of students' perceptions revealed that flipped classroom had advantages over didactic lectures in terms of better opportunities, interaction and involvement by students. Flipped classroom is an effective way to engage students in their learning and can be incorporated in medical college with proper planning and implementation.

INTRODUCTION

The competency-based medical education undergraduate curriculum emphasizes active learning and student-centric approaches to curriculum delivery, along with more interactive teaching-learning methods. Traditional ways of teaching are mostly dependent on didactic lectures which are teacher-centered with a focus on knowledge acquisition and students are passive listeners with less interaction between teacher and student. Educational research studies have shown that active teaching-learning strategies with technology-based resources and materials greatly affect students' retention of knowledge and improved performance[1]. Learner-centered modalities such as flipped classrooms encourage self-directed learning and enhance student engagement[2]. Teaching the embryology component of anatomy is a challenging task for teachers as students find it difficult to understand due to the vastness of the subject and ignore it due to the lower weight of marks in university examinations. The traditional way of teaching embryology by didactic lectures with PowerPoint presentations and the use of chalk and board to simplify the concepts along with visual aids like 3D models was substituted with a flipped classroom approach with homework of preparative material learned before active learning methods in the classroom and repurposing of class time into a learner-centered activity where students can enquire on topic content, applying knowledge and interact with peers and teachers increasing level of student engagement in the class[3]. Hence converting didactic lectures into flipped classrooms may benefit students in achieving higher cognitive ability in terms of integration and analysis. This study was conducted to compare the effectiveness of flipped classrooms over traditional didactic lectures with their academic scores and assess students' perceptions regarding the use of flipped classrooms as a teaching-learning method in embryology.

MATERIALS AND METHODS

This study was a comparative study conducted in JJM Medical College, Davangere after obtaining Institutional Ethics Committee approval (JJMMC/IEC-07-2021). Students were sensitized about the flipped classroom method and written informed consent was taken from all students who wanted to participate in the study voluntarily. First-year medical students who gave consent for the study, n=120 were included in the study. Students who did not give consent were excluded from the study. 120 students were randomly divided into two batches-batch A and batch B, with 60 students in each batch. Teaching activity was conducted during classroom teaching hours in two sessions with the crossover of study and control groups under the supervision of faculty. Two topics in the subject of embryology were considered to assess this strategy. In the first session on the development of pharyngeal apparatus, batch A had a flipped classroom modality of teaching and batch B had a traditional way of teaching with didactic lectures. After a week in the second session on the development of face and palate, batch B had flipped classroom modality of teaching and batch A had a traditional way of teaching with didactic lectures. Batches allotted with didactic lectures had a traditional way of teaching with a PowerPoint presentation along with chalk and board and demonstration of 3D models in the class. For the implementation of the flipped classroom approach relevant preparative material in the form of printed handouts and pre-recorded informative videos were given 4 days before the class for the batch allotted to the flipped classroom. Adequate time was given for students to prepare for the topic before the class. During the flipped classroom active learning methods were engaged, the topic was divided into 6 sub topics, and each group of ten students was allotted a sub topic and was asked to prepare for a presentation. Students inquired about the lecture content and interacted with peers and teachers. One student from each group was randomly picked for presentation on the sub topic and other students were encouraged to ask questions to the group which presented on the topic. The teacher facilitated group discussions and summarised all topics. In each session of the didactic lecture and flipped classroom students were given pre-test and post-test with the same 10 multiple choice questions. Perception of students regarding the conduct of the flipped classroom approach was assessed through a qualitative method at the end of the final session by using a prevalidated questionnaire on a Like rt scale and expressed in the form of percentages. Data of test scores were analyzed using IBM SPSS version 20 software. Paired t-test was used to compare pre-test and post-test scores. $P<0.05$ was considered for statistical significance.

RESULTS AND DISCUSSIONS

Significant difference in academic scores was observed after flipped classroom sessions compared to traditional didactic lecture sessions with a significant p-value<0.001 (Table 1).

Students expressed flipped classroom teaching to be more effective method as they were actively involved in their learning and helped to understand concepts better (Table 2).

Advancements in teaching-learning methods in medical education are changing towards more flexible, effective, active learning and student-centered teaching approaches. To increase the attention span of students during classroom sessions they should be motivated through active learning and give them opportunities to participate and engage in their

Table 1: Comparison of Academic Scores Between two Groups Using Paired t-test.

Session 1 on Development of pharyngeal apparatus			
T/L Method	**Evaluation tests**	**Mean score +/-SD**	**Significance**
Flipped Classroom	Pre-test	8.5738 +/- 1.23929	t-score-11.225 Significance level- .05
Batch A (N=60)	Post-test	9.7377 +/- 0.51109	p-value<0.00001
Didactic lecture	Pre-test	6.7236 +/- 1.58528	t-score-19.744 Significance level - .05
Batch B (N=60)	Post-test	9.2033 +/- 0.91400	p-value<0.00001
Session 2 on Development of face and palate			
T/L Method	Evaluation tests	Mean score +/-SD	Significance
Didactic lecture	Pre-test	6.4797 +/- 1.47853	t-score-21.270 Significance level - .05
Batch A (N=60)	Post-test	9.0000 +/- 0.95814	p-value<0.00001
Flipped classroom	Pre-test	8.3197 +/- 1.27446	t-score -12.511 Significance level - .05
Batch B (N=60)	Post-test	9.2033 +/- 0.91400	p-value<0.00001

Table 2: Perception of Students on Flipped Classroom Teaching in Percentages

Content	**Strongly disagree**	**Disagree**	**Not sure**	**Agree**	**Strongly agree**
Flipped classroom was beneficial in understating the given topic	1.1	1.1	10.5	33.7	53.7
Preparative material was appropriate to help accomplish the in-class session activity	1.1	2.1	5.3	32.6	58.9
Flipped classroom session activity was relevant	1.1	2.1	5.3	40	51.6
Flipped classroom session activity was appropriately challenging	2.1	8.4	14.7	31.6	43.2
Pace of the Flipped classroom session was good	1.1	3.2	10.5	33.7	51.6
Feedback provided during the debriefing session was constructive	1.1	2.1	14.7	34.7	47.4
Flipped classroom approach encourages independent, creative and critical thinking	1.1	2.1	12.6	27.4	56.8
The Flipped classroom was an effective teaching strategy compared to traditional didactic lecture	2.1	0	9.5	30.5	57.9
Flipped classroom should be continued in embryology as a teaching leaning method	1.1	3.2	12.6	32.6	50.5
Flipped classroom is fair in covering all the aspects of the topic	0	4.2	6.3	37.9	51.6
Flipped classroom is good in improving communication skills	3.2	2.1	20	30.5	44.2
Flipped classroom improves my academic performance	3.2	1.1	11.6	35.8	48.4
Flipped classroom is less stressful as compared to traditional didactic lecture method	2.1	2.1	11.6	29.5	54.7
Flipped classroom helps to interact with my peers and facilitator in a better way	2.1	0	17.9	40	40
Flipped classroom helps to consolidate the concepts	1.1	1.1	7.4	36.8	53.7
Flipped classroom improves clinical application	2.1	3.2	12.6	35.8	46.3
Flipped classroom provides fair chance to present my view on the topic	1.1	2.1	17.9	28.4	50.5
Flipped classroom has been an enjoyable experience	2.1	0	12.6	33.7	51.6

learning. This will be beneficial for students in long-term learning and development of self-directed learning skills. As facilitators, we need to improve teaching methodologies for a better learning environment with novel approaches for repurposing the class time into student-centered learning and encouraging students to test their skills in applying knowledge and to interact with peers and teachers. The present study shows the advantages of flipped classrooms for better student learning compared to traditional ways of teaching with didactic lectures. In literature search, it was evident that the finding was consistent with similar types of comparative studies done earlier. Arathi *et al.* conducted a study of 218 first year MBBS students on effectiveness of flipped classroom approach compared to didactic lectures in teaching early clinical exposure modules in anatomy. They expressed flipped classroom method promoted team based learning, enhanced critical thinking and improved understanding of core concepts[4]. Nkomo *et al.* have emphasised student engagement in the learning environment by deploying various digital technologies foster enhanced learning outcomes in students. It is critical to design a flexible and highly adaptive learning environment to cater diverse student learning preferences[1]. Singh et al. have elaborated tips for effective flipped classroom teaching. Encouraging active learning and creating awareness of self-learning skills in students are inculcated through flipped classroom. Providing a balanced pre-reading material considering the understanding level of learners without overburdening learners improves flipped classroom learning[5]. Nanjundaiah *et al* compared academic achievements between two groups taught by flipped classroom and didactic lectures. They found that flipped classrooms were perceived by students with greater involvement and interest to learn and an effective student-centered teaching strategy when properly planned and implemented[6].

CONCLUSION

Students found flipped classroom as a novel idea with more understanding of embryology topics during in-classroom activity, more learner-centric but more time-consuming, more pressure to prepare beforehand and adaptation to this method will take some time. Flipping the traditional classroom is both a feasible and necessary move to educate students to reinvent their classroom in a way that empowers students to develop higher-order cognitive skills and to engage in meaningful learning that will ultimately improve the delivery of health care.

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